

APPENDIX F

Biodiversity Assessment Report prepared by Jacobs.

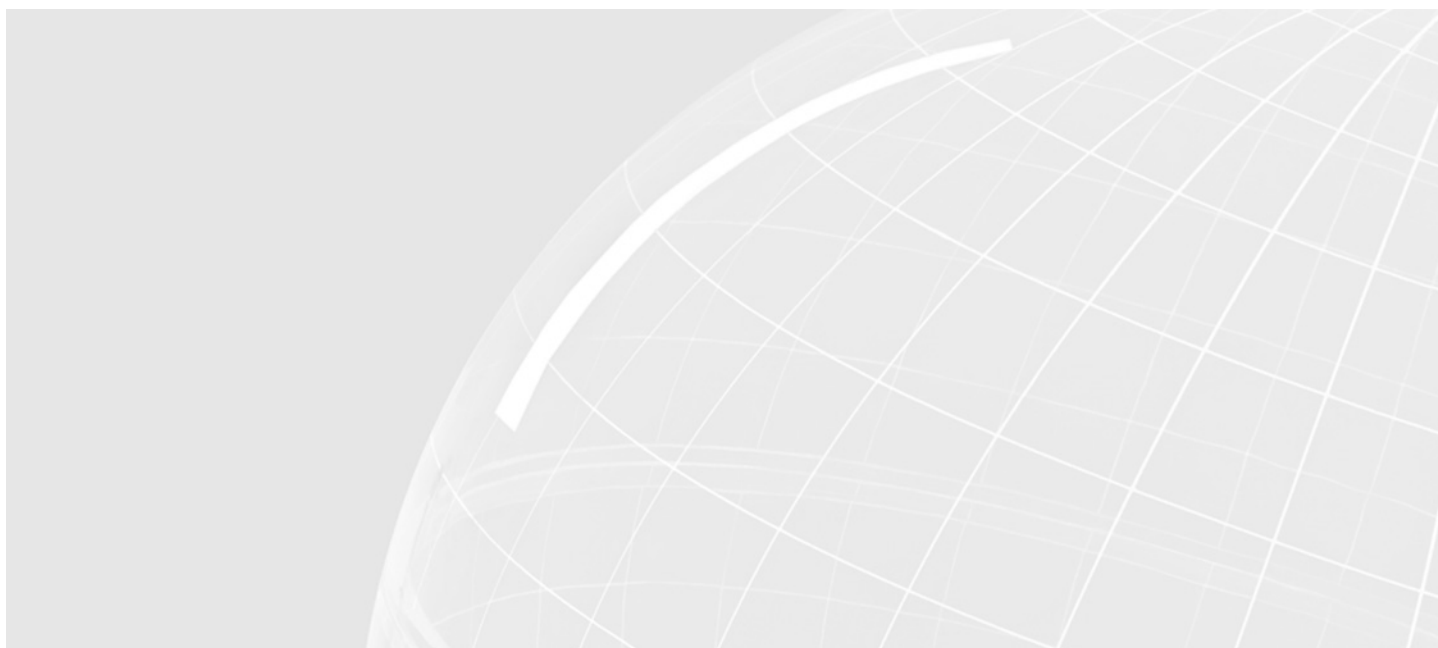
New Grafton Correctional Centre

Infrastructure New South Wales

Biodiversity Assessment Report

Final V2

3 November 2016



New Grafton Correctional Centre

Project No: IA101200
Document Title: Biodiversity Assessment Report
Document No.: Final
Revision: V2
Date: 3 November 2016
Client Name: Infrastructure New South Wales
Client No: NGCC EIS Support
Project Manager: Rachel Vazey
Author: Jonathan Carr, Andrew Carty, Brenton Hays and Chris Thomson
File Name: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA101200\02 Documents_Final
Report_Revised_20161101_DPE OEH\IA101200_Grafton_BAR_Revised
final_20161103_Tolssue.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
Rev1	25/02/2016	Draft report v.1	Jonathan Carr, Andrew Carty and Brenton Hays	Chris Thomson	Rachel Vazey
Rev2	8/04/2016	Final draft v.1	Jonathan Carr	Jonathan Carr	Rachel Vazey
Final draft Rev 3	25/05/2016	Final draft v.2	Abbee Warskitt	Jonathan Carr	Rachel Vazey
Final draft Rev 4	21/06/2016	Final draft v.3	Rachel Vazey	Jonathan Carr	Rachel Vazey
Final draft Rev 5	7/07/2016	Final draft v.4	Rachel Vazey	Jonathan Carr	Rachel Vazey
Final Version 1	1/08/2016	Final Version 1 as issued for display with the EIS	Rachel Vazey	Jonathan Carr	Rachel Vazey
Final Version 2	3/11/2016	Final Version 2 following review by DPE and OEH	Jonathan Carr	Andrew Carty	Rachel Vazey

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Terms and acronyms used in this document

Acronym	Definition
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator
BOM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
BVT	Biometric Vegetation Types
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environment Management Plan
CMA	Catchment Management Authority
CSIRO	Not need as was picked up form Reference list only
CSNSW	Correctional Services New South Wales
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DEE	Department of Environment and Energy formerly the Department of the Environment
DEWHA	Department of Environment, Water, Heritage and the Arts
DPE	Department of Planning and the Environment
DPI	Department of Primary industries
DotE	Department of the Environment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FBA	Framework of Biodiversity Assessment
GDE	Groundwater dependent ecosystems
GIS	Geographic information system
GPS	Global positioning system
IBRA	Interim Biogeographic Regionalisation for Australia
INSW	Infrastructure New South Wales
KTP	Key threatening process
LEP	Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NGCC	New Grafton Correctional Centre
NP&W Act	<i>National Parks and Wildlife Act 1974</i>
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

Acronym	Definition
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	Comprises 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.
SAT	Scat Assessment Technique
SEARS	Secretary's Environmental Assessment Requirement
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SPRAT	Not need as was picked up form Reference list only
SSD	State Significant Development
TAFE	Technical and Further Education Institute
TSC Act	<i>Threatened Species Conservation Act 1995</i>
TSPD	Threatened Species Profile Database
VEC	Vulnerable Ecological Community
VIS	Vegetation Information System
WIRES	Wildlife Information, Rescue and Education Services

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 is located in a landscape that has been modified by past land-uses for rural settlement and agriculture. Much of the native vegetation on the Project Site has been completely cleared or the native understorey removed for grazing. However, remnant tree cover is present on the site and also widely surrounding the site throughout contiguous properties. These properties were identified as providing habitat for listed threatened flora and fauna species.

This Biodiversity Assessment Report (BAR) has been prepared to meet the requirements of the *Framework for Biodiversity Assessment* (Office of Environment and Heritage 2014a) and the *NSW Offsets Policy for Major Projects* (Office of Environment and Heritage (OEH 2014b)). This has involved an assessment of the landscape values on the site and surrounding area, the vegetation communities present on the site and their condition, and the known or potential presence of threatened flora or fauna species and populations listed in NSW under the TSC Act and / or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

There are no rivers or streams traversing the Project site. The Coldstream River (5th order stream) is the closest main waterway and is located approximately 600 metres to the east from the Project Site. The Project Site is largely cleared, albeit for scattered small patches of remnant vegetation, the most extensive of which occurs on the western boundary and is contiguous with similar vegetation to the west and south of the Project Site. The vegetation survey identified two Plant Community Types (PCTs) within the Project Site based on sampled plot results and landscape features matched against the VIS classification database. Vegetation condition was assessed using the site attributes compared with benchmark values. PCTs include:

- Coastal freshwater meadows and forblands of lagoons and wetlands (PCT: 782) (not consistent with endangered ecological community listed under TSC Act).
- Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT: 1209).
- Spotted Gum – Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT: 1211).

The potential presence of threatened flora and fauna species as candidate species was considered in the assessment of impacts and targeted surveys. Candidate species are listed species that are identified by the OEH in the *Framework for Biodiversity Assessment* (FBA) (2014) as ecosystem credit species, which are predicted to occur based on their known presence in the Interim Biogeographic Regionalisation for Australia (IBRA) subregion, the presence of associated PCTs, and the size and condition of the vegetation patches on the site. Species credit species are those that cannot be reliably predicted from the habitat surrogates and their presence is to be assessed through habitat assessment and targeted surveys. From consideration of the default list of species identified in the BioBanking Credit Calculator (BBCC) and the background review and assessment of likelihood, 16 flora species and 16 fauna species were identified as candidate species on the Project Site.

No threatened plant species were recorded from the targeted survey on the site. A total of eight threatened fauna species were recorded on the site listed below. Several other threatened fauna species not recorded are also considered to have a moderate to high likelihood of occurring. Threatened species include:

- Grey-headed Flying Fox (*Pteropus poliocephalus*) – vulnerable species under the TSC Act and EPBC Act.
- Rufous Bettong (*Aepyprymnus rufescens*) – vulnerable species TSC Act.
- Little Lorikeet (*Glossopsitta pusilla*) – vulnerable TSC Act.

- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) – vulnerable TSC Act.
- Brolga (*Grus rubicunda*) – vulnerable TSC Act.
- Brown Treecreeper (*Climacteris picumnus victoriae*) – vulnerable TSC Act.
- Little Bentwing-bat (*Miniopterus australis*) - vulnerable TSC Act.

The Project would be unlikely to have a significant impact on any threatened species, populations or ecological communities listed under the TSC Act or the EPBC Act.

The Project Site was selected using a dedicated site planning and selection process which compared multiple sites and decision criteria. These criteria included among other items, the intent to avoid impacts to remnant vegetation as much as possible, hence the selection of a site that is 84 percent cleared of vegetation. Despite this site selection process, the Project would involve the loss of some remnant vegetation. The impacts of the Project are described in the BAR along with measures to further avoid and mitigate potential impacts to biodiversity.

This BAR has identified matters which are relevant to the assessment of impacts to threatened species, populations and ecological communities including direct and indirect impacts. Direct impacts would include clearing of three PCTs ranging in condition from poor to good, as well as habitat for known and potential threatened species.

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

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

A list of recommended mitigation measures is provided to address these impacts during the construction and operational stages of the project. These measures are to be outlined in the project construction environmental management (CEMP) plan or flora and fauna management plan to be prepared prior to construction.

The direct loss of vegetation required for the project 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) is included which identifies the biodiversity offset credits required to meet the conditions of the FBA. 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 developing appropriate protection and management measures for offset areas.

This working paper has considered and fulfilled the Secretary's Environmental Assessment Requirements (SEARs) No 8 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* as per SEAR No 8.

1. Introduction

1.1 Background

Infrastructure NSW (INSW) on behalf of Corrective Services NSW, 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) for the concept proposal and Stage 1 Development Application (Proposal) for the New Grafton Correctional Centre (the Project). The Proposal is the first stage of the delivery of the Project.

The Project satisfies the criteria of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* as the capital investment value of the correctional centre exceeds \$30 million. As such, the Project is declared to be as a State Significant Development (SSD) under Division 4.1, Part 4 of the EP&A Act and the Minister for Planning is the consent authority for the application. The Secretary's Environmental Assessment Requirements (SEARs) for the Proposal were issued by the Department of Planning and Environment (DPE) on 21 December 2015.

1.2 Locality

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 (**Figure 1-1**) (the Project Site). The Project Site is zoned RU2 – Rural Landscape under the *Clarence Valley Local Environmental Plan 2011*. Development for the purpose of a correctional centre is permissible with consent within the RU2 – Rural Landscape zone.

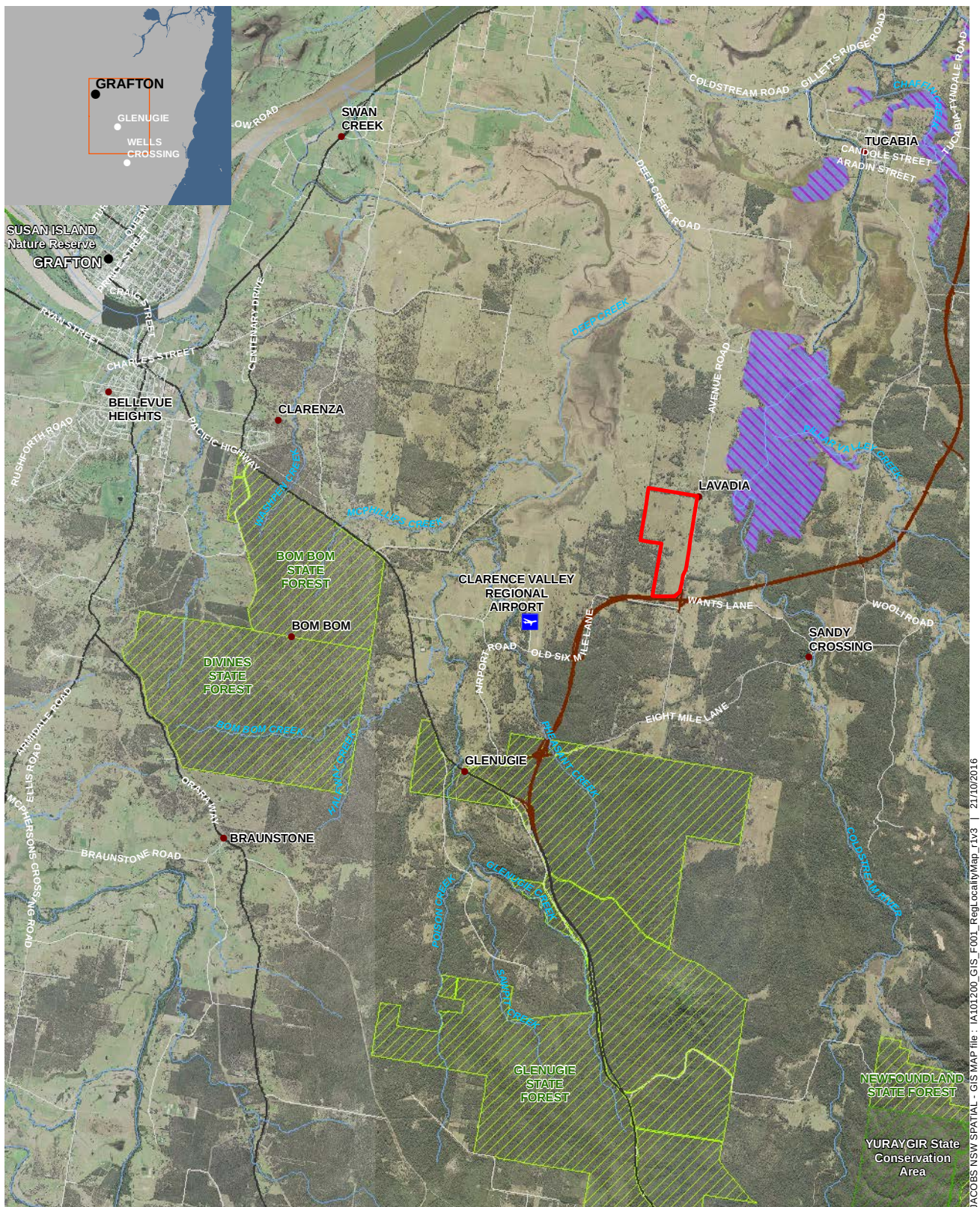
The Project Site includes two properties comprised of Lot 26 DP 751376 and Lot 1 DP 1190399 and is 195 hectares (ha) in size (**Figure 1-2**). The site has historically been used for cattle grazing. In July 2015, development consent for a dwelling house in the southeast corner of Lot 1 DP 1190399 was granted by Clarence Valley Council (the Council) and construction of the house and sheds is complete.

The Project Site is bounded by Avenue Road (also recognised as Golden Mile Road) to the east, and Old Six Mile Lane to the south. Avenue Road connects to the Pacific Highway via Eight Mile Lane to the south and Old Six Mile Lane connects to the Pacific Highway to the west.

It is noted that the Grafton bypass portion of the upgraded Pacific Highway project (by Roads and Maritime Services) will, in addition to the reconfigured Old Six Mile Road, form the southern boundary of the Project Site once completed in approximately 2019. As part of that project, Avenue Road will pass over the Pacific Highway. The intersection of Avenue Road and Old Six Mile Road will be upgraded to improve local access, without direct connection to the highway.

1.3 Project description

The New Grafton Correctional Centre (NGCC) requires a staged development application that sets out a concept proposal for a new correctional centre at Grafton 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 staged development application also seeks concurrent Stage 1 approval for site clearance and preparatory works. The concept proposal and the Stage 1 works development application comprise the Proposal. **Table 1-1** provides a summary of the proposal's key components and features.



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Legend

- The Project
- Pacific Highway Upgrade alignment
- SEPP 14 Wetlands
- NPWS area
- State Forest

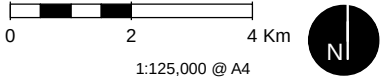
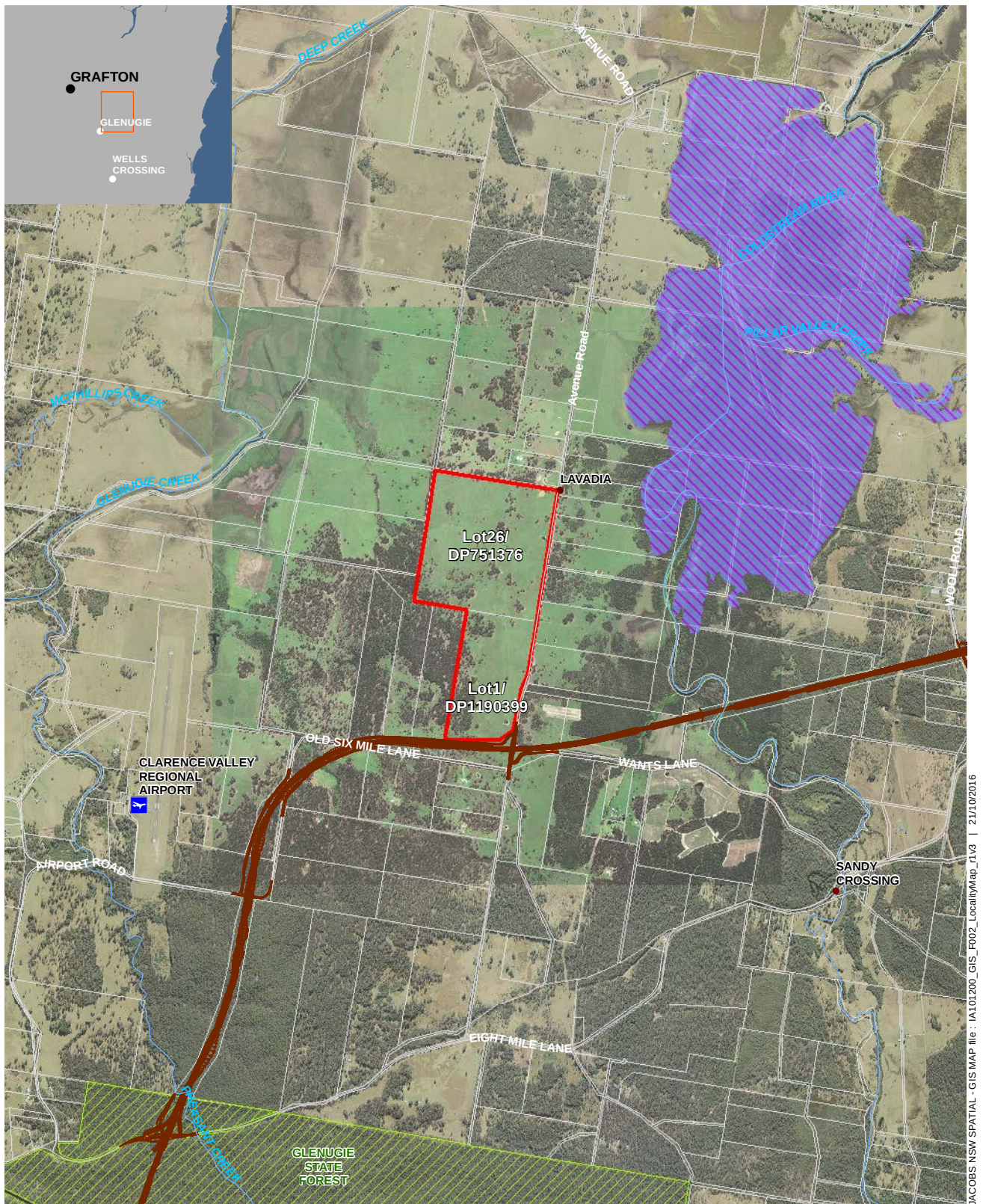


Figure 1-1 | Regional Locality

Data sources

- JACOBS 2015
- LPI 2015
- NSW DPE 2015
- RMS 2013 (W2B Alliance)



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Legend

- | | |
|---|---|
| The Project | SEPP 14 Wetlands |
| Pacific Highway Upgrade alignment | State Forest |

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Data sources

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

Figure 1-2 | The Project

Table 1-1 Key Project Components

Stage	Description
Development summary	The staged SSD application seeks approval for: • A concept proposal for the New Grafton Correctional Centre. • First stage site clearance and preparatory works for the Project. Together referred to as the Proposal.
Project Concept Proposal	The NGCC includes a maximum and minimum security correctional centre of 1,700 beds comprised of: • A maximum security section of 1,300 beds that will include: – 1000 beds for male inmates. – 300 beds for female inmates. • A minimum security section that will include: – 400 bed residential accommodation for male inmates. 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 complete as part of the Stage 2 works. Consequently, the stage 2 construction works for the Project could occur anywhere within the development zone shown in Figure 1-3. The total footprint around both the maximum and minimum correctional centres, including the carpark, is around 45 hectares. Features of the Project would include the following: • The concept proposal includes a maximum built form height of 12 metres (approximately three storeys). • The gross floor area will be approximately 100,000 square metres. • A six metre high fence or wall will be constructed around the perimeter of the facility, with light and security camera poles up to 10 metres in height. • Store buildings, small ancillary facilities and a central energy plant will be located outside the perimeter walls / fences. • Internal access into and out of the correctional centre from Avenue Road will be provided. • Car parking for approximately 500 car spaces. • Other associated facilities include recreational oval, special accommodation units, health facilities, education and programs areas, administration, workshops, staff amenities, visitor facilities and utilities. • A 100-metre wide Asset Protection Zone (APZ) zone would be cleared around the correctional centre and associated facilities and car parking area in accordance with the Rural Fires Act 1997 and requirements of the Planning for Bush Fire Protection (PBP; NSW Rural Fire Service [RFS], 2006). • A vegetation buffer would be provided outside the APZ along the northern, eastern and southern boundaries of the Project Site. The buffer would be 50 metres wide along the northern property boundary, 15 metres wide to the east along Avenue Road and 30 metres wide along the southern property boundary. • Fire access road on the inside and the outside of the perimeter fence of the facility will be constructed to ensure safe operational access for emergency services personnel responding to a bushfire event. • Water, wastewater, power and communication utilities within the Project Site. • Landscaping of ground cover and /or shrubbery in areas to be defined.

Stage	Description
Stage 1 Site Clearance and Preparatory Works	Stage 1 (early works), includes preparatory work 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 provision 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.
Value	The capital investment value for the Project is in excess of \$30 million.
Project Site	• Located at 313 Avenue Road, Lavadia. • Lot 26 DP 751376. • Lot 1 DP 1190399. • Project Site is 195 hectares (ha) in size.

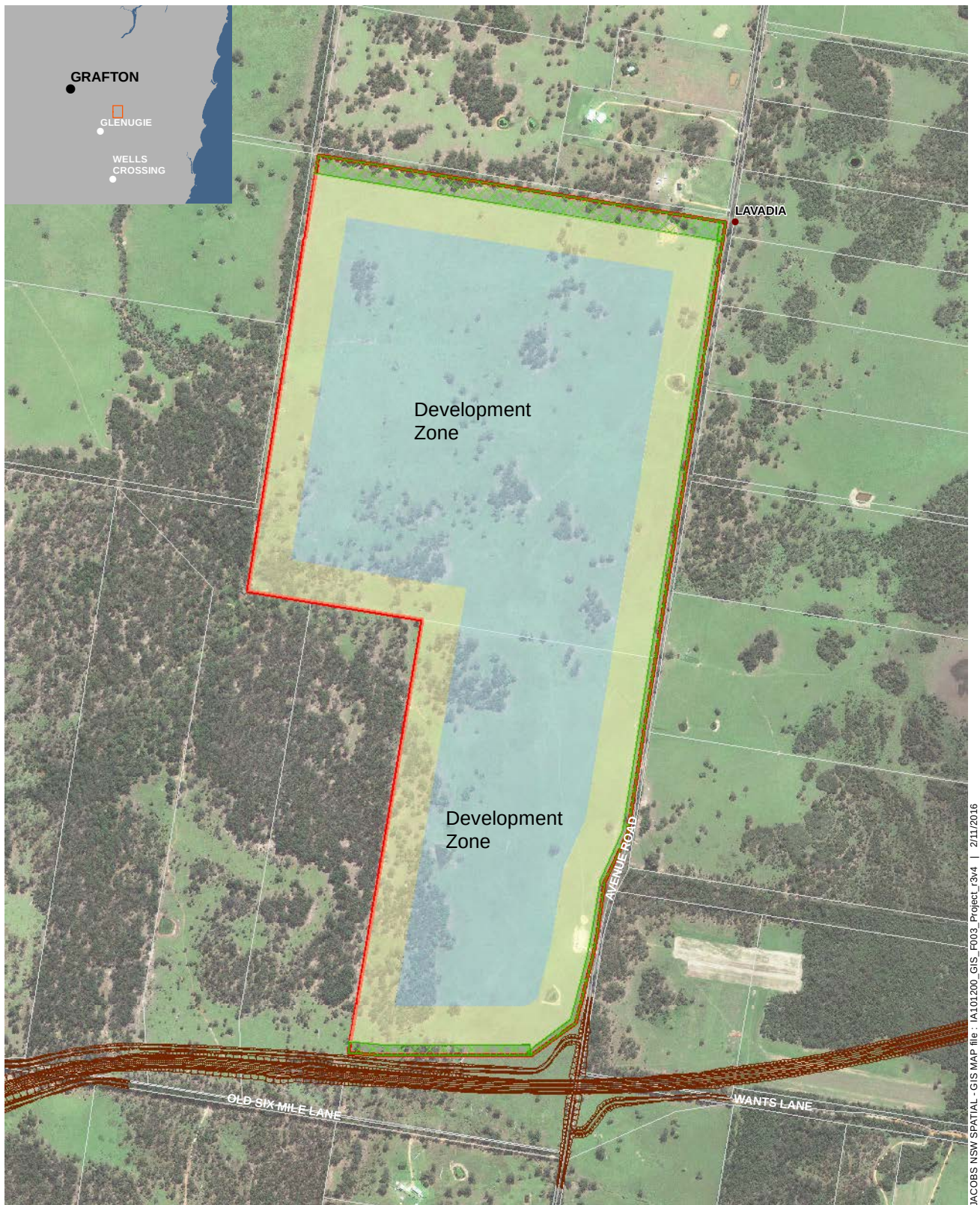
Future works regarding the design, construction and servicing of the Project will be based on the final design and layout of the facilities and will be the subject of future staged development application(s).

The construction activities associated with the Stage 1 site clearance and preparatory works is estimated to take approximately 6 to 12 months and provide up to 50 full time equivalent positions.

1.4 Project objectives

The objectives of the Project are:

- 1) Be a safe and secure correctional centre.
- 2) Be a humane and ethically managed centre.
- 3) Help reduce the risk of re-offending through (among other things) preparing inmates for reintegration into the community on release from the CSNSW network.
- 4) Manage resources effectively and efficiently, enhancing value for money.
- 5) Utilise effective governance arrangements.
- 6) Produce strong economic and social benefits to the local Grafton region, the northern NSW region and the broader NSW community.
- 7) Be a valuable physical asset for the duration of the Operating Phase and beyond.
- 8) Be operated in such a way as to keep pace with best correctional practice over the term of its operational life.
- 9) Be operated so that it links with the broader management strategies and operational needs of the CSNSW network.



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Legend

- | | | | |
|---|-------------------|--|-----------------------------------|
| | The Project | | Asset Protection Zone |
| | Vegetation buffer | | Development Zone |
| | | | Pacific Highway Upgrade alignment |

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Data sources

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

Figure 1-3 | The Development Zone

1.5 Report structure

This report is the Biodiversity Assessment Report (BAR) that supports the EIS that is required for the Proposal under Division 4.1, Part 4 of the EP&A Act. The structure of the report is summarised in **Table 1-2**.

This BAR has been prepared in accordance with the requirements of the Framework for Biodiversity Assessment (FBA) (Office of Environment and Heritage, 2014a) to assess the potential biodiversity impacts from the construction and operation of the NGCC in Lot 26 DP 751376 and Lot 1 DP 1190399.

Clearance of the whole site has been assessed as part of this BAR. All indirect impacts have been assessed within the site boundary. The inner and outer assessment circles used for this assessment are shown in Figure 3-1 along with the landscape features in the region.

Table 1-2 Report structure

Section reference	Section heading	Description
Executive summary	Executive summary	Concise summary of this technical paper and the key findings
1	Introduction - Background - Locality - Project description - Report structure	Description of the Project relevant to potential impacts on biodiversity. Provides an overview of the study objectives and structure of technical report.
2	Legislative context and SEARS Other legislative requirements	Identifies the key legislation that this technical study must follow and lists the biodiversity guidelines that the project must comply with.
3	Landscape features	Establishes local and regional landscape features in line with the FBA and identifies biodiversity values.
4	Native vegetation	Outlines the floristic survey effort and identifies Plant Community Types (PCTs) and TECs
5	Threatened species	Outlines the species survey effort and provides results on identified threatened species and their habitat
6	Matters of National Environmental Significance	Identifies matters of NES in the study area.
7	Impact assessment - Avoidance and minimisation - Relevant construction activities - Construction related impacts	Assesses the potential impacts to biodiversity values under and outside of the FBA.
8	Mitigation	Establishes management measures to manage construction and operational impacts associated with biodiversity values.
9	Biodiversity offsets	Outlines what biodiversity values qualify for offsets under the FBA.
10	Conclusions and recommendations - Conclusions - Recommendations	Concise statement of key findings of the construction and operational impacts of the Project on biodiversity values.
11	Acronyms	Summarises the acronyms used throughout this report.
12	References	Information sources used

1.6 Project personnel

This assessment was carried out by appropriately qualified and experienced ecologists (refer to **Table 1-2**).

Table 1-3 Personnel and qualifications

Name	Role	Qualifications
Chris Thomson	Technical lead and review	Bachelor of Applied Science (Environmental Management, UNE 1992 Graduate Certificate in Natural Resources, UNE 2010 Accredited BioBanking and major projects assessor
Jonathan Carr	Ecology assessment and GIS analysis	Bachelor of Environmental Science and Management, University of Newcastle 2009 Accredited BioBanking and major projects assessor
Andrew Carty	Ecology assessment and GIS analysis	Bachelor of Environmental Science - University of Newcastle Natural Area Restoration and Management Cert. IV Hunter Institute TAFE Bush Regeneration Cert. II Hunter Institute TAFE Accredited BioBanking and major projects assessor
Brenton Hays	Ecology assessment	Bachelor of Environmental Science with Honours (first class) – University of Newcastle 2014

2. Legislative context and SEARS

This BAR will be used to support the preparation of the EIS required under Division 4.1, Part 4 of the EP&A Act. SEARs relevant to this report and where they have been addressed are summarised in **Table 2-1**.

Table 2-1 Summary of SEARs relevant to this specialist working paper

SEARs	Cross reference
SEAR No 8 - Flora and Fauna Biodiversity impacts related to the proposed development are to be assessed. <i>Relevant Policies and Guidelines:</i> Clarence Valley Council's Biodiversity Management Strategy 2010	Chapters 3 - 10

2.1.1 Biodiversity required guidelines and policies

The information presented this BAR assesses the potential biodiversity impacts of the Project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy.

This BAR was completed in accordance with the requirements specified by the SEARs issued on 21 December 2015 and has therefore considered the following:

- Biodiversity Management Strategy 2010* (Clarence Valley Council, 2010).
- Framework for Biodiversity Assessment* (FBA) (OEH 2014a).
- NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014b).
- Fisheries NSW Policy and guidelines for fish habitat conservation and management* (Department of Primary Industries (DPI 2013).
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC, 2004).
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (DECCW, 2009).
- Commonwealth Policy Statements on survey guidelines for Australia's threatened fauna including bats birds, frogs, fish, mammals and reptiles.*

2.1.2 Context of the BAR

The *NSW Biodiversity Offsets Policy for Major Projects* (BOPMP) (OEH 2014b) provides a standard method for assessing impacts of major projects (i.e. SSDs) on biodiversity and determines offsetting requirements. The FBA adopts the BOPMP and provides an assessment methodology to identify terrestrial biodiversity values, assess impacts and quantify and describe biodiversity offsets required for unavoidable impacts. This comprises of three stages:

- Stage 1 – Biodiversity assessment.
- Stage 2 – Impact assessment (biodiversity values).
- Stage 3 – Biodiversity Offset Strategy.

For aquatic biodiversity impacts, the FBA refers to the requirements guided by the *Fisheries NSW Policy and guidelines for fish habitat conservation and management* (DPI 2013) and is generally conducted separately to the BAR.

2.1.3 Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)

The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and ecological communities.

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on matters of national environmental significance (MNES) undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, undertaking, or activity. An action that 'has, will have or is likely to have a significant impact on a MNES' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Government Minister for Department of Environment and Energy (DEE) (the 'Minister').

The MNES relevant to the Project include threatened species and ecological communities and migratory species.

2.1.4 Environmental Planning and Assessment Act 1979 (EP&A Act)

Under a Division 4.1, Part 4 of the EP&A Act, application for a Major Project including a State Significant Development (SSD) must have an Environmental Impact Assessment Statement (EIS) prepared with consent from the Minister for Planning. The Secretary's Environmental Assessment Requirements (SEARs) for the Proposal were issued by the Department of Planning and Environment (DPE) on 21 December 2015.

The Minister may grant consent to SSD subject to a condition that requires the proponent to acquire and retire biodiversity credits (s89I of the EP&A Act). The consent authority is not required to consider the likely impacts of the site biodiversity values if a BioBanking statement is submitted and granted in line with the FBA and *Biodiversity Offsets Policy for Major Projects*. Submitting a BioBanking statement with the required number and type of credits (to maintain or improve biodiversity values) and onsite measures is an alternative to completing an assessment of significance (as determined in Section 5A of the EP&A Act) for potential significant impacts to threatened species, populations and ecological communities listed under the TSC Act.

2.1.5 NSW Threatened Species Conservation Act 1995 (TSC Act)

The *Threatened Species Conservation Act 1995* (TSC Act) provides legal status for biota of conservation significance in NSW. The Act aims to 'conserve biological diversity and promote ecologically sustainable development'. It provides for:

- The listing of 'threatened species, populations and ecological communities', with endangered species, populations and communities listed under Schedule 1, 'critically endangered' species and communities listed under Schedule 1A, vulnerable species and communities listed under Schedule 2.
- The listing of 'Key Threatening Processes' (KTP) (under Schedule 3).
- The preparation and implementation of Recovery Plans and Threat Abatement Plans.
- Requirements or otherwise for the preparation of Species Impact Statement (SIS).

2.1.6 NSW Fisheries Management Act 1994 (FM Act)

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. In particular, this includes:

- To conserve fish stocks and key fish habitats.
- To conserve threatened species, populations and ecological communities of fish and marine vegetation.
- To promote ecologically sustainable development, including the conservation of biological diversity and, consistently with those objects.
- To promote viable commercial fishing and aquaculture industries.
- To promote quality recreational fishing opportunities.
- To appropriately share fisheries resources between the users of those resources.
- To provide social and economic benefits for the wider community of New South Wales.

- To recognise the spiritual, social and customary significance to aboriginal persons of fisheries resources and to protect, and promote the continuation of, aboriginal cultural fishing.

2.1.7 NSW Noxious Weeds Act 1993 (NW Act)

The *Noxious Weeds Act 1993* (NW Act) provides for the declaration of noxious weeds by the Minister for Primary Industries. Noxious weeds may be considered noxious on a National, State, regional or local scale. All private landowners, occupiers, public authorities and Councils are required to control noxious weeds on their land under Part 3 Division 1 of the NW Act. As such, if present, noxious weeds in the Project Site would need to be assessed and controlled.

3. Landscape features

3.1 Identified features

In accordance with Chapter 4 of the FBA, the BAR is required to identify a number of landscape features such as the IBRA region, IBRA sub-region, Mitchell landscape, rivers and streams, wetlands and extent of native vegetation in the area assessed for the Project Site. The landscape features of the Project Site are shown in **Figure 3-1** and described in **Sections 3.1.1 to 3.1.5**.

The FBA also requires that the landscape value score is determined, which is described in **Section 3.2**.

3.1.1 IBRA bioregion and subregion

The Project Site is located in the southern extent of the Southern Eastern Queensland Bioregion (IBRA 7) (formerly part of the North Coast Bioregion – IBRA 5.1) which extends from Sherwood Nature Reserve near Glenreagh in New South Wales north up to Gladstone in Queensland and west to Bunya Mountains National Park. The Project Site is close to the North Coast Bioregion in the south east which adjoins the New England Tablelands Bioregion in the west (Thackway and Creswell 1995; National Parks and Wildlife Service, 2003). The Project Site is located within the Clarence Lowlands (Clarence Basin) subregion which is characteristic of low hills and plains with steeper hills to the west and south.

3.1.2 NSW Landscape Regions (Mitchell landscapes)

The Project Site occurs across two Mitchell Landscapes with the majority of the site occurring within the Grafton – Whiporie Basin Mitchell Landscape, and a small section to the west mapped as part of the Clarence – Richmond Alluvial Plains Mitchell Landscape (Mitchell 2002). These are summarised in **Table 3-1** and includes an estimated proportion of cleared land for these landscapes reported by OEH (2013).

Table 3-1 NSW Mitchell landscapes over the Project Site of the North Coast Bioregion (source Mitchell 2002, OEH 2013)

Landscape	Landscape characteristics (geomorphic, pedologic and vegetation)	Percentage of landscape cleared
Grafton – Whiporie Basin	Extensive low undulating hills and large drainage basins on sub-horizontal upper Jurassic interbedded quartz sandstone, lithic sandstone, clayey siltstone and coal measures. Often exhibits ironstone concretions in the weathering profile. General elevation 50 to 150 m, local relief 50 m. Yellow and brown texture-contrast soils on slopes and dark grey clays along valley floor streamlines. Dry hardwood forest of; spotted gum (<i>Corymbia maculata</i>), blackbutt (<i>Eucalyptus pilularis</i>), large-fruited blackbutt (<i>Eucalyptus pyrocarpa</i>), with grasses and burrawang (<i>Macrozamia</i> sp.).	33 %
Clarence – Richmond Alluvial Plains	Wide valleys, channels, floodplains, terraces and estuaries of the Clarence and Richmond Rivers and other coastal streams on Quaternary alluvium, general elevation 0 to 50m, local relief 15m. Deep brown earths and structured brown clay on floodplains. Terrace with yellow texture-contrast soil containing ironstone concretions. Extensively cleared the valley floor supported forest of cabbage gum (<i>Eucalyptus amplifolia</i>), forest red gum (<i>Eucalyptus tereticornis</i>), broad-leaved apple (<i>Angophora subvelutina</i>), river oak (<i>Casuarina cunninghamiana</i>), silky oak (<i>Grevillea robusta</i>), rough-barked apple (<i>Angophora floribunda</i>), native teak (<i>Flindersia australis</i>), coastal grey box (<i>Eucalyptus bosistoana</i>), pink bloodwood (<i>Corymbia intermedia</i>), spotted gum (<i>Corymbia henryi</i>), grey ironbark (<i>Eucalyptus paniculata</i>), broad-leaved paperbark (<i>Melaleuca quinquenervia</i>), blackwood (<i>Acacia melanoxylon</i>) and black she-oak (<i>Allocasuarina littoralis</i>). On the margins of the basalt based Lamington Volcanic Slopes Landscape; dry closed forest with native cascarilla (<i>Croton</i>	73 %

Landscape	Landscape characteristics (geomorphic, pedologic and vegetation)	Percentage of landscape cleared
	<i>verreauxii</i>), yellow tulip (<i>Drypetes deplanchei</i>), silver basswood (<i>Polyscias elegans</i>), guioa (<i>Guioa semiglauc</i>), red cedar (<i>Toona australis</i>) with abundant vines and emergent hoop pine (<i>Araucaria cunninghamii</i>). Salt marsh, mangrove communities and paperbark (<i>Melaleuca quinquenervia</i>) freshwater swamps occur in the estuary.	

3.1.3 Rivers and streams

There are no rivers or streams traversing the Project Site. The Coldstream River (5th order stream) is the closest main waterway and is located approximately 600 metres to the east of the Project Site and within the outer assessment circle. Minor tributaries (1st and 2nd order streams) in the Project Site feed into the Coldstream River (to the east) and Deep-Glenugie Creek (to the west) which eventually drain north to the major Clarence River approximately 10 kilometres to the north west (refer to **Figure 3-2**). Fisheries NSW have mapped the Clarence River, Coldstream River and Deep-Glenugie Creek as Key Fish Habitat.

3.1.4 Wetlands

The Clarence River region is important for providing extensive areas of floodplain and associated wetlands encompassing a total area of 8,006 hectares (DECC 2008). Large connecting wetlands and flood prone areas are present approximately one kilometre to the east (Coldstream River) and two kilometres to the north west (Deep-Glenugie Creek). These areas are referred to as the Upper Coldstream wetlands listed in the Directory of Important Wetlands of Australia and SEPP 14 Coastal wetlands located to the north east in low lying areas of the Coldstream River.

The area has been extensively cleared and converted to grazing land, sugar cane and rural residential with highly modified drainage and water control structures (DECC, 2008). The wetlands still provide high quality breeding and foraging habitat for a range of fauna species of birds, fish, frogs, mammals and reptiles as well as listed threatened species such as Black-necked Stork (*Ephippiorhynchus asiaticus*), Comb-crested Jacana (*Irediparra gallinacea*), Magpie Goose (*Anseranas semipalmata*), Brolga (*Grus rubicunda*) and Australian Painted Snipe (*Rostratula australis*), and provide a movement corridor and important habitat for migratory bird species.

Wetlands are limited on the Project Site to four artificially constructed farm dams with limited macrophyte cover and moderate levels of stock pugging. Although in poor 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). Other widespread and common water birds, frogs and turtles may also occur.

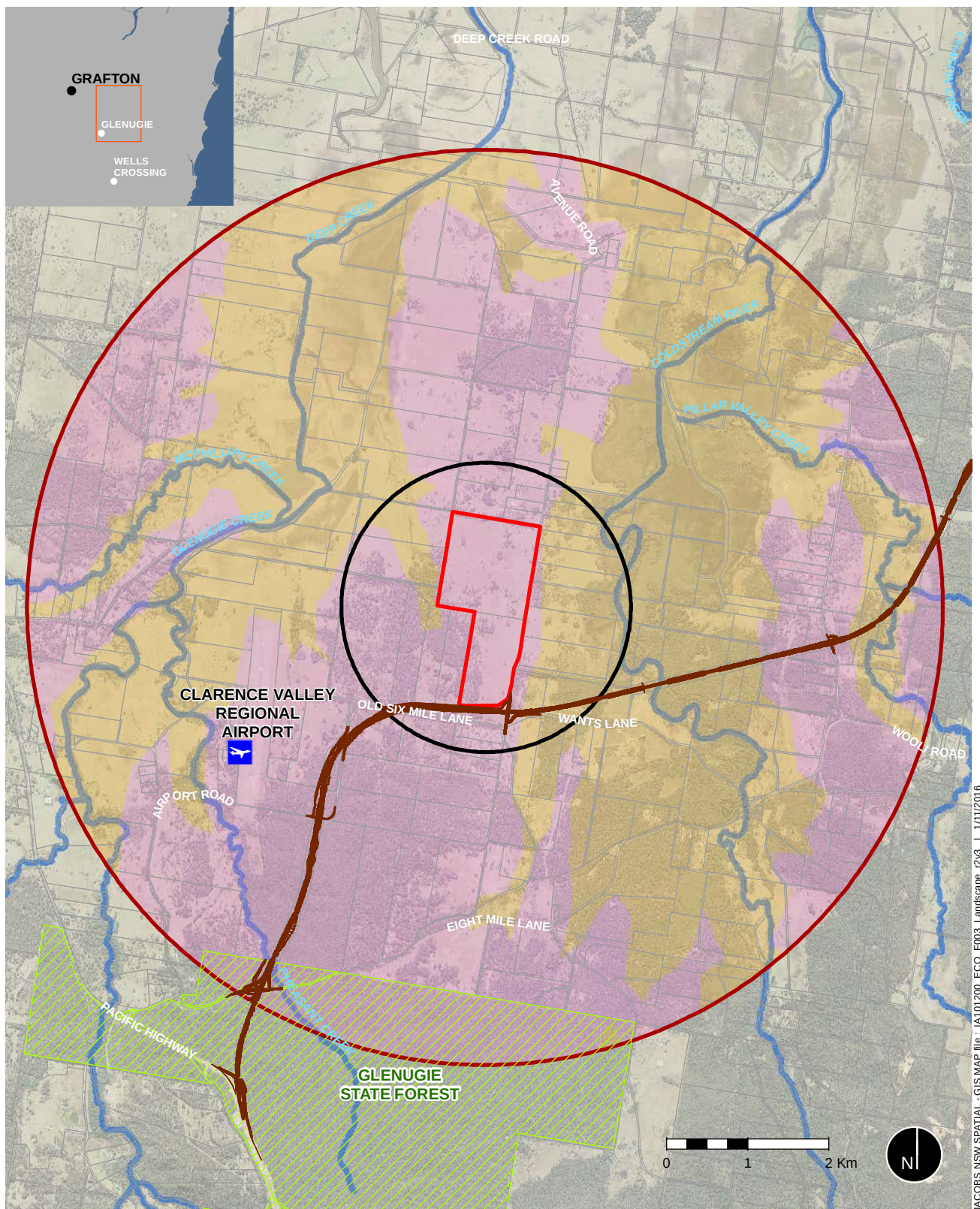
3.1.5 Native vegetation extent

The Project Site is largely cleared, albeit for scattered small patches of remnant vegetation, the most extensive of which occurs on the western boundary and is contiguous with similar vegetation to the west and south of the Project Site. The extent of native vegetation within the outer assessment circle is mapped in Figure 3-3

3.1.6 State or Regionally Significant Biodiversity Links

No formal state or regional biodiversity links are recorded within the Project Site or locality. The important Upper Coldstream wetland and associated tributaries (riparian buffers) classified as State significant and regional corridors occur approximately 600 metres to the east of the Project Site (refer to Figure 3-2).

Five native vegetation patches in the Project Site are defined as part of a connecting link heading south west adjoining larger native vegetation patches. Current connection links heading directly south from the Project Site would be subsequently inhibited by the construction of the Pacific Highway but not the Project. A connecting link traversing south west into Glenugie would remain intact. No connecting links are dissected by the Project Site.

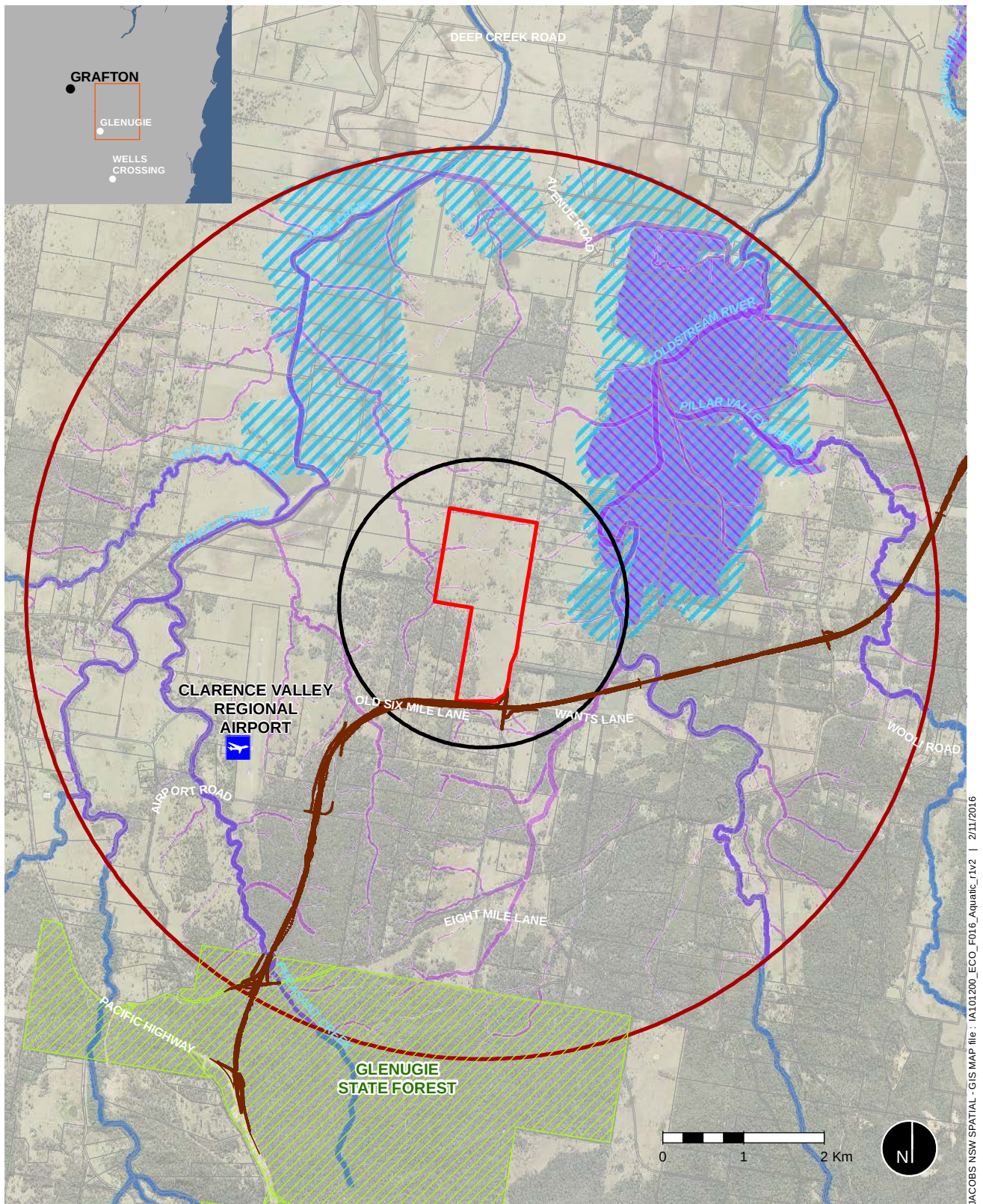


JACOBS NSW SPATIAL - GIS MAP file: I\101200_ECO_F003_Landscape_r2v3 | 1/11/2016

Legend

- | | |
|---|---|
| The Project | Mitchell landscapes |
| Pacific Highway Upgrade alignment | Clarence - Richmond Alluvial Plains |
| Inner assessment circle | Grafton - Whiporie Basin |
| Outer assessment circle | |

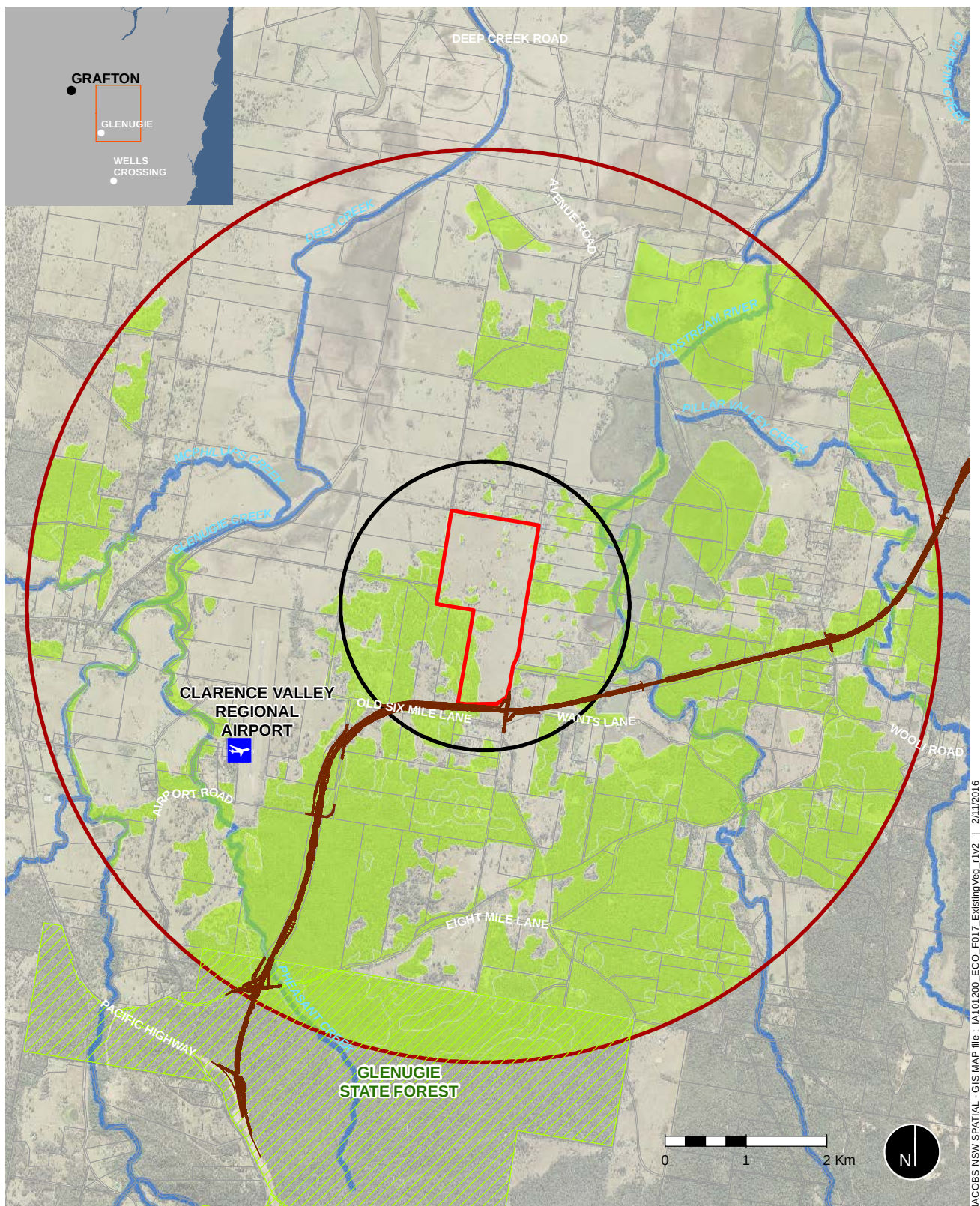
Figure 3-1 | Landscape features (terrestrial)



Legend

- | | |
|---|--|
| The Project | SEPP 14 Wetlands |
| Pacific Highway Upgrade alignment | Important wetlands - 50 m buffer |
| Inner assessment circle | Riparian zone (strahler order) |
| Outer assessment circle | |

Figure 3-2 | Landscape features (aquatic)



JACOBS NSW SPATIAL - GIS MAP file: I\A101200_ECO_F017_ExistingVeg_r1v2 | 2/11/2016

Legend

- The Project
- Existing vegetation
- Pacific Highway Upgrade alignment
- Inner assessment circle
- Outer assessment circle

Figure 3-3 | Existing native vegetation

A review of the DECC (2003) key habitats and corridors for the locality identified local fauna key habitats on the western extent of the Project Site as well as in adjoining native vegetation further south west. The remaining connecting link traverses south west / north east and would allow wildlife movement between the Project Site and the Dry Climate Change Corridor for Coastal Emu (*Dromaius novaehollandiae*) and regional fauna corridors at Gleungie State Forest. The regional fauna corridor for Brush-tailed Phascogale (*Phascogale tapoatafa*) occurs approximately two kilometres to the east of the Project Site linking to Pine Brush State Forest in the north and Yuraygir National Park further east.

3.2 Landscape value

A site based assessment was chosen in accordance with the FBA to calculate landscape score values.

3.2.1 Percent native vegetation cover

To achieve an assessment ratio of 1:10, the inner assessment circle was applied at 1,000 hectares, and 10,000 hectares for the outer assessment circle (refer to **Figure 3-1**).

The percentage native vegetation cover was analysed before development (current stage) for both the inner and outer assessment circles. ArcGIS was used to interpret regional vegetation mapping from the Comprehensive Regional Assessment Floristic Types Information (CRAFTI) database (Resource and Conservation Division 2001) and the Woolgoolga to Ballina Pacific Highway Upgrade vegetation community spatial layer (RMS, 2012). Manual interpretation of recent aerial imagery was necessary to generate buffers on unknown or unidentified vegetation patches to calculate a total vegetation cover. Vegetation cover within the approved Pacific Highway upgrade corridor was excluded from the total landscape cover in assessing current extent. The total future (post-development) vegetation cover was subtracted from pre-development cover to calculate the total native vegetation cover loss after development. A future extent of native vegetation cover as a percentage (in five percent increments) was calculated for both the inner and outer assessment circles and entered into the BioBanking credit calculator (BBCC) (refer to **Table 3-2**).

The preliminary assessment for loss of native vegetation cover on the Project Site is 30.3 hectares (or 15%). This figure was subtracted from approximately 400 hectares (inner assessment circle) and approximately 4,090 hectares (outer assessment circle) representing the total native vegetation cover before development which amounted to 41 percent and 40 percent, respectively. The results after development showed no change in percentage cover for the outer assessment circle and changed to 37 percent for the inner assessment circle, however both assessment circles remained in the same vegetation cover class with no change to percent cover score (refer to **Table 3-2**).

Table 3-2 Predicted change in native vegetation cover in the landscape

Assessment circle (area)	Native vegetation cover				Change in percent cover scores
	Before development		After development		
	Area / percent cover	Cover class	Area / percent cover	Cover class	
Inner (1,000 ha)	400 ha (40 %)	36-40 %	370 (37 %)	36-40 %	0
Outer (10,000 ha)	4,090 ha (41 %)	41-45 %	4,060 ha (41 %)	41-45 %	0

3.2.2 Connectivity value

A connectivity site based assessment was undertaken in accordance with Appendix 4 of the FBA. No formal state or regional biodiversity links are recorded across the Project Site.

Minor riparian buffers (1st and 2nd order streams) within the Project Site are not eligible for classification under state or regional biodiversity links according to Appendix 4 in the FBA. As no eligible significant biodiversity links occur over the Project Site, the connectivity value class is scored as zero.

One connecting link was identified from native vegetation within and surrounding the Project Site, traversing south west-north east direction into a large area biodiversity link (i.e. 2,923 hectares). The current linkage width class of the narrowest area of the connecting link occurs outside of the Project Site and is approximately 90 metres which represents a linkage width class of moderate. This linkage width threshold would not be crossed or cleared. Therefore the results of the connectivity value score remains at zero.

A second connecting link was identified in the southern portion of the Project Site but has not been included in the assessment due to the approved construction of the Pacific Highway immediately adjacent to the Project Site which would obstruct this link.

The functional connecting link within the outer assessment circle comprises woody PCTs assumed to have a percentage foliage cover in over-storey and mid-storey or ground cover condition within benchmark. There would be no change to the woody condition of the connecting link after development and would remain within benchmark, scoring zero.

3.2.3 Patch size

Small patches of remnant vegetation are present within the Project Site. Those patches on the western boundary are part of a large contiguous native vegetation patch which extends to the south and west outside the property boundary and beyond the outer assessment circle. Almost all of the Project Site and the associated patch resides in the Grafton - Whiporie Basin Mitchell Landscape with a small portion of native vegetation within the Clarence – Richmond Alluvial Plains Mitchell Landscape. For this assessment patch size scores were based on the Grafton - Whiporie Basin and determined in accordance with Table 15 of the FBA. At a percentage cleared estimate of 33% (Grafton - Whiporie Basin) and a patch size of 2,923 hectares the assessment equates to an extra-large patch size class which scores 12 (refer to **Table 3-3**).

Table 3-3 Mitchell landscape, patch size, size class and patch size score

Mitchell landscape	Patch size (ha)	Patch size class	Patch size score
Grafton – Whiporie Basin	2, 923 ha	30-70%	12

4. Native vegetation

The following section documents the methods used to identify and map the extent of native vegetation within the Project Site. PCTs are classified based on the NSW Vegetation Information System (VIS) Classification database (OEH 2015).

4.1 Methods

4.1.1 Background research

A background review of existing information was undertaken to identify the existing environment of the Project Site and locality, including lands within the outer assessment circle. The review focussed on database searches, relevant ecological reports pertaining to the study area, property boundaries, and relevant GIS layers. Relevant databases and literature included:

- *OEH VIS Classification: Plant Community Types* (OEH, 2016c).
- *Comprehensive Regional Assessment Floristic Types Information* (CRAFTI) database.
- *Atlas of Groundwater Dependent Ecosystems* (Bureau of Meteorology, 2016a).
- IBRA Bioregions and Mitchell Landscapes GIS layers.
- Other land use spatial (GIS) data (streams, key fauna corridors, SEPP wetlands and Directory of Important wetlands).
- Woolgoolga to Ballina Pacific Highway Upgrade biodiversity working paper and report and spatial layers (RMS, 2012).
- *Biodiversity Management Strategy* (Clarence Valley Council, 2010).

Information obtained during the background review was used to further define the scope of the field investigation and inform the vegetation stratification, identifying areas of likely ecological value and focus for the BioBanking plot based assessment. The Project Site was stratified into PCTs and indicative Vegetation Zones to inform the field surveys and start the assessment process in BBCC. Vegetation zones were refined in the field.

4.1.2 Vegetation survey

The vegetation survey was completed using field survey methods in line with Chapter 5 of the FBA and implementing the guidelines for *Threatened Biodiversity Survey and Assessment* (DEC, 2004). The survey was undertaken over a five day period (1-5 February 2016) in order to complete the minimum number of transects and plots for each vegetation zone on the Project Site in accordance with the requirements of the FBA (refer to **Table 4-1**).

Table 4-1 Minimum number of transects/plots required per vegetation zone area (Table 3: OEH 2014a)

Vegetation zone area (ha)	Minimum number of transects/plots
0-4	1 transect/plot per 2 ha (or part thereof) or 1 transect/plot if vegetation is in low condition
>4-20	3 transects/plots or 2 transects/plots if vegetation is in low condition
>20-50	4 transects/plots or 3 transects if vegetation is in low condition
>50-100	5 transects/plots or 3 transects/plots if vegetation is in low condition
>100-250	6 transects/plots or 4 transects/plots if vegetation is in low condition

Vegetation zone area (ha)	Minimum number of transects/plots
>250-1000	7 transects/plots or 5 transects/plots if vegetation is in low condition. More transects/plots may be required if the condition of the vegetation is variable across the zone
> 1000	8 transects/plots or 5 transects/plots if vegetation is in low condition or in a homogenous landscape in the Western Division. More transects/plots may be required if the condition of the vegetation is variable across the zone

Assessment of vegetation zones

The preliminary vegetation mapping accessed from the desktop review was used along with aerial photography to identify vegetation extent. Broad-scale soil and vegetation mapping and contour data was used to stratify vegetation across the Project Site. The preliminary vegetation mapping was then ground-truthed using a mobile GPS unit and later converted into polygons and mapped as PCTs and any identified Threatened Ecological Communities (TECs).

Surveys assessed the environmental variation within the Project Site and any areas with gaps in existing mapping and site information to determine vegetation zones. The condition of PCTs for the Project Site was then assessed in accordance with Chapter 5 of the FBA and vegetation zones assigned by comparing the dominant canopy species, the general description of location, soil type and other attributes as described in the TSPD (OEH 2016b) and OEH online VIS classification database (OEH 2016c).

A total of five vegetation zones were identified on the Project Site. Vegetation polygons assigned as 'moderate-good' vegetation zones were also classified into a sub-condition class of poor, moderate or good using the following criteria:

- 1) Poor condition vegetation had predominantly exotic species in the mid storey and ground cover layers, with very few native species in any stratum.
- 2) Moderate condition vegetation had predominantly native species in the mid storey and ground cover layers but included a moderate abundance and cover of exotic species.
- 3) Good condition vegetation was predominantly native, had high native species diversity, and had very few exotic species in any stratum.

Plot-based floristic survey

A total of five vegetation zones were identified on the Project Site (**Table 4-2**). The plot-based full floristic survey focused on these five strata using a series of 20 by 20 metre quadrats nested inside a 20 by 50 metre transect. In total 13 plots / transects were completed to record the following information:

- Stratum and layer – in which each species occurs.
- Growth form – for each recorded species.
- Species name – above ground vascular plant species were identified to the lowest taxonomic order possible using nomenclature consistent with PlantNet NSW.
- Cover – a measure or estimate of the appropriate cover measure for each recorded species; recorded from one to five percent and then to the nearest five percent. If the cover of a species is less than one percent and the species is considered important, then the estimated cover should be entered (e.g. 0.4).
- Abundance rating – a relative measure of the number of individuals or shoots of a species within the plot. The following intervals were used; numbers above about 20 and 1,000 are estimates only: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500 and 1000.

Assessment site value (vegetation condition)

The following site attributes were assessed at each of the 13 plots to obtain a quantitative measure of vegetation condition to be applied for each zone:

- Native species richness (measured in a 20 by 20 metre quadrat).
- Native overstorey cover (measured along a 50 metre line transect).
- Native midstorey cover (measured along a 50 metre line transect).
- Native ground cover (grasses) (measured along a 50 metre line transect).
- Native ground cover (shrubs) (measured along a 50 metre line transect).
- Native ground cover (other) (measured along a 50 metre line transect).
- Exotic plant cover (measured along a 50 metre line transect).
- Number of trees with hollows (estimated by counting the number of trees with hollows visible from the ground in the 50 by 20 metre plot).
- Proportion of over-storey species occurring as regeneration (assessed across the entire vegetation zone)
- Total length of fallen logs (the total length of woody material greater than 10 centimetres in diameter within the 50 by 20 metre plot).

These 10 site attributes were ranked against benchmark data for the relevant PCT and a site value score for each vegetation zone was determined in accordance with subsection 5.3.3 of the FBA. Additionally, a noxious weed assessment was undertaken.

Identification of Plant Community Types (PCTs)

The extent of native vegetation within the Project Site was mapped onto digital aerial photography using existing maps of native vegetation in the area and the detailed floristic assessment data described above to identify and map PCTs on the site.

4.1.3 Summary of vegetation survey effort

The number of vegetation zones and respective number of floristic plots / transects sampled in the field is presented in **Table 4-2**.

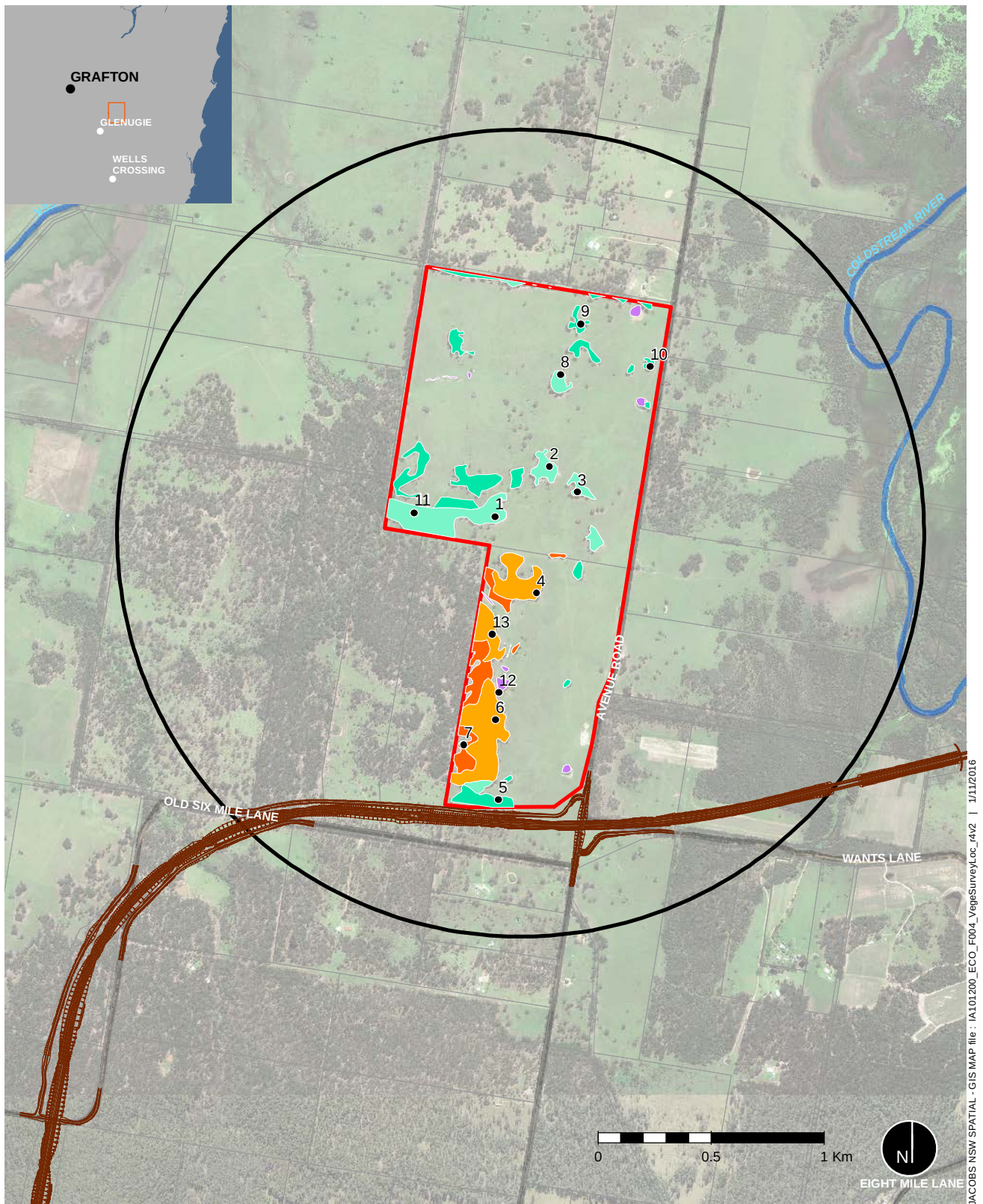
4.1.4 Limitations

The vegetation field survey was able to provide adequate spatial coverage and survey effort of the entire Project Site. This was achievable in the timeframe given that the majority of vegetation is cleared and generally confined to the western border of the Project Site. Detailed survey of floristics was undertaken to provide a comprehensive list of flora species for that point in time. While any undetected flora species may appear in other times of the year, particularly cryptic orchids, a period of several seasons or years is often needed to identify all the species present in an area.

The Groundwater Dependent Ecosystem assessment was limited to a desktop assessment in order to determine the type and intensity of potential impacts. Information regarding detailed volume and extent of groundwater extraction was not collected.

Table 4-2 Summary of PCTs / vegetation zones and vegetation survey effort

Vegetation Zone Number	Plant Community Type (PCT)	Ancillary code	Vegetation area (ha)	No. plots required	No. plots collected	Location of plots sampled (refer Figure 4-1 for site locations)
1	Coastal freshwater meadows and forblands of lagoons and wetlands (PCT 782)	Low	0.8	1	1	Plot 12 was located at Site FD2 and near Site 1
2	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1209)	Moderate/ Good (Medium)	8.2	3	5	Plot 1 located at Site 8 Plot 2 located at Site 7 Plot 3 located to the east of Site 7 Plot 8 located at Site 6 Plot 11 located at Site 2
3	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1209)	Low	8.0	2	3	Plot 5 located near Site 9 Plot 9 located near Site 5 Plot 10 located to the south of Site 5
4	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1211)	Moderate/Good (Medium)	10.6	3	3	Plot 4 located at Site 3 Plot 6 located at Site 1 Plot 13 located to the south of Site DL1
5	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1211)	Low	4.0	1	1	Plot 7 located near Site 9
TOTAL			31.6	10	13	



Legend

 	The Project	•	Biometric plot locations	 	NR244 Good/Moderate
	Pacific Highway Upgrade alignment		Vegetation zone	 	NR246 Poor
	Inner assessment circle	 	NR150 Poor	 	NR246 Good/Moderate
		 	NR244 Poor		

Figure 4-1 | Vegetation survey locations

4.2 Plant Community Type descriptions

Native vegetation of the inner assessment circle applied at 1,000 hectares, and outer assessment circle applied at 10,000 hectares is shown in **Figure 3-3**. The vegetation survey identified three PCTs within the Project Site based on sampled plot results and landscape features matched against the VIS classification database. Vegetation condition was assessed using the site attributes compared with benchmark values. Each PCT is described below in **Table 4-3**, **Table 4-4** and **Table 4-5** and are mapped within the Project Site shown in **Figure 4-2**.

The majority of native vegetation is generally confined to the western extent of the Project Site and has isolated patches scattered throughout. Past and present land use activities such as land clearing, cattle grazing, exotic grass seeding, tree ringbarking and under-scrubbing have significantly reduced the extent and condition of native vegetation. As a result mid-storey and ground cover shrubs are absent reflecting the poorer condition scores. The groundcover is dominated by a mix of both native and exotic plant species including native Barbed-wire Grass (*Cymbopogon refractus*) and Blady Grass (*Imperata cylindrica*) and exotic Broad-leaved Carpet Grass (*Axonopus compressus*) and Paspalum (*Paspalum dilatatum*).

Table 4-3 Description of Coastal freshwater meadows and forblands of lagoons and wetlands

Coastal freshwater meadows and forblands of lagoons and wetlands (PCT:782)	
Vegetation zones: 1 (Poor condition) PCT Code: 782 BVT (Biometric Vegetation Type) Code: NR150 Vegetation formation: Freshwater Wetlands Vegetation class: Coastal Freshwater Lagoons Conservation status: None Estimate of percent cleared: 40 % Condition: Poor Extent in the Project Site: 0.8 hectares Plots completed in vegetation zone: 1	 Plate 1 Coastal freshwater meadows and forblands of lagoons and wetlands facing north at Plot 12
Description: This community occurs on low elevation flats as man-made farm dams and drainage lines. This community is a permanent, semi-permanent or periodically inundated by freshwater and dominated on the fringes by native sedges and sub-aquatic plants such as Slender Spike Rush (<i>Eleocharis gracilis</i>), Frogsmouth (<i>Philydrum lanuginosum</i>) and Spike-rush (<i>Eleocharis equisetina</i>) up to one metre high. Other less common species include Branching Rush (<i>Juncus prismatocarpus</i>), Angled Club-rush (<i>Schoenoplectiella mucronata</i>), Water Couch (<i>Paspalum distichum</i>), Bunch Flat-sedge (<i>Cyperus polystachyos</i>) and <i>Gratiola pedunculata</i>. On the outer fringes and throughout drainage lines, this community is in a disturbed condition as a result of introduced pasture grasses, heavy stock pugging and grazing. Pasture grasses such as Paspalum (<i>Paspalum dilatatum</i>) and Broad-leaved Carpet Grass (<i>Axonopus compressus</i>) are in high abundance. Landscape features: This community occurs on low elevated flats as farm dams and drainage lines. The substrate is generally on dark or light brown clays potentially over siltstone. Elevation is less than 30 metres AHD. Site and Regional Distribution: The community consists of four scattered farm dams, drainage lines and associated soaks on the site. This community is found naturally linked to lakes, swamps, lagoons and on floodplains and as constructed waterbodies throughout the Northern Rivers, particularly in association with	

Coastal freshwater meadows and forblands of lagoons and wetlands (PCT:782)

the Clarence floodplain environment.

Diagnostic features: This community is generally distinguished by areas of inundated freshwater and aquatic / sub-aquatic flora species, particularly when dominated by Spike-rush (*Eleocharis equisetina*) and Water Couch.

Threatened flora species: No threatened flora species were recorded.

Threatened ecological community: Wetlands are artificial farm dams and are not located on the floodplain and is not consistent with *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* Endangered Ecological Community – TSC Act.

Fauna habitat features: The wetland habitat exhibits standing water which fluctuates in depth forming small persistent pools and temporary flooded depressions which are important for life-cycle activities (feeding/breeding) for a range of fauna, including amphibians, reptiles, fish and waterbirds as well as micro- and macro-invertebrates. These may be important foraging and refuge areas for threatened and migratory waterbirds such as Brolga, Black-necked Stork, Latham's Snipe and Cattle Egret.

Condition: This PCT represents a poor condition class (Vegetation Zone 1) but scored well with a benchmark score of 76 due to high native flora diversity and greater than 50 percent groundcover of native flora. The condition of this community is considered poor as a result of disturbance by cattle grazing, heavy stock pugging, soil disturbance and abundance of introduced pasture grasses. Drainage lines at sites DL1 and DL2 contain bank erosion and have low water depths with small abundance of native wetland flora.

Coastal freshwater meadow	Vegetation Zone 1	Benchmark score
Plot number:	12	
Native plant species	16	7
Native overstorey cover (%)	0	0-5
Native midstorey cover (%)	0	0-5
Native ground cover – grass	0	0-5
Native ground cover – shrub (%)	0	0-80
Native ground cover – other (%)	54	0-10
Exotic plant cover (%)	0	5-100
Number of hollow trees	0	-
Canopy Regeneration (%)	0	-
Fallen logs (m)	0	0
Total score	76.09	-

Table 4-4 Description of Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion

Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1209)	
Vegetation zones: 2 (Good / Moderate condition) and 3 (Poor condition) PCT Code: 1209 BVT Code: NR244 Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation) Vegetation class: Clarence Dry Sclerophyll Forests Conservation status: None Estimate of percent cleared: 45 % Condition: Poor to Moderate/Good Extent in the Project Site: 8.2 hectares (Good/moderate condition) and 8 hectares (Poor condition) Plots completed in vegetation zone: 1, 2, 3, 8, 11, (Good/moderate condition) 5, 9 and 10 (Poor condition)	 Plate 2 Spotted Gum - Grey Box - Grey Ironbark dry open forest facing north at Plot 1
Description: This community occurs on slopes and hills on quartz sediments in scattered patches generally confined to Lot 26 DP 751376. The community is a dry sclerophyll forest dominated by Spotted Gum (<i>Corymbia henryi</i>), Grey Box (<i>Eucalyptus moluccana</i>) and Small-fruited Grey Gum (<i>Eucalyptus propinqua</i>), Northern Grey Ironbark (<i>Eucalyptus siderophloia</i>) up to 20 metres high. The sub-canopy and mid-storey are generally absent with low abundances of Red Ash seedlings (<i>Alphitonia excelsa</i>) and the exotic Narrow-leaved Cotton Bush (<i>Gomphocarpus fruticosus</i>). The ground layer is dominated by native grasses and herbs including Blady Grass (<i>Imperata cylindrica</i>), Weeping Grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>), Barbed Wire Grass (<i>Cymbopogon refractus</i>), Three-awned Spear Grasses <i>Aristida vagans</i> and <i>Aristida ramosa</i>, Kidney Weed (<i>Dichondra repens</i>) Vernonia (<i>Vernonia cinerea</i> var. <i>cinerea</i>), Swamp Pennywort (<i>Centella asiatica</i>), Slender Tick-trefoil (<i>Desmodium varians</i>) and Slender Flat Sedge (<i>Cyperus gracilis</i>). Many areas of this community including derived grassland, pasture grasses such as Narrow-leaved Carpet Grass (<i>Axonopus compressus</i>) and Paspalum (<i>Paspalum dilatatum</i>) have been introduced in the ground layer. Landscape features: This community occurs on slopes and hills on quartz sediments in scattered patches and as part of larger contiguous vegetation to the west. Elevation is around 30 metres AHD. Site and Regional Distribution: The community occurs as 12 main scattered patches in various sizes confined to the northern portion of the Project Site. This community is found on the lowland fringes of the Clarence River Valley and is generally common, but succumbed to widespread clearing for grazing land on the lowlands of the floodplain. Diagnostic features: This community is distinguished by the canopy dominated by Spotted Gum (<i>Corymbia henryi</i>), Grey Box (<i>Eucalyptus moluccana</i>), and Grey Ironbark (<i>Eucalyptus siderophloia</i>) with a sub-canopy of Red Ash (<i>Alphitonia excelsa</i>) and a diverse understorey dominated by grasses and herbs. Threatened flora species: No threatened flora species were recorded. Threatened ecological community: This community does not qualify as an EEC but can have associations with Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC on lower slopes influenced by the floodplain. Potential EEC occurs adjacent to this community on the property to the west. Fauna habitat features: This community comprises of a species rich tree canopy with year-round flowering, particularly winter flowering Spotted Gum which is an important food resource at a time when food bottlenecks may occur for nectivorous fauna such as the Grey-headed Flying-fox, and Little Lorikeet and birds such as Swift Parrot. This community provides a low to moderate abundance of multi-sized hollow-bearing trees and standing stags for hollowing nesting fauna such as gliders and forest owls and Little Lorikeet. Although the	

Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1209)

mid-storey is absent some patches have a good supply of logs and woody debris providing sheltering habitat for small mammals and reptiles.

Condition: There are two condition classes of this PCT in the study area.

Good/moderate condition areas of this community (Vegetation Zone 2) (refer to Plate 3) have low-moderate levels of introduced Narrow-leaved Carpet Grass and Paspalum. Poor condition areas of this community (Vegetation Zone 3) (refer to Plate 4) have smaller patches sizes and have moderate to high levels of pasture grasses with greater disturbance from logging which has reduced the diversity of canopy species.

Good/moderate condition patches have an average benchmark score of 64.06, with the main factors reducing the site value score comprising lack of mid-storey and shrub cover, low native ground cover (other than grasses) and low abundance hollow trees.

Plot 2 (refer to Plate 3) has the highest score (87.5) which is located at Site 7 (vegetation zone 2) in the centre of the site. Although this patch is relatively isolated, it displays high native species diversity with no weed cover. Poor condition (refer to Plate 4) areas of this community (vegetation zone 3) have an average benchmark score of 63.02, although this is relatively high, plots in this zone express high weed cover.

	Vegetation Zone 2	Vegetation Zone 3	Benchmark
Plot number:	Mean	Mean	
Native plant species	41.6	30.3	37
Native overstorey cover (%)	32	18.7	20-50
Native midstorey cover (%)	0	0	10-60
Native ground cover – grass	34.4	22.7	10-60
Native ground cover – shrub (%)	0	0	5-60
Native ground cover – other (%)	10	11.3	10-50
Exotic plant cover (%)	12.4	47.3	-
Number of hollow trees	0.4	1	1
Canopy Regeneration (%)	1	1	-
Fallen logs (m)	44	19	10
Total score	64.06	63.02	-



Plate 3 Good/moderate condition Spotted Gum - Grey Box - Grey Ironbark dry open forest facing south at Plot 2.



Plate 4 Poor condition Spotted Gum - Grey Box - Grey Ironbark dry open forest facing south at Plot 9.

Table 4-5 Description of Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion

Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1211)	
Vegetation zones: 4 (Good / Moderate condition) and 5 (Poor condition) PCT Code: 1211 BVT Code: NR246 Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation) Vegetation class: Clarence Dry Sclerophyll Forests Conservation status: None Estimate of percent cleared: 50 % Condition: Poor to Moderate/Good Extent in the Project Site: 10.6 hectares (Good/moderate condition) and 4 hectares (Low condition) Plots completed in vegetation zone: 4, 6, 13 (Good/moderate condition) and 7 (Poor condition).	 Plate 5 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest at Plot 13
Description: This community occurs on slopes and ridges in undulating terrain in scattered patches generally confined to Lot 1 DP 1190399. The community is a dry sclerophyll forest dominated by Pink Bloodwood (<i>Corymbia intermedia</i>), Small-fruited Grey Gum (<i>Eucalyptus propinqua</i>), Grey Box (<i>Eucalyptus moluccana</i>), Spotted Gum (<i>Corymbia henryi</i>) and Northern Grey Ironbark (<i>Eucalyptus siderophloia</i>) up to 20 metres high. The sub-canopy and mid-storey are generally absent with low abundances Red Ash seedlings (<i>Alphitonia excelsa</i>) and the exotic Narrow-leaved Cotton Bush (<i>Gomphocarpus fruticosus</i>). The ground layer is dominated by native grasses and herbs including Blady Grass (<i>Imperata cylindrica</i>), Open Summer-grass (<i>Digitaria diffusa</i>), Hedgehog Grass (<i>Echinopogon caespitosus</i>), Barbed Wire Grass (<i>Cymbopogon refractus</i>), Three-awned Spear Grasses <i>Aristida vagans</i> and <i>Aristida ramosa</i>, Kidney Weed (<i>Dichondra repens</i>) <i>Vernonia cinerea</i> var. <i>cinerea</i>, Swamp Pennywort (<i>Centella asiatica</i>), Common Fringe-rush (<i>Fimbristylis dichotoma</i>), Slender Tick-trefoil (<i>Desmodium varians</i>) and <i>Hybanthus stellarioides</i>. Many areas of this community including derived grassland, pasture grasses such as Narrow-leaved Carpet Grass (<i>Axonopus compressus</i>) and Paspalum (<i>Paspalum dilatatum</i>) have been introduced in the ground layer. Landscape features: This community occurs on slopes and ridges in undulating terrain in scattered patches and as part of larger contiguous vegetation to the west. Elevation is around 30 metres AHD. Site and Regional Distribution: The community occurs as two of the largest patches on the property confined to the south west portion of the Project Site. This community is found on the lowland fringes of the Clarence River Valley and is generally common, but succumbed to widespread clearing for grazing land on the lowlands of the floodplain. Diagnostic features: This community is distinguished by the canopy dominated by Pink Bloodwood, Spotted Gum and Grey Ironbark which generally has a mid-storey of Forest Oak (<i>Allocasuarina torulosa</i>) but absent on the Project Site. The understorey is dominated by grasses and herbs. Threatened flora species: No threatened flora species were recorded in this community. Threatened ecological community: This community does not qualify as an EEC but can have associations with Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC on lower slopes influenced by the floodplain. Potential EEC occurs further north west to this community on the adjacent property. Fauna habitat features: This community comprises of a species rich tree canopy with year-round flowering, particularly winter flowering Spotted Gum which is an important food resource at a time when food bottlenecks may occur for nectivorous fauna such as the Grey-headed Flying-fox, and Little Lorikeet and birds such as Swift Parrot. This community provides a low to moderate abundance of multi-sized hollow-bearing trees and	

Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1211)

standing stags for hollowing nesting fauna such as birds, gliders and forest owls and Little Lorikeet. Although the mid-storey is absent some patches have a good supply of logs and woody debris providing sheltering habitat for small mammals and reptiles.

Condition: There are two condition classes of this PCT in the study area.

Good/moderate condition areas of this community (Vegetation Zone 4) have low-moderate levels of introduced Narrow-leaved Carpet Grass and Paspalum. Poor condition areas of this community (Vegetation Zone 5) have smaller patches sizes and have moderate to high levels of pasture grasses with greater disturbance from logging which has reduced the diversity of canopy species.

Good/moderate condition patches have an average benchmark score of 70.83, with the main factors reducing the site value score comprising lack of mid-storey and low abundance of hollow trees and weed invasion.

Plot 4 (refer to Plate 6) had the highest score (79.1) which is located in a relatively isolated patch dominated with Small-fruited Grey Gum (vegetation zone 4) which displays a high abundance of hollows. Poor condition areas of this community (vegetation zone 5) (refer to Plate 7) have an average benchmark score of 47.4 generally as a result of weed invasion, lack of hollows and fallen timber.

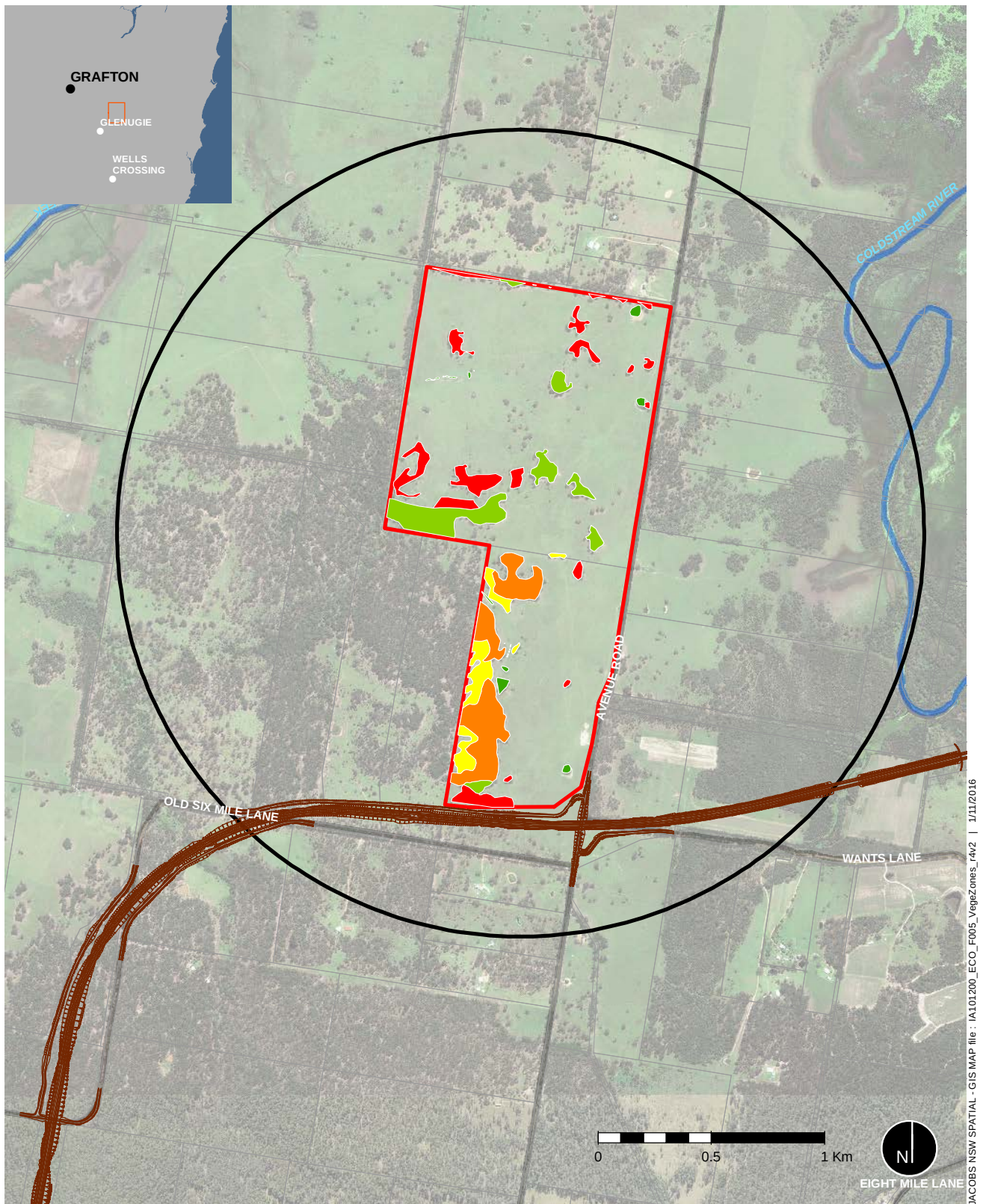
	Vegetation Zone 4	Vegetation Zone 5	Benchmark
Plot number:	Mean	Mean	
Native plant species	37	44	37
Native overstorey cover (%)	23.3	15	20-50
Native midstorey cover (%)	0	0	10-60
Native ground cover - grass	33.3	56	10-60
Native ground cover – shrub (%)	0	0	5-60
Native ground cover – other (%)	8	10	10-50
Exotic plant cover (%)	24.7	28	-
Number of hollow trees	0.6	0	1
Canopy Regeneration (%)	1	1	-
Fallen logs (m)	28	2	10
Total score	70.83	47.4	-



Plate 6 Good/moderate condition Spotted Gum - Grey Ironbark - Pink Bloodwood open forest facing east at Plot 4



Plate 7 Poor condition at Spotted Gum - Grey Ironbark - Pink Bloodwood open forest at Plot 7



Legend

	The Project	Zone Name, Vegetation	 NR244_Poor, Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast
	Pacific Highway Upgrade alignment	 NR150_Poor, Coastal freshwater meadows and forblands of lagoons and wetlands	 NR246_Good/Moderate, Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast
	Inner assessment circle	 NR244_Good/Moderate, Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast	 NR246_Poor, Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast

Figure 4-2 | Vegetation zones, PCTs and management zones

4.3 Other vegetation

The remaining vegetation on the Project Site has been cleared and modified for stock grazing in approximately 160 hectares and comprises a mix of native and exotic grassland. Many areas are dominated with introduced pasture grasses including exotic Narrow-leaved Carpet Grass and Paspalum. These areas represent grasslands dominated by exotic species. There are lower diversity of native species comprising native grasses Blady Grass, Barbed-wire Grass, Wire-grasses (*Aristida* spp.) and native herbs Yellow buttons (*Chrysocephalum apiculatum*), Kidney Weed (*Dichondra repens*), Woodland Bindweed (*Polymeria calycina*). The noxious Fireweed (*Senecio madagascariensis*) also occurs in these areas in moderate abundance.

Paddock trees and dead standing trees are scattered across these grassland areas, some of which provide tree hollows and temporary shelter for a range of fauna species, including potential threatened species such as hollow-roosting bats. The landscape position of these open grasslands also provides a corridor for foraging Coastal Emu and both breeding and foraging habitat for Rufous Bettong (*Aepyprymnus rufescens*).

4.4 Vegetation zones

Vegetation zones are defined as a 'relatively homogeneous area of native vegetation within a Project Site that is the same PCT and broad condition state' (OEH 2014a). Vegetation zones were identified and mapped for the PCT areas only (31.6 hectares) and not the cleared exotic grasslands (163.4 hectares). The Project Site contains five vegetation zones with their extent mapped in **Figure 4-2**.

Table 4-6 Identification of vegetation zones in the Project Site

Vegetation community	Vegetation Zone No.	Corresponding PCT	Ancillary code	Total vegetation area (ha)	Comments
Coastal freshwater meadows and forblands of lagoons and wetlands	1	Coastal freshwater meadows and forblands of lagoons and wetlands (PCT:782)	NR150 Low	0.8	-
Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	2	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1209)	NR244 Moderate/ Good (Medium)	8.2	-
Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	3	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1209)	NR244 (Low)	8	-
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	4	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1211)	NR246 Moderate/ Good (Medium)	10.6	-

Vegetation community	Vegetation Zone No.	Corresponding PCT	Ancillary code	Total vegetation area (ha)	Comments
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	5	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT:1211)	NR246 Low	4	-
Modified grazing land - native and exotic	Excluded from impact assessment as it is not a native vegetation community and original PCT cannot be determined – this includes majority of cleared portion of site, dominated by exotic and native grasses			163.4	Non-native vegetation and cleared areas are not included in calculations
Total				195 ha	

4.5 Flora species

The field surveys identified 200 individual plant species from 52 families, comprising 161 native species (80.5 percent) and 39 exotic species (19.5 percent). The complete list of flora species recorded at the Project Site is provided in **Table B-1** of **Appendix B**.

4.6 Threatened ecological communities

There were no threatened ecological communities (TEC) listed under the TSC Act or the EPBC Act. The Coastal freshwater meadows and forblands of lagoons and wetlands (PCT 782) are permanent freshwater bodies with diagnostic sub-aquatic and terrestrial flora species and generally meet the criteria for *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* (Endangered, TSC Act). However, these wetlands are man-made farm dams and do not occur on the coastal floodplain as described in the Final Determinations for state listed communities on the OEH website and are not consistent with EEC listing (OEH 2011).

4.7 Groundwater dependant ecosystems

The level of water dependence of vegetation communities in the Project Site has been identified using the *Atlas of Groundwater Dependiant Ecosystems* (Bureau of Meteorology (BOM), 2016) and the *Risk Assessment Guidelines for Groundwater Dependiant Ecosystems* released by the NSW DPI (Kuginis et al. 2012). The level of groundwater dependence and potential for interaction is identified for each PCT on the Project Site (refer to **Table 4-7**).

Table 4-7 Level of groundwater dependence of vegetation in Project Site

Plant Community Type	Potential for GDE interaction (BoM, 2016)	Level of groundwater dependence (Kuginis et al. 2012)
Coastal freshwater meadows and forblands of lagoons and wetlands	Not analysed	Low. Minor tributaries of the Coldstream River is fresh surface water fed and possible interaction with groundwater is unknown
Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Low (subsurface)	Low
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Low (subsurface)	Low
Modified grazing land - native and exotic	Low (subsurface)	Low

5. Threatened species

5.1 Candidate species

The following section addresses the potential presence of threatened flora and fauna species as candidate species to be considered in the assessment of impacts and targeted surveys. Candidate species, either ecosystem credit species or species credit species, are listed species identified by the FBA. Ecosystem credit species are predicted to occur based on their known presence in the IBRA subregion, the presence of associated PCTs, and the size and condition of the vegetation patches on the site. Species credit species are those that cannot be reliably predicted from the habitat surrogates and their presence is to be assessed through habitat assessment and targeted surveys.

A default list of candidate species were firstly identified using the assessment filtering tool in the BBCC. A background review was also conducted to confirm these and possible additional candidate species using the database sources shown in **Table 5-1**.

Table 5-1 Wildlife databases used to identify potentially occurring candidate species

Database	Search area	Date accessed
BioBanking credit calculator (BBCC)	Northern Rivers CMA	12 January 2016
OEHS NSW Atlas of Wildlife	10 km radius	25 January 2016
Protected Matters Search Tool (DEE)	10 km radius	25 January 2016
OEHS Threatened Species Profile Database (TSPD)	Potential presence of vegetation class	25 January 2016

An assessment of the likelihood of occurrence of each candidate species was conducted using the criteria described in **Appendix A**. The results of this assessment are also provided in **Appendix A**. All species credit species assessed as having a moderate to high likelihood of occurring on the site were considered candidate species and targeted in surveys of the site. Ecosystem credit species have also been surveyed where such species have a high threatened species multiplier, to inform credit calculations.

5.1.1 Ecosystem credit species

Twenty-four ecosystem credit species were produced by the BBCC assessment tool. The likelihood of occurrence for each species (**Appendix A**) has considered the presence of these predicted species, and the list of species included in the impact assessment is provided in **Table 5-2**. These species are subsequently assessed in conjunction with biodiversity values reported in **Chapter 6** and potential impacts in **Chapter 8**.

Table 5-2 Predicted species based on IBRA subregion, PCT, patch size and condition

Species	Scientific name
Barking Owl	<i>Ninox connivens</i>
Barred Cuckoo-shrike	<i>Coracina lineata</i>
Beccari's Freetail-bat	<i>Mormopterus beccarii</i>
Black-chinned Honeyeater (eastern subspecies)	<i>Meliphaga gularis subsp. gularis</i>
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus subsp. victoriae</i>
Bush Stone-curlew	<i>Burhinus grallarius</i>
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis subsp. temporalis</i>
Hoary Wattled Bat	<i>Chalinolobus nigrogriseus</i>

Species	Scientific name
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata subsp. cucullata</i>
Little Eagle	<i>Hieraaetus morphnoides</i>
Little Lorikeet	<i>Glossopsitta pusilla</i>
Masked Owl	<i>Tyto novaehollandiae</i>
Powerful Owl	<i>Ninox strenua</i>
Scarlet Robin	<i>Petroica boodang</i>
Speckled Warbler	<i>Chthonicola sagittata</i>
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>
Square-tailed Kite	<i>Lophoictinia isura</i>
Swift Parrot	<i>Lathamus discolor</i>
Varied Sittella	<i>Daphoenositta chrysoptera</i>
Yellow-bellied Glider	<i>Petaurus australis</i>
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>

5.1.2 Species credit species

The FBA requires an assessment of geographic / habitat features to determine what species would be filtered into the assessment for consideration as species credit species. To assess this, the BBCC required an answer to the questions identified in **Table 5-3**, responses are provided.

Table 5-3 Potential candidate species credit species, BBCC geographic and habitat questions and assessment

Species	Scientific name	Question: does any of the following features occur on the area to be assessed	Assessment
FLORA			
Masons Grevillea	<i>Grevillea masonii</i>	open forest or woodland on gravelly loam soil	Yes
Tephrosia filipes	<i>Tephrosia filipes</i>	Grows in a range of woodland and forest habitats on soils derived from granite, sandstone or metasediments.	Yes
Weeping Paperbark	<i>Melaleuca irbyana</i>	Open eucalypt forest on poorly drained soils	Yes
Hairy Melichrus	<i>Melichrus hirsutus</i>	Land south of Pillar Valley in Clarence Lowlands CMA subregion	Yes
Narrow-leaf Melichrus	<i>Melichrus sp. Gibberagee</i>	Land within Giberaggee State Forest or within a 20 km buffer around this SF in Clarence Lowlands CMA subregion	No
Waterwheel Plant	<i>Aldrovanda vesiculosa</i>	Land within 5 km of coast in Yuraygir CMA subregion	No
Bordered Guinea Flower	<i>Hibbertia marginata</i>	Open forest on sandstone substrate	No
Square-stemmed Spike-rush	<i>Eleocharis tetraquetra</i>	Stream edges, low lying areas or in and on the margins of freshwater swamps	Yes
Lemon-scented Grass	<i>Elyonurus citreus</i>	Sandy soils within 40 m of rivers or along the coast in wallum areas or sand dunes	No
Slender Screw Fern	<i>Lindsaea incisa</i>	Land containing waterlogged or poorly drained sites	Yes

Species	Scientific name	Question: does any of the following features occur on the area to be assessed	Assessment
Swamp Foxglove	<i>Centranthera cochinchinensis</i>	Swampy or moist sites	Yes
Oldenlandia galioides	<i>Oldenlandia galioides</i>	seasonally inundated paperbark swamps or forest red gum open forest	No
Rotala tripartita	<i>Rotala tripartita</i>	Occurs around water bodies such as farm dams and freshwater wetlands, or in swamp forest or open forest in poorly drained locations.	Yes
Water Nutgrass	<i>Cyperus aquatilis</i>	Ephemerally wet areas	Yes
Slaty Red Gum	<i>Eucalyptus glaucina</i>	Land north of Copmanhurst in Clarence Sandstones CMA subregion	No
Maundia triglochinoides	<i>Maundia triglochinoides</i>	Swamps or shallow fresh water on clay	Yes
Swamp Mint-bush	<i>Prostanthera palustris</i>	Shrubland or heath on poorly drained sandy soils	No
FAUNA			
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	No
White-crowned Snake	<i>Cacophis harriettae</i>	Land north of Coffs Harbour in Coffs Coast & Escarpment CMA subregion	No
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	No
Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area	<i>Dromaius novaehollandiae</i> - <i>endangered population</i>	Land within 5 km of Arrawarra in Coffs Coast & Escarpment CMA subregion	No
Red-tailed Black-Cockatoo (coastal subspecies)	<i>Calyptorhynchus banksii</i> subsp. <i>banksii</i>	Tree-hollows, primarily in Eucalyptus but also in Melaleuca; often in dead trees. Riparian Eucalyptus woodland or forest, or remnant patches of eucalypt woodland or forest.	Yes
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Land east of Guy Fawkes River in Wongwibinda Plateau CMA subregion	No
Common Planigale	<i>Planigale maculata</i>	Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Yes
Red Goshawk	<i>Erythrotriorchis radiatus</i>	Tall trees in forest or woodland, within 1 km of permanent water	Yes
Green-thighed Frog	<i>Litoria brevipalmata</i>	Land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter	Yes
Coastal Petaltail	<i>Petalura litorea</i>	Coastal freshwater sedgeland, wetlands and peatlands	No
Wallum Froglet	<i>Crinia tinnula</i>	Land within 10 km of coast in Yuraygir CMA subregion	No

Species	Scientific name	Question: does any of the following features occur on the area to be assessed	Assessment
Black Bittern	<i>Ixobrychus flavicollis</i>	Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation	No
Eastern Osprey	<i>Pandion cristatus</i>	Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	No
Pale-vented Bush-hen	<i>Amaurornis moluccana</i>	Land north of south west Rocks in Macleay Hastings CMA subregion	No
Eastern Ground Parrot	<i>Pezoporus wallicus subsp. wallicus</i>	Land within 15 km of coast in Clarence Lowlands CMA subregion	No
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	Yes
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Land containing brackish or freshwater wetlands	No
Comb-crested Jacana	<i>Irediparra gallinacea</i>	Land within 40 m of permanent wetlands with a good surface cover of floating vegetation	No
Green and Golden Bell Frog	<i>Litoria aurea</i>	Land within 100 m of emergent aquatic or riparian vegetation.	Yes
Olongburra Frog	<i>Litoria olongburensis</i>	Land within 10 km of coast in Yuraygir CMA subregion	No

From the assessment of the geographic / habitat features present at the Project Site 11 threatened flora and six threatened fauna species were identified for further consideration as target species. For the next level of assessment, the FBA identifies these species and additional species credit species to be targeted in surveys of the Project Site. The FBA allows the assessor to review and refine the list of candidate species. In this regard a candidate species is not considered present from the Project Site where it can be demonstrated that:

- The habitat is substantially degraded for that species.
- An expert report states that the species is unlikely to be present.
- The species is a vagrant and is unlikely to use habitat on the Project Site.
- Records of the species are at least 20 years old or have doubtful authenticity.

The candidate species listed above as matching geographic and habitat features were assessed further with the addition of all subject species identified in the BBCC survey list considering these criteria, refer **Table 5-4** for results. This assessment resulted in further filtering out of three threatened flora species and five threatened fauna species on the basis of poor habitat and records being greater than 20 years old for the study area. These species are shown as shaded in **Table 5-4**.

While the BBCC has identified unsuitable geographic habitat features for the Coastal Emu and Brush-tailed Phascogale, both species are considered as moderate to high likelihood of occurring based on the distribution of known records and suitable habitat on the site and have therefore been included in the list of candidate species.

Table 5-4 List of candidate species credit species and second filtering step

Species	Scientific name	Distribution, habitat and condition	Likelihood of occurring / target species
Flora			
Frogbit	<i>Hydrocharis dubia</i>	Grows in small shallow wetlands	Moderate / Included
Hairy Melichrus	<i>Melichrus hirsutus</i>	Dry eucalypt forest with a shrubby understorey with sandstone rock outcrops. Found at low altitudes (20 to 150 m) in sandy soils. Habitat is to degraded for this species, understorey and shrub layer removed and replaced with native and exotic grasses	Low / Excluded
Masons Grevillea	<i>Grevillea masonii</i>	Open forest or woodland on gravelly loam soil	Moderate / Included
Maundia triglochinos	<i>Maundia triglochinos</i>	Swamps or shallow fresh water on clay	High / Included
Native Milkwort	<i>Polygala linariifolia</i>	Herb grows in dry sclerophyll forest	Moderate / Included
Noahs False Chickweed	<i>Lindernia alsinoides</i>	This species has been recorded in coastal areas from Buladelah to Coopersnook. Populations are known to occur further north from Halfway Creek to Pillar Valley near Mitchell Road and Mahogany Drive. Grows in swamp forests and wetlands along coastal and hinterland creeks. There are 16 records within a 10 km radius of the site	Moderate / Included
<i>Rotala tripartita</i>	<i>Rotala tripartita</i>	Occurs around water bodies such as farm dams and freshwater wetlands, or in swamp forest or open forest in poorly drained locations.	Moderate / Included
Slender Screw Fern	<i>Lindsaea incisa</i>	Found in 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. The site is too degraded and modified for this species	Low / Excluded
Square-fruited Ironbark	<i>Eucalyptus tetrapleura</i>	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. There are 56 records within a 10 km radius of the site	Moderate / Included
Square-stemmed Spike-rush	<i>Eleocharis tetraquetra</i>	Stream edges, low lying areas or in and on the margins of freshwater swamps	Moderate / Included
Swamp Foxglove	<i>Centranthera cochinchinensis</i>	Swampy or moist sites	Moderate / Included
Tall Knotweed	<i>Persicaria elatior</i>	Swampy or moist sites	Moderate / Included

Species	Scientific name	Distribution, habitat and condition	Likelihood of occurring / target species
Tephrosia filipes	<i>Tephrosia filipes</i>	Is widespread in Queensland, but is confined from Guy Fawkes River National Park to the Tenterfield district in NSW, there are no records of the species in the locality. It grows in a range of woodland and forest habitats on soils derived from granite, sandstone or metasediments. Habitat is too degraded for this species, and outside range	Unlikely / Excluded
Water Nutgrass	<i>Cyperus aquatilis</i>	Ephemerally wet areas	Moderate / Included
Weeping Paperbark	<i>Melaleuca irbyana</i>	Open eucalypt forest on poorly drained soils	High / Included
White-flowered Wax Plant	<i>Cynanchum elegans</i>	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honey Myrtle <i>Melaleuca armillaris</i> scrub to open scrub.	Moderate / Included
Fauna			
Australian Fritillary	<i>Argyreus hyperbius</i>	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 <i>Viola betonicifolia</i> occurs. Host plant not present and habitat not suitable and too degraded for this species. There are no recent records within proximity to this site	Low / Excluded
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)	Moderate / Included
Common Planigale	<i>Planigale maculata</i>	Rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Moderate / Included
Cotton Pygmy-Goose	<i>Nettapus coromandelianus</i>	Freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The cleared grazing site habitats are too disturbed for this species	Low / Excluded
Eastern Chestnut Mouse	<i>Pseudomys gracilicaudatus</i>	In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. The site is too degraded for this species, there is a long history of shrub and tree removal for	Low/ Excluded

Species	Scientific name	Distribution, habitat and condition	Likelihood of occurring / target species
		grazing resulting in a cleared and grassy understorey	
Eastern Pygmy-possum	<i>Cercaretus nanus</i>	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest	Moderate / Included
Coastal Emu <i>Dromaius novaehollandiae</i> (Endangered population)	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	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.	High / Included
Green and Golden Bell Frog	<i>Litoria aurea</i>	Land within 100 m of emergent aquatic or riparian vegetation. Habitat is too degraded and modified for this species. No records within past 20 years for this location	Low / Excluded
Green-thighed Frog	<i>Litoria brevipalmata</i>	Land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter. The wetlands on the site occur in a cleared grazing paddock that has a high degree of long-term impact from cattle grazing. The habitats are considered to be degraded for this species.	Low / Excluded
Koala	<i>Phascolarctos cinerus</i>	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. There are 48 records from a 10 km radius of the site	Moderate / Included
Red Goshawk	<i>Erythroriorchis radiatus</i>	Tall trees in forest or woodland, within 1 km of permanent water	Moderate / Included

Species	Scientific name	Distribution, habitat and condition	Likelihood of occurring / target species
Red-backed Button-quail	<i>Turnix maculosus</i>	Red-backed Button-quail inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, said to occur in grasslands, heath and crops. Said to prefer sites close to water, especially when breeding. The species has been observed associated with the following grasses (in various vegetation formations): speargrass <i>Heteropogon</i> , Blady Grass <i>Imperata cylindrica</i> , <i>Triodia</i> , <i>Sorghum</i> , and Buffel Grass <i>Cenchrus ciliaris</i> .	Moderate / Included
Red-tailed Black-Cockatoo (coastal subspecies)	<i>Calyptrorhynchus banksii subsp. banksii</i>	Tree-hollows, primarily in Eucalyptus but also in Melaleuca; often in dead trees. Riparian Eucalyptus woodland or forest, or remnant patches of eucalypt woodland or forest.	Moderate / Included
Regent Honeyeater	<i>Anthochaera phrygia</i>	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.	Moderate / Included
Rufous Bettong	<i>Aepyprymnus rufescens</i>	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. There are 140 records in the Atlas for 10 km of the site	High / Included
Squirrel Glider	<i>Petaurus norfolcensis</i>	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 <i>Acacia</i> midstorey. There are 8 records from a 10 km radius of the site.	Moderate / Included
Wallum Froglet	<i>Crinia tinnula</i>	Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgeland and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests.	Moderate / Included

Species	Scientific name	Distribution, habitat and condition	Likelihood of occurring / target species
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	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.	Moderate / Included

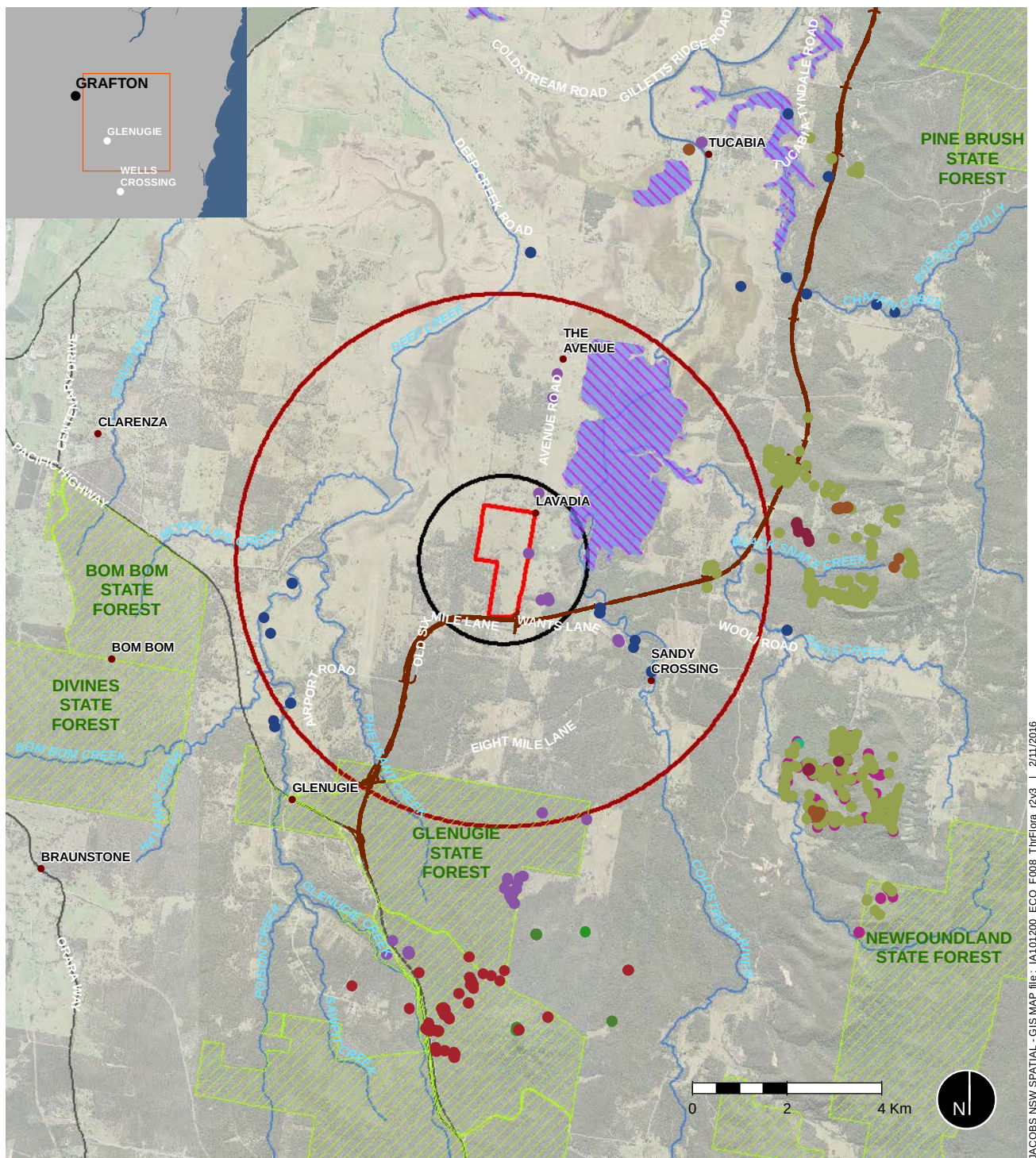
5.1.1 Additional candidate species

Additional threatened species not identified in the BBCC although identified from the background review were assessed for their likelihood of occurrence (refer **Appendix A**). Those additional species credit species assessed with moderate to high likelihood of occurring on the Project Site are identified in **Table 5-5**. These species are also considered candidate species and were targeted in field surveys on the Project Site. All threatened flora and fauna records from the NSW Wildlife Atlas in the site locality are presented in **Figure 5-1** and **Figure 5-2**.

Table 5-5 Additional candidate species with a moderate to high likelihood of occurring in the Project Site

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features	Source /No records+
FLORA					
<i>Arthraxon hispidus</i>	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.	PMST
<i>Grevillea quadricauda</i>	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 gravelly loam, in the understorey of dry eucalypt forest, usually along or near creeks.	2 OEH, PMST
<i>Marsdenia longiloba</i>	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 <i>Eucalyptus crebra</i> , <i>E. microcorys</i> , <i>E. acmenoides</i> , <i>E. saligna</i> , <i>E. propinqua</i> , <i>Corymbia intermedia</i> and <i>Lophostemon confertus</i> .	PMST

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features	Source /No records+
FAUNA					
<i>Miniopterus australis</i>	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
<i>Miniopterus schreibersii oceanensis</i>	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
<i>Myotis macropus (Myotis adversus)</i>	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



Legend

	The Project			●	<i>Grevillea quadricauda</i>
	Pacific Highway Upgrade alignment	●	<i>Angophora robur</i>	●	<i>Lindernia alsinoides</i>
	SEPP 14 Wetlands	●	<i>Callistemon linearifolius</i>	●	<i>Lindsaea incisa</i>
	Inner assessment circle	●	<i>Centranthera cochinensis</i>	●	<i>Maundia triglochinosides</i>
	Outer assessment circle	●	<i>Corynocarpus rupestris subsp. rupestris</i>	●	<i>Melaleuca irbyana</i>
		●	<i>Eucalyptus tetrapleura</i>	●	<i>Melichrus hirsutus</i>
				●	<i>Quassia sp. Mooney Creek</i>

Figure 5-1 | Threatened flora records in the site locality

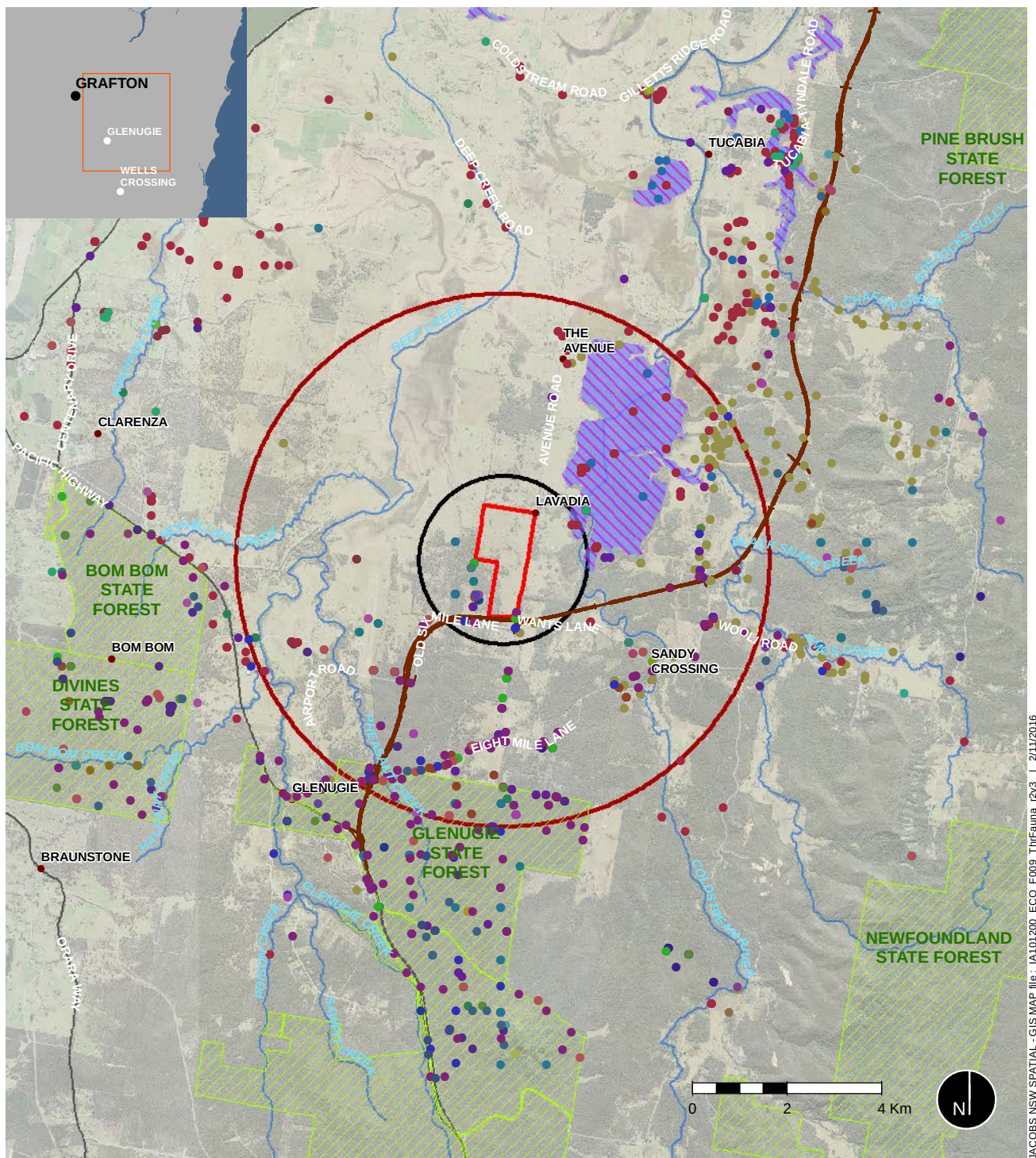


Figure 5-2 | Threatened fauna records in the site locality

5.2 Threatened species survey

5.2.1 Terrestrial flora surveys

Targeted flora surveys were undertaken for all identified candidate flora species following the methods described in *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft* (DEC, 2004). A combination of random meander surveys (Cropper 1993) and floristic plot surveys (described in section 4.1.2) was undertaken to identify, search and record any candidate species.

The random meander technique is used in preference to systematic, plot-based surveys when attempting to detect threatened plants. Random meander in suitable habitat is more likely to detect threatened species than plot or transect based survey used in floristic surveys. This technique is considered preferable in terms of searching large areas of potential habitat and generally allows for greater area coverage than a plot-based survey walked meanders are illustrated in **Figure 5-3**. A summary of flora survey techniques employed is provided in **Table 5-6**.

Table 5-6 Summary of flora survey timing, methods and survey effort

Survey dates	Methods	Effort
1-5 February	Targeted searches and random meanders in preferred habitats	5 person days
	Floristic plots and transects	13 plots (5 person days)
	Rapid assessment of access roads	Half person day

The timing for majority of threatened flora candidates was suitable during the summer survey period. The survey time matrix produced by the assessment tool in the BBCC and from review of the TSPD is shown in **Table 5-7**.

Table 5-7 Targeted threatened flora survey time matrix (source BBCC and TSPD)

Common name	Scientific name	Complete survey period / season suitable
Hairy Jointgrass	<i>Arthraxon hispidus</i>	Yes
Swamp Foxglove	<i>Centranthera cochinensis</i>	Yes
Water Nutgrass	<i>Cyperus aquatilis</i>	Yes
Square-stemmed Spike-rush	<i>Eleocharis tetraquetra</i>	Yes
Square-fruited Ironbark	<i>Eucalyptus tetrapleura</i>	Yes
Four-tailed Grevillea	<i>Grevillea quadricauda</i>	Yes
Masons Grevillea	<i>Grevillea masonii</i>	Yes
Noahs False Chickweed	<i>Lindernia alsinoides</i>	Yes
Maundia triglochinoides	<i>Maundia triglochinoides</i>	Yes
Slender Mardenia	<i>Marsdenia longiloba</i>	Yes
Weeping Paperbark	<i>Melaleuca irbyana</i>	Yes
Rotala tripartita	<i>Rotala tripartita</i>	Yes
Frogbit	<i>Hydrocharis dubia</i>	Yes

Common name	Scientific name	Complete survey period / season suitable
Native Milkwort	<i>Polygala linarifolia</i>	Yes
Tall Knotweed	<i>Persicaria elatior</i>	Yes
White-flowered Wax Plant	<i>Cynanchum elegans</i>	Yes

5.2.2 Terrestrial fauna surveys

The location and type of the terrestrial fauna survey methods were designed in accordance with recommended survey guidelines in DEC (2004), DECC (2009) and DEWHA (2010a; 2010b; 2010c; 2011a & 2011b). Surveys were conducted across the entire Project Site. The Project Site was stratified firstly by PCT, this included the two dry forest PCTs comprising around 30 hectares in area and then focused on discrete habitats such as farm dams and soaks, matching the freshwater wetland PCT. Finally targeted and opportunistic surveys were conducted across the cleared and modified grazing land which comprises the majority of the Project Site.

Timing and weather conditions

The fauna survey was conducted over a total of five field days (1-5 February). Details of the field survey times, average temperature and daily rainfall conditions experienced during the surveys are provided in **Table 5-8**. Climate records are taken from Clarence Valley Regional Airport (Station 058161) (BOM, 2016). The total monthly rainfall for January 2016 preceding the survey was 52.0 millimetres and 4.0 millimetres in the seven days prior to the survey week.

Table 5-8 Timing, weather and rainfall conditions for fauna surveys

Survey dates	Temp (°C)		Total daily rainfall (mm)	Weather conditions
	Min	Max		
1 Feb 2016	20.4	33.2	0	Sunny, light winds
2 Feb 2016	15.5	31.4	0	Sunny, no cloud, light winds
3 Feb 2016	21.7	33.4	0	Light rain in morning, then sunny with 1/4 cloud, light winds
4 Feb 2016	21.6	26.5	0.2	Light rain in morning, then overcast, light winds
5 Feb 2016	20.2	29.1	0	Sunny, light winds

Survey times were considered suitable for detection of the majority of fauna groups and targeted threatened species. The timing for majority of threatened fauna candidates was suitable during the summer survey period. The survey time matrix produced by the assessment tool in the BBCC and from review of the TSPD is shown in **Table 5-9**.

Table 5-9 Targeted threatened fauna survey time matrix (source BBCC and TSPD)

Common name	Scientific name	Suitable survey timing (February)
Red-tailed Black-Cockatoo	<i>Calyptrorhynchus banksia ssp banksia</i>	Yes
Common Planigale	<i>Planigale maculata</i>	Yes
Red Goshawk	<i>Erythrorhynchus radiatus</i>	Yes
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	Yes
Regent Honeyeater	<i>Anthochaera phrygia</i>	Yes
Red-backed Button-quail	<i>Turnix maculosus</i>	Yes
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	<i>Dromaius novaehollandiae</i> (Endangered population)	Yes
Rufous Bettong	<i>Aepyprymnus rufescens</i>	Yes
Little Bentwing-bat	<i>Miniopterus australis</i>	Yes
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	Yes
Southern Myotis	<i>Myotis macropus (Myotis adversus)</i>	Yes
Squirrel Glider	<i>Petaurus norfolcensis</i>	Yes
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Yes
Koala	<i>Phascolarctos cinereus</i>	Yes
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Yes
Wallum Froglet	<i>Crinia tinnula</i>	Yes

Survey methods

A summary of the survey method used to target identified species credit species is identified in **Table 5-10**. This includes information on the species targeted, the survey technique and minimum effort documented in survey guidelines and a summary of the technique used at the Project Site. Further details on the survey effort per habitat strata are provided in **Table 5-11**. The following is an overview of the fauna survey methods and effort.

Water body assessments were undertaken on the Project Site targeting suitable threatened frog and waterfowl habitat. This included farm dams, ephemeral soaks and drainage lines. Data collected included type and abundance of any macrophytes, bank stability and disturbance. All sites were also targeted for nocturnal surveys at sites FD1, FD2, FD3, and FD4 illustrated in **Figure 5-3**.

Table 5-10 Targeted fauna species, minimum survey requirements (DEC 2004) and completed survey details

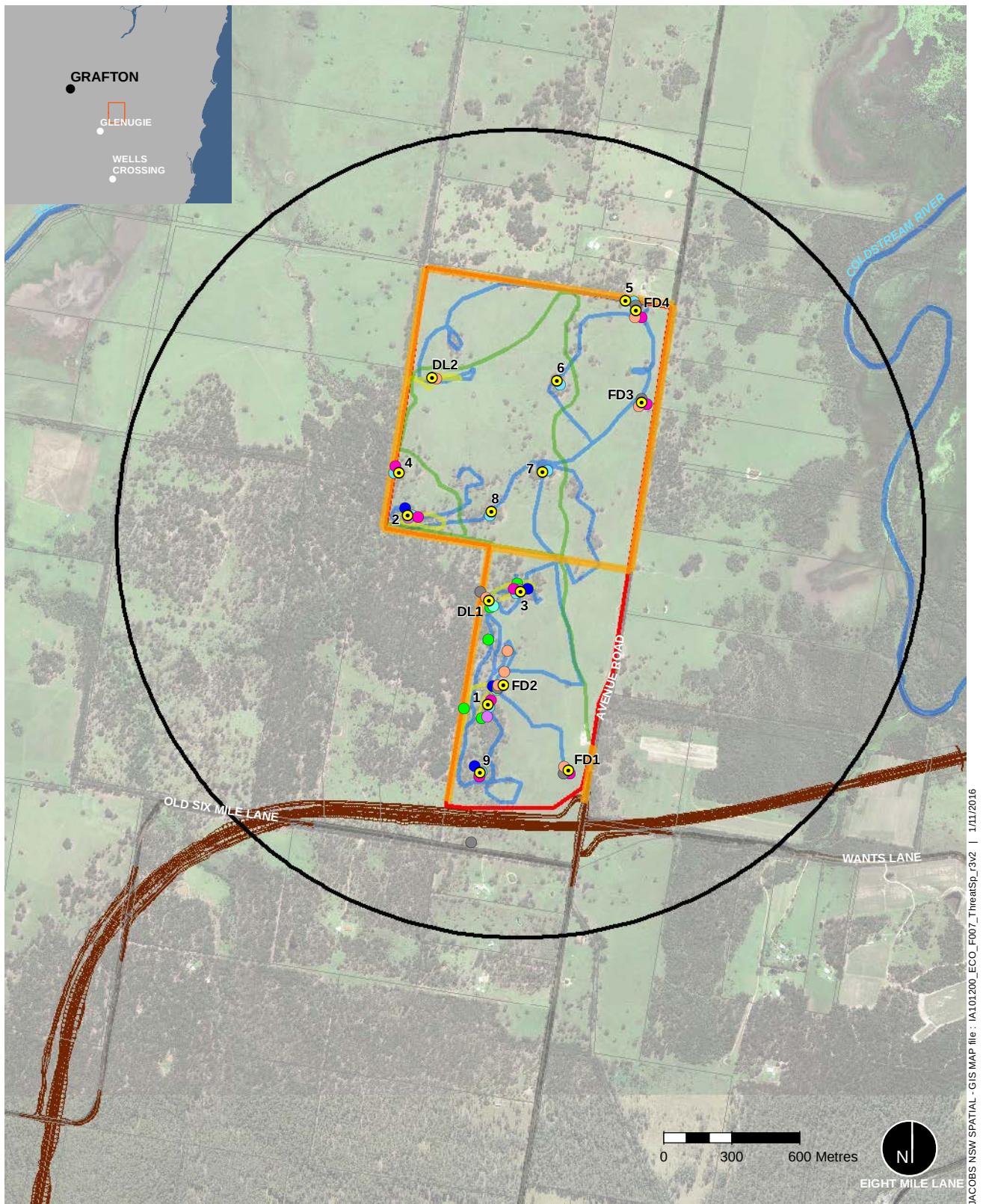
Target species	Minimum survey requirements ¹	Surveys completed on Project Site
Wallum Froglet	All surveys should be undertaken in spring/summer after a suitable period of rainfall. 1 hour diurnal survey within relevant habitat of each stratifications unit Fixed time searches generally involve one person undertaking two hours of effort per 200 m of river, stream or gully. Damp and watery sites such as dams, wetlands, soaks and seepages should be visited on two separate nights for 30 minutes each to search for frogs. At least one playback on each of two separate nights	Survey effort for these two amphibian species involved surveys of each aquatic habitat feature on two separate nights, including one diurnal survey. All surveys were at least 30 minutes long. Aquatic habitat types visited included farm dams, soaks and drainage lines. Call playback was undertaken at least once at all sites during nocturnal surveys.
Regent Honeyeater Red Goshawk Red-tailed Black-Cockatoo Red-backed Button-quail	20 minute surveys of 2 hectare plots per stratification unit.	20 minute dedicated surveys of approximately 2 hectares plots by two ecologists. Surveys undertaken at five sites across study area, including opportunistic sightings.
Black-necked Stork	A one-hour bird observation must be conducted at dawn or dusk. A 20-minute census at dawn or an hour before dusk should also be conducted at each identified source of water in the survey area.	20 minute point census at each aquatic habitat type at either dawn or dusk. Two-one hour observations after dusk during spotlighting.
Koala	Spotlighting - 1 hour and 1km up to 200 hectares of stratification unit on 2 separate nights per 50 hectares of stratification unit Scat Assessment Technique (SAT)	Spotlighting – 11 person hours across three separate nights in all habitat strata including area based searches and car spotlighting. SAT surveys undertaken at seven sites across the study area.
Common Planigale	Small Elliot traps - 100 trap nights over 3-4 consecutive nights per 50 hectares of stratification unit Pitfall traps - 24 trap nights over 3-4 consecutive nights per 50 hectares of stratification unit Spotlighting - 1 hour and 1km up to 200 hectares of stratification unit on 2 separate nights per 50 hectares of stratification unit	Small Elliot traps – 160 trap nights over 4 nights Spotlighting – 11 person hours across three separate nights including area based searches and car spotlighting. Camera traps – Four camera traps over three nights.

Target species	Minimum survey requirements ¹	Surveys completed on Project Site
Brush-tailed Phascogale Squirrel Glider	Arboreal Elliot traps - 24 trap nights over 3-4 consecutive nights per 50 hectares of stratification unit Spotlighting - 1 hour and 1km up to 200 hectares of stratification unit on 2 separate nights per 50 hectares of stratification unit	Large Elliot traps – 42 trap nights over 3-4 nights, attached to tree 3-4 metres above ground with a bracket Spotlighting – 11 person hours across three separate nights including area based searches and car spotlighting. Camera traps – Four camera traps over three nights. Camera traps were set for continuous night recording and baited with peanut butter and oats
Rufous Bettong	Spotlighting - 1 hour and 1km up to 200 hectares of stratification unit on 2 separate nights per 50 hectares of stratification unit	Spotlighting – 11 person hours across three separate nights including area based searches and car spotlighting. Surveys focused on the entire site, which include the open forest and cleared and modified grazing land Camera traps – Four camera traps over three nights.
Little Bentwing Bat Eastern Bentwing-bat Southern Myotis	Harp trapping - Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night) per 100 hectares of stratification unit Call detection - Two sound activated recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights per 100 hectares of stratification unit	Harp traps – four trap nights over two consecutive nights at two different locations. No suitable flyways in study area so aquatic habitat was targeted. Call detection – Two AnaBat™ II bat detectors used for four full nights each recording from 2000 hours to 0500 hours.
Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area	20 minute surveys of 2 hectare plots per stratification unit.	20 minute dedicated surveys of approx. 2 hectares plots by two ecologists. Surveys undertaken at five sites across study area, including opportunistic sightings. Surveys along approx. 6km of a total of approx. 7km of fence line to search for signs of emus (feathers, tracks and scats).

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) 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) 48 hours (Site FD2) 24 hours (Site FD3) 24 hours (Site FD4)
Time and area based bird surveys	Red-tailed Black-cockatoo, Red Goshawk, Black-necked Stork Emu, Regent Honeyeater, Red-backed Button-quail	90 person minutes (Site 1) over two consecutive days 120 person minutes (Site 3) over two consecutive days 60 person minutes (Site 9) over one day	120 person minutes (Site 2) over two consecutive days 60 person minutes (Site 4) over one day	20 person minutes (Site FD4) over one day 20 person minutes (Site FD3) over one day
Walked spotlighting transects	Koala, Brush-tailed Phascogale, Squirrel Glider, Rufous Bettong	Four person hours (Site 1)\ 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) Two person hours (Site FD2) One person hours (Site FD1) One person hours (Site FD3) 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 Rufous Bettong	Three camera trap days (Site 9)	Three camera trap days (Site 2) 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) 380 metres of fence length (near Site 1) 380 metres of fence length (near Site 9)	973 metres of fence length (near Site 2) 1,105 metres of fence length (near Site 5)	260 metres fence length (near FD1) 597 metres fence length (near FD3) 597 metres fence length (near FD4) 586 metres of fence length (near DL2)



JACOBS NSW SPATIAL - GIS MAP file: I\A101200_ECO_F007_ThreatSp_r3v2 | 1/11/2016

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 to 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 82 fauna species recorded. This comprised 55 birds, nine terrestrial mammals, four bats, eight 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 (*Calyptrorhynchus lathamii*) – 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 solely 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.

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 discolor*), 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 (<i>E. eugenioides</i>)	October to December / variable	N/A	N/A	29.9%
Northern Grey ironbark (<i>E. siderophloia</i>)	August – January / 2 months	0.91	0.60	21.8%
Small-fruited grey gum (<i>E. propinqua</i>)	December to March / 2 months	0.47	0.15	19.6%
Pink Bloodwood (<i>C. intermedia</i>)	December to March / 2 months	1	0.60	16%
Grey Box (<i>E. moluccana</i>)	February March / 2 months	0.37-0.59	0.30-0.80	5.1
Broad-leaved Ironbark (<i>E. fibrosa</i>)	October to July / 2 months	0.70	0.30	4.4%
Narrow-leaved Red Gum (<i>E. seeana</i>)	August – November / 2 months	0.77	0.80	1.1%
Spotted Gum (<i>C. henryi</i>)	October to January / 3 months	0.70	0.30	1.1%
Forest Red Gum (<i>E. tereticornis</i>)	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) throughout 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	<i>Calyptorhynchus lathami</i>	V	
Brown Treecreeper (eastern subsp.)	<i>Climacteris picumnus picumnus</i>	V	
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	
Powerful Owl	<i>Ninox strenua</i>	V	
Masked Owl	<i>Tyto novaehollandiae</i>	V	
Hoary Wattled Bat	<i>Chalinolobus nigrogriseus</i>	V	
Little Pied Bat	<i>Chalinolobus picatus</i>	V	
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	
Beccari's Freetail-bat	<i>Mormopterus beccarii</i>	V	
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	V	
Southern Myotis	<i>Myotis macropus</i>	V	
Eastern Long-eared Bat	<i>Nyctophilus bifax</i>	V	
Yellow-bellied Glider	<i>Petaurus australis</i>	V	
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	V	
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	

Common name	Scientific name	TSC Act	EPBC Act
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	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 (<i>E. tereticornis</i>)	Primary species	Yes	0	0	0	5	0	25	10
Small-fruited grey gum (<i>E. propinqua</i>)	Secondary species	No	37	0	61	0	0	0	20
Narrow-leaved Red Gum (<i>E. seeana</i>)	Secondary species	No	0	0	6	0	0	0	0
Grey Box (<i>E. moluccana</i>)	Secondary species	No	0	0	6	10	10	70	63
Thin-leaved stringbark (<i>E. eugenioides</i>)	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.

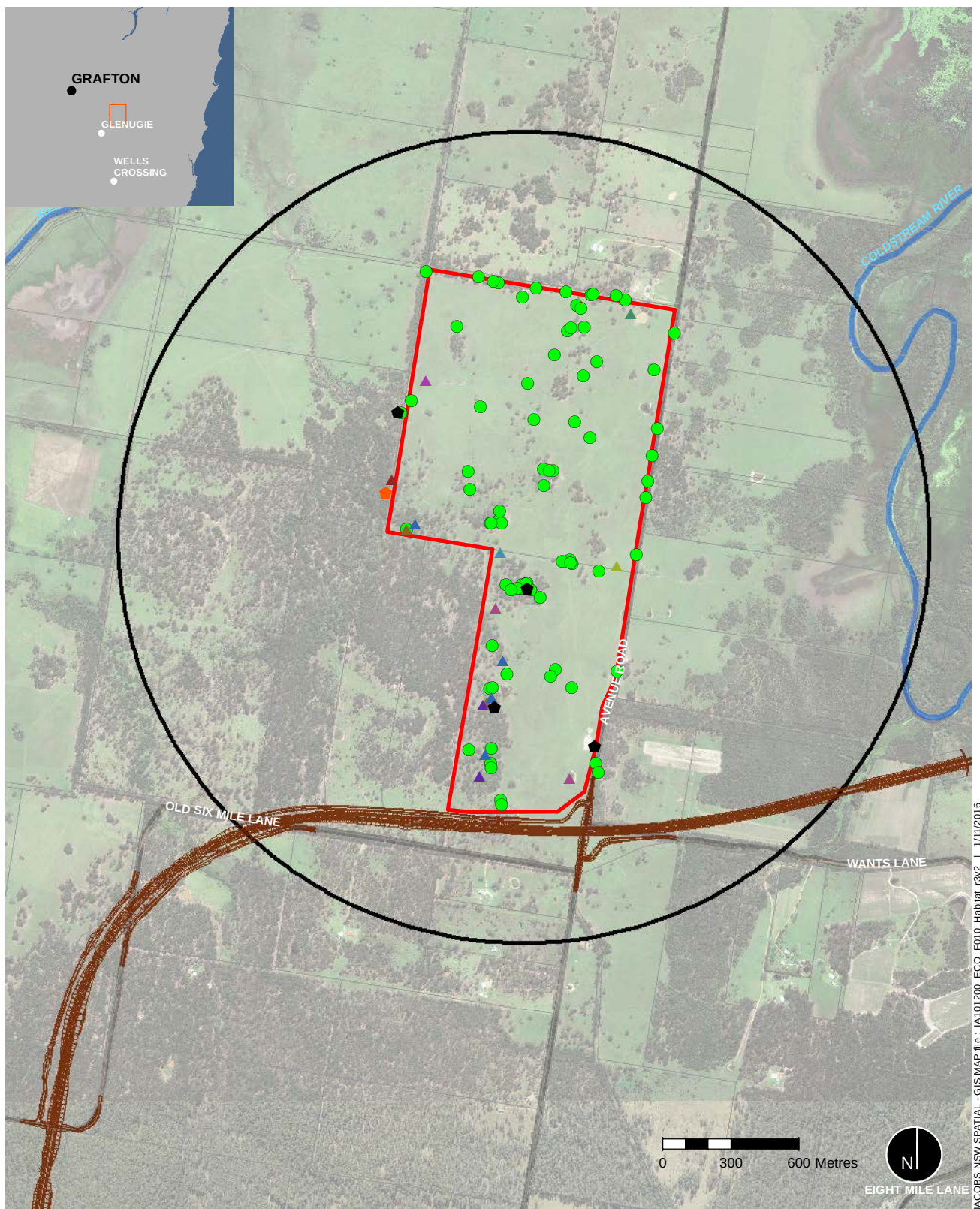
Two minor tributaries (1st and 2nd order streams) of the Coldstream River also occur on the Project Site and are in poor condition with low water quality as a result of cattle grazing, compaction and bank erosion. The introduced Plague Minnow (*Gambusia holbrooki*) was observed in shallow isolated pools.

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 (<i>Aepyprymnus rufescens</i>)	Species credit	V	-	Yes	Survey - confirmed	Recorded in open grassland near site 3	195
Little Bentwing-bat (<i>Miniopterus australis</i>)	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 (<i>Grus rubicunda</i>)	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 (<i>Calyptorhynchus lathami</i>)	Ecosystem credit	V	-	Yes	Survey - confirmed	High density of chewed cones observed from <i>Allocasuarina</i> spp. trees on western fence line near site 2.	30.8
Little Lorikeet (<i>Glossopsitta pusilla</i>)	Ecosystem credit	V	-	Yes	Survey - confirmed	Recorded feeding on flowering <i>Eucalyptus</i> / <i>Corymbia</i> trees at sites 1 and 2.	30.8
Brown Treecreeper (<i>Climacteris picumnus</i>)	Ecosystem credit	V	-	Yes	Survey - confirmed	Recorded foraging on branches and trunks of <i>Eucalyptus</i> / <i>Corymbia</i> trees at sites 1 and 9.	30.8
Grey-crowned Babbler (eastern subspecies) (<i>Pomatostomus temporalis temporalis</i>)	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 (<i>Pteropus poliocephalus</i>)	Ecosystem credit	V	V	Yes	Survey - confirmed	Recorded in high abundance in all nocturnal surveys in all vegetation patches feeding on nectar from <i>C. intermedia</i> trees.	30.8



Legend

 The Project	Migratory Species	▲ Brown Tree-creeper	▲ Little Bent-wing Bat
 Pacific Highway Upgrade alignment	◆ Rainbow Bee-eater	▲ Glossy Black-cockatoo (chewed cones)	▲ Little Lorikeet
 Inner assessment circle	◆ Satin Flycatcher	▲ Grey-crowned Babbler	▲ Rufous Bettong
● Hollow trees and stags	Threatened Species	▲ Grey-headed Flying Fox	▲ Wallum Froglet
	▲ Brolga		

Figure 5-4 | Recorded threatened species, migratory species and habitat values on the Project 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 (*Pteropus poliocephalus*) 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 (*Lathamus discolor*) 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.

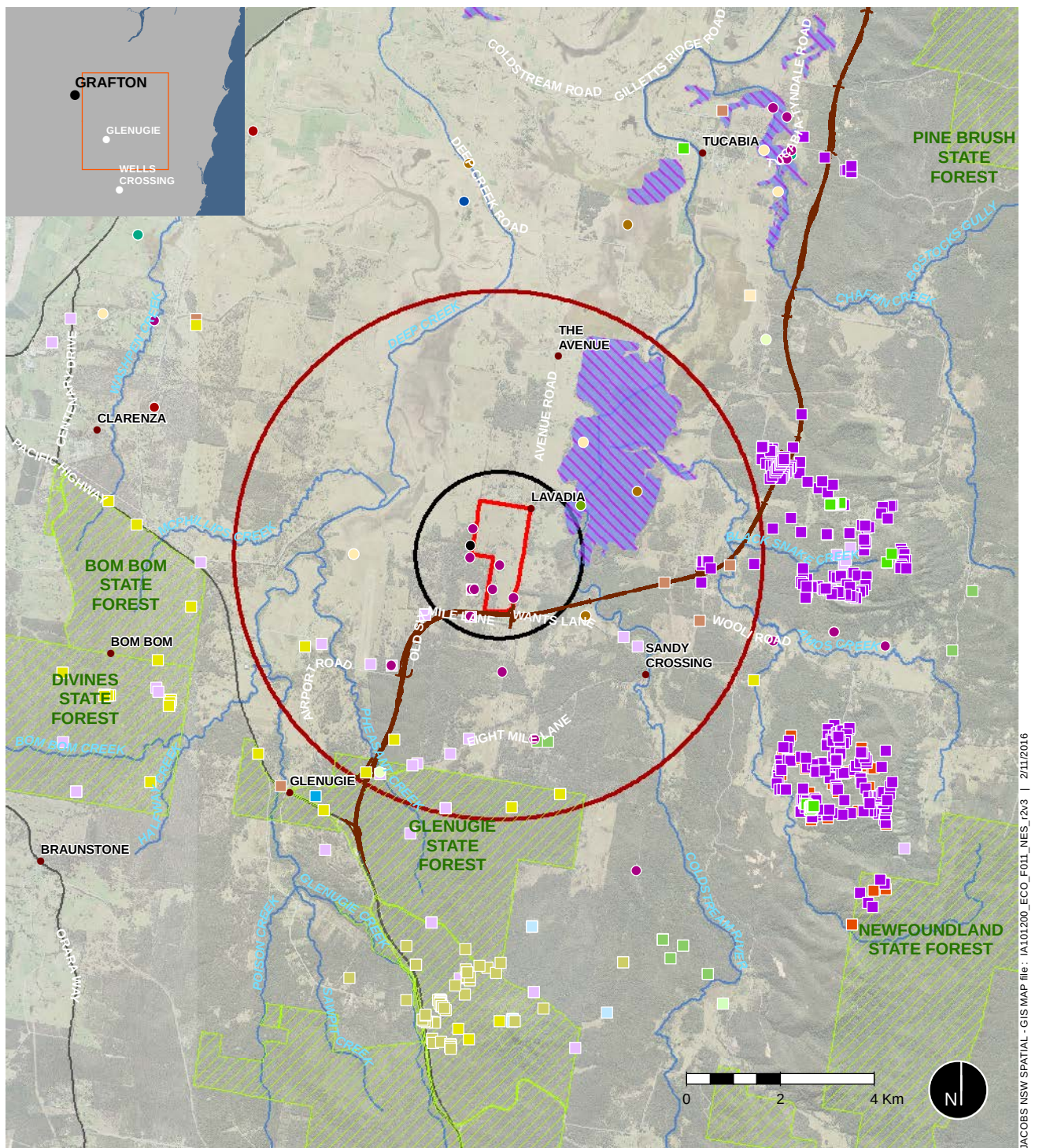


Figure 6-1 | Records of threatened and migratory species (EPBC Act) - MNES

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, including bush fire protection zones (APZ) and fire trails. 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.
- Including a vegetation buffer (along the northern, eastern and southern boundaries of the Project Site) comprising 10.4 hectares which would retain 1.3 hectares of PCTs and be incorporated into the landscaping zone.

7.2 Assessment of direct impacts

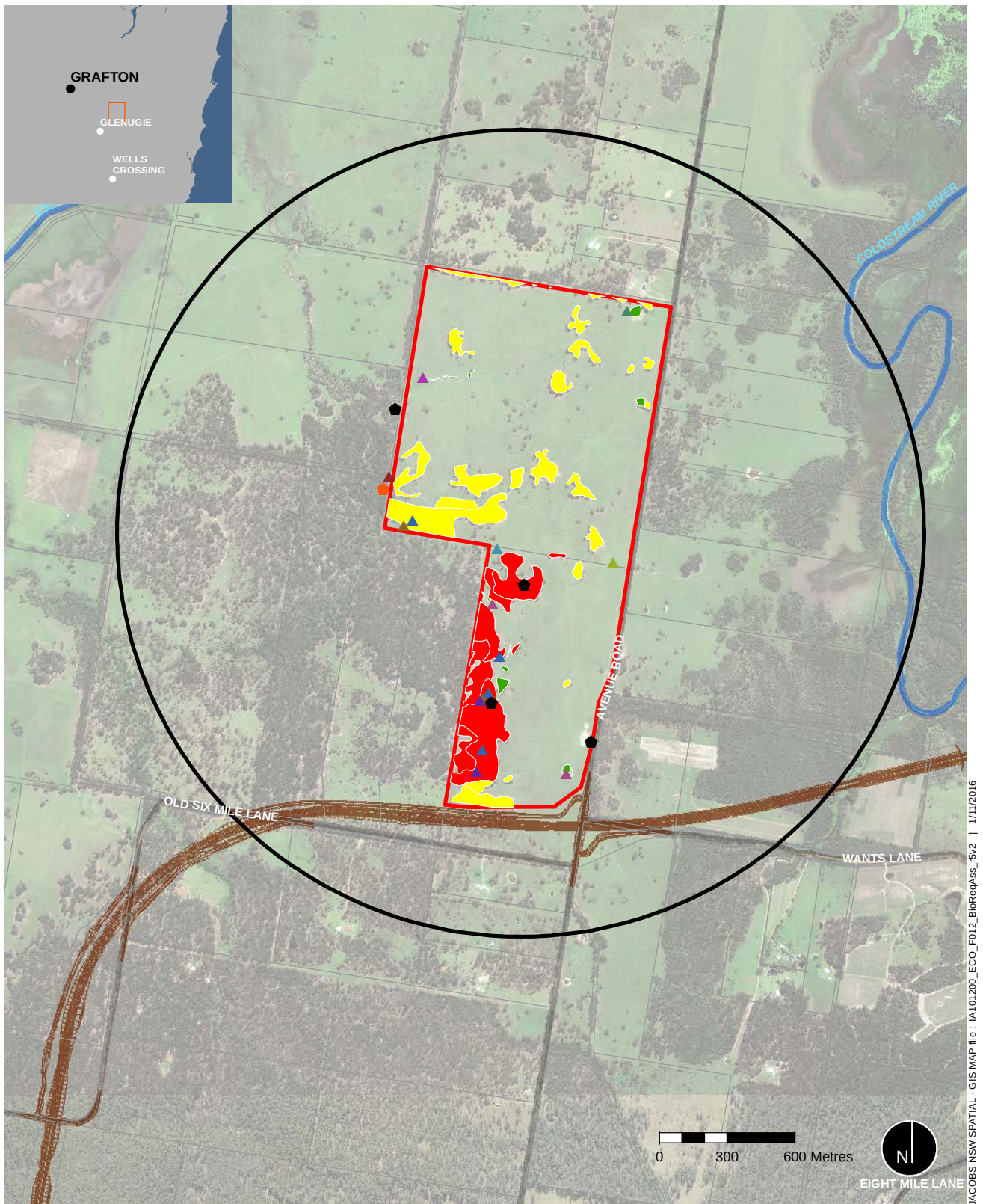
The assessment of direct and indirect impacts of the Project on biodiversity are summarised in this chapter. The potential for indirect impacts on biodiversity values are considered to be minimal given that much of the Project Site boundary is already largely cleared and edge effects would remain unchanged.

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, farm dams, open grassland and small isolated patches of paddock trees. Clearing of native vegetation constitutes a key threatening process listed under the TSC Act and EPBC Act. Of the total area of PCTs on the Project Site (31.6 ha), 30.3 hectares of PCTs is estimated to be removed and is detailed in **Table 7-1**. The vegetation buffer (along the northern, eastern and southern boundaries of the Project Site) comprising 10.4 hectares would retain 1.3 hectares of PCTs and be incorporated into the landscaping zone.



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Legend

	The Project	▲	Migratory Species	▲	Grey-crowned Babbler	■	Vegetation
	Pacific Highway Upgrade alignment	◆	Rainbow Bee-eater	▲	Grey-headed Flying Fox	■	Coastal freshwater meadows and forblands of lagoons and wetlands
	Inner assessment circle	◆	Satin Flycatcher	▲	Little Bent-wing Bat	■	Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast
		▲	Threatened Species	▲	Little Lorikeet	■	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast
		▲	Brolga	▲	Rufous Bettong		
		▲	Brown Tree-creeper	▲	Wallum Froglet		
		▲	Glossy Black-cockatoo (chewed cones)				

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	-	-	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 (vegetation buffer)					1.3 hectares
		Open grassland (exotic) and paddock trees					163.4 hectares
		Total Project Site (excluding vegetation buffer)					184.6 hectares
		Total Project Site Footprint					195 hectares

7.2.2 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.

7.2.3 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 (<i>Ambrosia artemisiifolia</i>)	5	Restricted Plant The requirements in the NW Act for a notifiable weed must be complied with. Low abundance.	No
Groundsel bush (<i>Baccharis halimifolia</i>)	3	Regionally Controlled Weed The plant must be fully and continuously suppressed and destroyed. Low abundance.	No
Lantana (<i>Lantana camara</i>)	4	Locally Controlled Weed 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 (<i>Senecio madagascariensis</i>)	4	Locally Controlled Weed 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 rangellii*)

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 in 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. 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. 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 Woolli approximately 19 km from the site. 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: Productive during winter and spring when food bottlenecks have been identified.

Impact considerations	Grey-headed Flying-fox (Vulnerable)
	- 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) - Productive during the final weeks of gestation and during the weeks of birth, lactation and conception (September to May) - 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 discolor*) 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. 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 (<i>Phascolarctos cinereus</i>) (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 the study area as part of the W2B Pacific Highway upgrade (RMS 2014) did not

Impact considerations	Koala (<i>Phascolarctos cinereus</i>) (Vulnerable)
	identify any significant activity or populations in this location. 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. 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 (Department of the Environment (DotE 2013))

Attribute	Score	Habitat assessment	
Koala occurrence	0	Desktop	EPBC PMST report identified the Koala as 'known to occur' in the study locality. The Atlas of NSW Wildlife identifies 5 records from the last 17 years within 5 km of the Project Site. 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. No Koala evidence was observed survey surveys. 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 (<i>E. tereticornis</i>). 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: One primary food tree (<i>E. tereticornis</i>) species (5.7% total mean tree proportion). Three secondary food tree (<i>E. propinqua</i>, <i>E. seeana</i> & <i>E. moluccana</i>) species (13.7% total mean tree proportion). One supplementary food tree (<i>E. eugenioides</i>) species (21.3 % total mean tree proportion). 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. 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 their 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 (<i>Pandion haliaetus</i>)	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 (<i>Egretta alba</i>)	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 (<i>Ardea ibis</i>)	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 (<i>Haliaeetus leucogaster</i>)	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 (<i>Myiagra cyanoleuca</i>)	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 (<i>Hirundapus caudacutus</i>)	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 (<i>Merops ornatus</i>)	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 (<i>Monarcha melanopsis</i>)	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 (<i>Rhipidura rufifrons</i>)	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
Latham's Snipe (<i>Gallinago hardwickii</i>)	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 (<i>Rostratula australis</i>)	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 <i>Muehlenbeckia</i> or canegrass or sometimes tea-tree (<i>Melaleuca</i>).	May occur and utilise the wet meadow habitat
Spectacled Monarch (<i>Monarcha trivirgatus</i>)	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 as:

- 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) • 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. • include nest boxes in buffer area	No
Removal of threatened fauna species habitat and habitat features	Grassy forests and open grassland: • Rufous Bettong • Coastal Emu population • Brolga • Woodland birds	Direct	Site based	Long term	• Clearing of native vegetation (TSC Act) • Land clearance (EPBC Act) • Loss of hollow-bearing trees (TSC Act) • Removal of dead wood and dead trees (TSC Act)	• Remove in stages and retain vegetation buffer around facility where possible. • Include nest boxes in retained habitat in buffer area • 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: - Barking Owl - Masked Owl - Powerful Owl - Glossy Black-Cockatoo - Yellow-bellied Glider - Squirrel Glider - Little Bentwing-Bat - Eastern Bentwing-bat - Eastern Freetail-bat - Greater Broad-nosed Bat - Hoary Wattled Bat - Yellow-bellied Sheath-tail-bat - Beccaris Freetail-bat - Brush-tailed Phascogale - Woodland birds	Direct	Site based	Long term	- Clearing of native vegetation (TSC Act) - Land clearance (EPBC Act) - Loss of hollow-bearing trees (TSC Act) - Removal of dead wood and dead trees (TSC Act)	- Remove in stages and retain vegetation buffer around facility where possible. - Include next boxes in retained habitat in buffer area - Revegetation / landscaping in buffer areas using native species	Yes
Removal of threatened fauna species habitat and habitat features	Farm dams, soaks and drainage lines - Wallum Froglet - Brolga - Black-necked Stork	Direct	Site based	Short / pre and during construction	- Infection of frogs by amphibian chytrid cause the disease chytridomycosis (TSC Act) - infection of amphibians with chytrid fungus resulting in chytridomycosis (EPBC Act)	- Retain habitat in buffer area where possible - Sediment control during construction - 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: • Grey-Headed Flying Fox • Little Lorikeet • Black-chinned Honeyeater • Swift Parrot • Yellow-bellied Glider	Direct	Site based	Long term	• Clearing of native vegetation (TSC Act) • Land clearance (EPBC Act) • Loss of hollow-bearing trees (TSC Act) • Removal of dead wood and dead trees (TSC Act)	• Remove in stages and retain vegetation buffer around facility where possible. • Include next boxes in retained habitat in buffer area • 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: • Brush-tailed Phascogale • Bush Stone-curlew	Direct	Site based	Long term	• Clearing of native vegetation (TSC Act) • Land clearance (EPBC Act) • Loss of hollow-bearing trees (TSC Act) • 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: • Grey-crowned Babbler • Spotted-tailed Quoll • Square-tailed Kite • Little Eagle • Varied Sittella • Scarlet Robin • Speckled Warbler • Hooded Robin • Brown Treecreeper • Barred Cuckoo-shrike	Direct	Site based	Long term	• Clearing of native vegetation (TSC Act) • Land clearance (EPBC Act) • Loss of hollow-bearing trees (TSC Act) • Removal of dead wood and dead trees (TSC Act)	• Remove in stages and retain vegetation buffer around facility where possible. • 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	• Retain habitat in buffer area where possible • 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 • Sediment control during construction •	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. • 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 <i>Lantana camara</i> (TSC Act) - 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 (<i>Oryctolagus cuniculus</i>) (TSC Act) - Predation and hybridisation of feral dogs (<i>Canis lupus familiaris</i>) (TSC Act) - Predation by the European red fox (<i>Vulpes vulpes</i>) (TSC Act) - Predation by the feral cat (<i>Felis catus</i>) (TSC Act) - Predation by Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>) (TSC Act) - Predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) (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 <i>Phytophthora cinnamomi</i> (TSC Act) • Dieback caused by root-rot fungus <i>Phytophthora cinnamomi</i> (EPBC Act) • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (TSC Act) • Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations • Infection of frogs by amphibian chytrid cause the disease chytridomycosis (TSC Act) 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 a Flora and Fauna Management Sub-plan (FFMSP) which will form part of a Construction Environmental Management Plan (CEMP).

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: • 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). • What to do in case of environmental emergency (chemical spills, fire, injured fauna). • Key contacts in case of environmental emergency. • Potential impacts 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. 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. Regular inspections should be undertaken to ensure all retained vegetation/fauna habitat is clearly marked and that fencing is in place, where appropriate. 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. A two-staged habitat removal procedure will be adopted to firstly remove non-habitat trees (i.e. trees with no hollows) 48 hours prior to removal of habitat trees. An experienced and licensed wildlife carer and/or ecologist would inspect habitat once it is removed e.g. after a tree is felled). Animals that emerge would be captured, inspected for injury then relocated to pre-determined habitat identified for fauna release. Suitable release sites are recommended in bushland to the west of the site. Any uninjured nocturnal fauna encountered should be held in a dark, quiet, warm, well ventilated box or carrier for release the following night. Wildlife Information, Rescue and Education Services (WIRES) Clarence Valley (Ph: 1300 094 737) should be consulted if any injured fauna are encountered. Any identified hollow bearing trees to be removed would need to be nudged and/or knocked before felling to allow any fauna to escape. 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). 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). Any dewatering of artificial farm dams if necessary has potential to impact on the breeding cycle of several frog species. 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. Dewatering of dams should be supervised by a suitably experienced aquatic ecologist. A suitable aquatic fauna release site (for eels, native fish, tadpoles and frogs) should be identified in proximity to the site prior to dewatering of dams.
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. 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. Ensure all works within close proximity to aquatic habitats have adequate sediment and erosion control. Further on site investigations may be required to confirm any interaction with groundwater.

Item	Timing	Recommended mitigation measures
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. Weeds should be controlled within the work area according to the requirements of the <i>Noxious Weeds Act 1993</i>. 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.
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	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 (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 (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 (<i>Ephippiorhynchus asiaticus</i>)	7.7	0.7	54
Brolga (<i>Grus rubicunda</i>)	1.3	0.7	9
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	2.0	29.6	592
Common Planigale (<i>Planigale maculata</i>)	2.6	29.6	770
Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area (<i>Dromaius novaehollandiae</i>)	2.6	30.3	788
Koala (<i>Phascolarctos cinereus</i>)	2.6	29.6	770
Little Bentwing-bat (<i>Miniopterus australis</i>)	1.3	30.3	394
Rufous Bettong (<i>Aepyprymnus rufescens</i>)	2.6	30.3	788

Species	Offset multiplier	Loss of potential habitat (ha)	Species credits required
Squirrel Glider (<i>Petaurus norfolcensis</i>)	2.2	29.6	651

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. No State or Nationally listed threatened ecological communities would be impacted by the Project.

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 some loss 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 (refer to **Appendix D**). The BOS currently presents the second stage of the offset package, which has identified the availability of potential offset sites to meet the impacts described. However further work is required in securing an offset and development appropriate protection and management measures. These will be determined during Stage 3 of the BOS when further investigation and liaison with OEH and relevant councils identifies potential offset sites with interested landowners.

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*.

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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 - 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: - Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range - Use specific habitats or resources not present in the study area - 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: - Have infrequently been recorded previously in the study area/surrounds - Use specific habitats or resources present in the study area but in a poor or modified condition - Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration - 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: - Have frequently been recorded previously in the study area/surrounds - Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area - Are known or likely to maintain resident populations surrounding the study area - 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 COMMUNITIES				
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	High
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 seaciffs 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							
<i>Allocasuarina defungens</i>	Dwarf Heath Casuarina	E	E	Dwarf Heath Casuarina is found only in NSW from the Napiac 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

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features*	Source+	Likelihood of occurrence	Class of credit
<i>Angophora robur</i>	Sandstone Rough Barked Apple	V	V	Occurs in a band from around Glenreagh, north-west of Coffs Harbour, to the 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.	300 OEH, PMST	Low	Species credit
<i>Archidendron hendersonii</i>	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. <i>Archidendron hendersonii</i> 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
<i>Arthraxon hispidus</i>	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
<i>Callistemon linearifolius</i>	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
<i>Centranthera cochinchinensis</i>	Swamp Foxglove	-	E	Occurs in northern Australia and south-east Asia and known from NSW north from Woolli. In NSW, it is known from only 6 locations from near Woolli 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
<i>Corynocarpus rupestris</i> subsp. <i>rupestris</i>	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

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features*	Source+	Likelihood of occurrence	Class of credit
<i>Cyperus aquatilis</i>	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 in ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	BBCC	Moderate	Species credit
<i>Cryptostylis hunteriana</i>	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 (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	PMST	Low	Species credit
<i>Davidsonia jerseyana</i>	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
<i>Dendrobium melaleucaphilum</i>	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 <i>Melaleuca styphelioides</i> , less commonly on rainforest trees or on rocks in coastal districts. Flowering period is between July and October.	BBCC	Low	Species credit
<i>Desmodium acanthocladum</i>	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
<i>Diploglottis campbellii</i>	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

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features*	Source+	Likelihood of occurrence	Class of credit
<i>Drynaria rigidula</i>	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, 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.	BBCC	Low	Species credit
<i>Eleocharis tetraquetra</i>	Square-stemmed Spike-rush	-	E	There is limited information regarding the life cycle of <i>Eleocharis tetraquetra</i> . It is known to spread through vegetative reproduction making counting individuals difficult. It is thought vegetative reproduction may be an essential strategy for the maintenance of local populations following initial establishment from seed (NPWS 1999). The recovery plan for <i>Eleocharis tetraquetra</i> 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). 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
<i>Endiandra muelleri</i> subsp. <i>bracteata</i>	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
<i>Elionurus citreus</i> (syn: <i>Elyonurus citreus</i>)	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
<i>Eucalyptus glaucina</i>	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	BBCC	Low	Species credit

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features*	Source+	Likelihood of occurrence	Class of credit
				of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.			
<i>Eucalyptus tetrapleura</i>	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
<i>Geodorum densiflorum</i>	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
<i>Gossia fragrantissima</i>	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
<i>Grevillea masonii</i>	Mason's Grevillea	E	E	Occurs in only a few locations between Grafton and Casino in north-eastern NSW. Occurs on gravelly 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
<i>Grevillea quadricauda</i>	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 gravelly loam, in the understorey of dry eucalypt forest, usually along or near creeks.	2 OEH, PMST	Moderate	Species credit
<i>Hibbertia marginata</i>	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
<i>Lindernia alsinoides</i>	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
<i>Lindsaea incisa</i>	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
<i>Macadamia tetraphylla</i>	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
<i>Marsdenia longiloba</i>	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 <i>Eucalyptus crebra</i> , <i>E. microcorys</i> , <i>E. acmenoides</i> , <i>E. saligna</i> , <i>E. propinqua</i> , <i>Corymbia intermedia</i> and <i>Lophostemon confertus</i> .	PMST	Moderate	Species credit
<i>Maundia triglochoides</i>	-	-	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. <i>Triglochin procerum</i> . 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
<i>Melaleuca irbyana</i>	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
<i>Melichrus hirsutus</i> (syn. <i>Melichrus</i> 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.			
<i>Melichrus sp. Gibberagee</i>	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
<i>Ochrosia moorei</i>	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
<i>Oldenlandia galioides</i>	-	-	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
<i>Peristeranthus hillii</i>	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
<i>Phaius australis</i>	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
<i>Phyllanthus microcladus</i>	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
<i>Quassia sp. 'Moonee Creek'</i>	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
<i>Rotala tripartita</i>	-	-	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
<i>Syzygium hodgkinsoniae</i>	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
<i>Tephrosia filipes</i>	-	-	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
<i>Thesium australe</i>	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 (<i>Themeda australis</i>).	PMST	Low	Species credit
<i>Tylophora woollsii</i>	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							
<i>Amaurornis moluccana</i>	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 (<i>Lantana camara</i>), 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.			
<i>Anseranas semipalmata</i>	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
<i>Anthochaera Phrygia</i> (syn: <i>Xanthomyza phrygia</i>)	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
<i>Botaurus poiciloptilus</i>	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
<i>Burhinus grallarius</i>	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
<i>Calyptorhynchus banksii banksii</i>	Red-tailed Black-cockatoo (coastal subspecies)	-	CE	The nominate subspecies (<i>banksii</i>) 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 <i>Eucalyptus</i> , <i>Casuarina</i> , <i>Acacia</i> and <i>Banksia</i> , 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 <i>Eucalyptus</i> but also in <i>Melaleuca</i> . Although there is no data for NSW, they have been recorded frequently nesting in dead trees, which can have deeper hollows than live trees.			
<i>Calyptrorhynchus lathamii</i>	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 (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, <i>A. diminuta</i> , and <i>A. gymnanthera</i> . 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 (<i>Casuarina cristata</i>).	BBCC, 58 OEH	Confirmed (chewed <i>A. littoralis</i> cones found on the western border of the Project Site)	Ecosystem credit
<i>Chthonicola sagittata</i> (<i>Pyrrholaemus sagittatus</i>)	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
<i>Circus assimilis</i>	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
<i>Climacteris picumnus victoriae</i>	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 (<i>Eucalyptus camaldulensis</i>) 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
<i>Coracina lineata</i>	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
<i>Daphoenositta chrysoptera</i>	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 decortivating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	BBCC, 6 OEH	High	Ecosystem credit
<i>Dasyornis brachypterus</i>	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.			
<i>Dromaius novaehollandiae</i> (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
<i>Ephippiorhynchus asiaticus</i>	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
<i>Erythrotriorchis radiatus</i>	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, <i>Melaleuca</i> swamp forest and riparian <i>Eucalyptus</i> forest of coastal rivers.	BBCC, 1 OEH, PMST	Moderate	Species credit
<i>Grantiella picta</i>	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. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	PMST	Low	Ecosystem species
<i>Grus rubicunda</i>	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 Brolgas was observed in the Project Site foraging in the north-eastern dam and over derived grasslands).	Ecosystem species
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (<i>angophora</i> sp.), paperbarks (<i>melaleuca</i> 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)	
<i>Hieraaetus morphnoides</i>	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
<i>Irediparra gallinacea</i>	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
<i>Ixobrychus flavicollis</i>	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
<i>Lathamus discolor</i>	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 (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>).	BBCC, PMST	Moderate	Ecosystem species

Scientific name	Common name	EPBC Act	TSC Act	Distribution and habitat features*	Source+	Likelihood of occurrence	Class of credit
<i>Lichenostomus fasciolaris</i>	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. 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
<i>Lophoictinia isura</i>	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 <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> , or <i>E. smithii</i> . Individuals appear to occupy large hunting ranges of more than 100 km ² . 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
<i>Melanodryas cucullata cucullata</i>	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
<i>Melithreptus gularis gularis</i>	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 (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.			
<i>Monarcha leucotis</i> (syn: <i>Carterornis leucotis</i>)	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
<i>Ninox connivens</i>	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
<i>Ninox strenua</i>	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 <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> 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
<i>Pachyptila turtur subantarctica</i>	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 <i>Colobanthus muscoides</i> or in burrows in peaty soil held together by a thick cover of <i>Cotula plumosa</i> .	PMST	Unlikely	N/A
<i>Pandion cristatus</i>	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 OEI	Moderate	Ecosystem species
<i>Petroica boodang</i>	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 OEI	Moderate	Ecosystem species
<i>Pezoporus wallicus wallicus</i>	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
<i>Pomatostomus temporalis temporalis</i>	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
<i>Ptilinopus regina</i>	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
<i>Rostratula australis</i>	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
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (<i>Eucalyptus pauciflora</i>) 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
<i>Turnix melanogaster</i>	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.			
<i>Tyto novaehollandiae</i>	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							
<i>Aepyprymnus rufescens</i>	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
<i>Cercartetus nanus</i>	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
<i>Chalinolobus dwyeri</i>	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
<i>Chalinolobus nigrogriseus</i>	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.			
<i>Dasyurus maculatus</i>	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
<i>Miniopterus australis</i>	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
<i>Miniopterus schreibersii oceanensis</i>	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
<i>Mormopterus beccarii</i>	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
<i>Mormopterus norfolkensis</i>	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
<i>Myotis macropus (Myotis adversus)</i>	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
<i>Petaurus australis</i>	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
<i>Petaurus norfolcensis</i>	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 <i>Acacia</i> midstorey.	BBCC, 8 OEH	Moderate	Species credit
<i>Petrogale penicillata</i>	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
<i>Phascogale tapoatafa</i>	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
<i>Phascolarctos cinereus</i>	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
<i>Planigale maculata</i>	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.			
<i>Pseudomys gracilicaudatus</i>	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
<i>Pseudomys novaehollandiae</i>	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
<i>Pteropus poliocephalus</i>	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
<i>Saccolaimus flaviventris</i>	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
<i>Scoteanax rueppellii</i>	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.			
<i>Vespadelus troughtoni</i>	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							
<i>Crinia tinnula</i>	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 sedgeland 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	Moderate	Species credit
<i>Litoria aurea</i>	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
<i>Litoria brevipalmata</i>	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
<i>Mixophyes balbus</i>	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
<i>Mixophyes iteratus</i>	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							
<i>Cacophis harriettae</i>	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
<i>Coeranoscincus reticulatus</i>	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
<i>Hoplocephalus bitorquatus</i>	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							
<i>Arhyreus hyperbius</i>	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 <i>Viola betonicifolia</i> occurs. The Australian Fritillary is found in open swampy coastal habitat.	BBCC	Low	Species credit
MIGRATORY							
<i>Apus pacificus</i>	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
<i>Ardea alba</i>	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
<i>Ardea ibis</i>	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
<i>Calidris acuminata</i>	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
<i>Cuculus optatus</i>	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
<i>Gallinago hardwickii</i>	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
<i>Gelochelidon nilotica</i>	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, brackish 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
<i>Haliaeetus leucogaster</i>	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
<i>Hirundapus caudacutus</i>	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
<i>Limosa lapponica</i>	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
<i>Merops ornatus</i>	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
<i>Monarcha melanopsis</i>	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
<i>Monarcha trivirgatus</i>	Spectacled Monarch	M	-	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges.	PMST	Low	N/A
<i>Motacilla flava</i>	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
<i>Myiagra cyanoleuca</i>	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 <i>Allocasuarina</i> sp. understorey)	N/A
<i>Plegadis falcinellus</i>	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
<i>Rhipidura rufifrons</i>	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 (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>); usually with a dense shrubby understorey often including ferns.	PMST	Moderate	N/A
<i>Tringa nebularia</i>	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
<i>Tringa stagnatilis</i>	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:

Australian Government Department of the Environment <http://www.environment.gov.au/biodiversity/threatened/index.html>

NSW Office of Environment and Heritage <http://www.environment.nsw.gov.au/threatenedspecies/>

Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx

+ Data source includes

BBCC = BioBanking Credit Calculator from the NSW Office of Environment and Heritage website (Accessed January 2016) <https://www.environment.nsw.gov.au/ASMSLightProfileAPP>

OEH = Number of records from the NSW Office of Environment and Heritage Wildlife Atlas record data (Accessed January 2016); and

PMST = Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Environment

<http://www.environment.gov.au/epbc/pmst/index.html>

Key:

CE = critically endangered

E = endangered

V = vulnerable

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	<i>Nymphaea capensis</i>	Cape Waterlily	i														✓
ADIANTACEAE	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Slender Cloak-fern														1	
MARSILEACEAE	<i>Marsilea mutica</i>	Nardoo															✓
ACANTHACEAE	<i>Brunoniella australis</i>	Blue Trumpet		1		2	1	1			1		1	1			
ACANTHACEAE	<i>Pseuderanthemum variable</i>	Pseuderanthemum						1	1								
AMARANTHACEAE	<i>Alternanthera denticulata</i>	Lesser Joyweed						1									
AMARANTHACEAE	<i>Alternanthera pungens</i>	Khaki Weed	i														✓
APIACEAE	<i>Centella asiatica</i>	Swamp Pennywort			1	1		1		2	2	2	2	2		2	
APIACEAE	<i>Cyclospermum leptophyllum</i>	Slender Celery	i								1						
APIACEAE	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort													2		
APIACEAE	<i>Hydrocotyle peduncularis</i>	Hairy Pennywort														1	
APIACEAE	<i>Hydrocotyle tripartita</i>	Tre-foil Pennywort															✓
APOCYNACEAE	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	i	1	1	2	1	1	1	1	1	1	1	1		1	
APOCYNACEAE	<i>Gomphocarpus physocarpus</i>	Balloon Cotton Bush	i									1					
APOCYNACEAE	<i>Parsonsia straminea</i>	Common Silkpod						2									
ASTERACEAE	<i>Ambrosia artemisiifolia</i>	Annual Ragweed	i														✓
ASTERACEAE	<i>Aster subulatus</i>	Wild Aster	i												1		
ASTERACEAE	<i>Baccharis halimifolia</i>	Groundsel Bush	i														✓
ASTERACEAE	<i>Bidens pilosa</i>	Cobblers Peg	i														✓
ASTERACEAE	<i>Centipeda minima</i> subsp. <i>minima</i>	Spreading Sneezeweed															✓
ASTERACEAE	<i>Chrysocephalum apiculatum</i>	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	<i>Cirsium vulgare</i>	Spear Thistle	i					1		1		1	1				
ASTERACEAE	<i>Conyza spp.</i>	Fleabane	i		1			1									
ASTERACEAE	<i>Eclipta platyglossa</i>	Eclipta				1					1						
ASTERACEAE	<i>Epaltes australis</i>	Spreading Nut-heads					1										
ASTERACEAE	<i>Euchiton gymnocephalus</i>			2	2	1		1		2	1			1			
ASTERACEAE	<i>Gamochaeta purpurea</i>	Cudweed	i		1												
ASTERACEAE	<i>Hypochaeris radicata</i>	Catsear	i		1	1					1	1	1	1		1	
ASTERACEAE	<i>Lagenophora stipitata</i>	Bottle-daisy				1											
ASTERACEAE	<i>Ozothamnus diosmifolius</i>	Tall Paperdaisy															✓
ASTERACEAE	<i>Senecio madagascariensis</i>	Fireweed	i	1	1	1	1	1	1	1	1	1	2	1		1	
ASTERACEAE	<i>Sonchus oleraceus</i>	Common Sow-thistle	i		1						1						
ASTERACEAE	<i>Vernonia cinerea</i> var. <i>cinerea</i>	Vernonia		2	2	2	2	1	1	2	2	1		2		2	
CAMPANULACEAE	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell			1								1	1		1	
CASUARINACEAE	<i>Allocasuarina littoralis</i>	Black She-oak															✓
CASUARINACEAE	<i>Casuarina glauca</i>	Swamp Oak															✓
CLUSIACEAE	<i>Hypericum gramineum</i>	Narrow-leaf St. Johns Wort								1							
CONVOLVULACEAE	<i>Dichondra repens</i>	Kidney Weed		3	3	2	3	3	2	3	3	3	3	3		3	
CONVOLVULACEAE	<i>Polymeria calycina</i>	Woodland Bindweed		2	1	2	2		1	2	2	2		1			
DILLENIACEAE	<i>Hibbertia vestita</i>	Hairy Guinea-flower							1	1							
PHYLLANTHACEAE	<i>Breynia oblongifolia</i>	Breynia												1			
PHYLLANTHACEAE	<i>Phyllanthus virgatus</i>	Small-leaf Spurge		2	1	1	1	1	1	2	1	2	1	1		1	
PHYLLANTHACEAE	<i>Poranthera microphylla</i>	Small Poranthera															✓
PHYLLANTHACEAE	<i>Suaropus hirtellus</i>								1	1							
FABACEAE-FABOIDEAE	<i>Aeschynomene villosa</i>	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	<i>Daviesia ulicifolia</i>	Gorse Bitter-pea							1	1							
FABACEAE-FABOIDEAE	<i>Desmodium gunnii</i>	Slender Tick Trefoil		1				1		1				1		1	
FABACEAE-FABOIDEAE	<i>Desmodium rhytidophyllum</i>	Rusty Tick-trefoil															
FABACEAE-FABOIDEAE	<i>Desmodium varians</i>	Slender Tick-trefoil		2	2	2	1	1	1	1	2	2	2	2		1	
FABACEAE-FABOIDEAE	<i>Galactia tenuiflora</i> var. <i>lucida</i>																✓
FABACEAE-FABOIDEAE	<i>Glycine clandestina</i>	Twining Glycine											1			1	
FABACEAE-FABOIDEAE	<i>Glycine tabacina</i>			2	1	2	2	1	1		1	1	1	2			
FABACEAE-FABOIDEAE	<i>Glycine tomentella</i>	Wooly Glycine				1											
FABACEAE-FABOIDEAE	<i>Lespedeza juncea</i>										2						
FABACEAE-FABOIDEAE	<i>Lespedeza striata</i>	Japanese Clover	i								2		1	1		1	
FABACEAE-FABOIDEAE	<i>Lupinus</i> sp.	Lupin	i									1					
FABACEAE-FABOIDEAE	<i>Podolobium scandens</i>	Netted Shaggy-pea							2	2							
FABACEAE-FABOIDEAE	<i>Trifolium repens</i>	White Clover	i									2	2				
FABACEAE-FABOIDEAE	<i>Vigna vexillata</i> var. <i>angustifolia</i>	Wild Cow Pea									2						
FABACEAE-MIMOSOIDEAE	<i>Acacia concurrens</i>	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	<i>Centaurium erythraea</i>	Common Centaury	i														✓
GOODENIACEAE	<i>Goodenia heterophylla</i>	Variable-leaf Goodenia		1		1			3	3				1		2	
GOODENIACEAE	<i>Goodenia paniculata</i>	Panicled Goodenia													2		
GOODENIACEAE	<i>Velleia paradoxa</i>	Spur Vellia				1				1							
HALORAGACEAE	<i>Haloragis heterophylla</i>	Variable Raspwort															✓
HALORAGACEAE	<i>Myriophyllum latifolium</i>	Water-milfoil															✓
LAMIACEAE	<i>Ajuga australis</i>	Austral Bugle									1					1	
LAMIACEAE	<i>Mentha satureioides</i>	Creeping Mint															✓
LAMIACEAE	<i>Plectranthus parviflorus</i>	Cockspur Flower						2									
LAURACEAE	<i>Cinnamomum camphora</i>	Camphor Laurel	i														✓
LENTIBULARIACEAE	<i>Utricularia gibba</i>	Floating Bladderwort															✓
LOBELIACEAE	<i>Lobelia alata</i>	Angled Lobelia													2		
LOBELIACEAE	<i>Pratia purpurascens</i>	White Root		1	1	1	2	1	1	1	2		1	1		1	
LOGANIACEAE	<i>Mitrasacme alsinoides</i>																✓
MALVACEAE	<i>Sida rhombifolia</i>	Paddys Lucerene	i	1		1	1	1				1					
MENYANTHACEAE	<i>Nymphoides indica</i>	White Marshwort															✓
MENYANTHACEAE	<i>Villarsia reniformis</i>														2		
MORACEAE	<i>Maclura cochinchinensis</i>	Cockspur Thorn															✓
MYOPORACEAE	<i>Eremophila debilis</i>	Winter Apple		1			1		1								
MYRTACEAE	<i>Angophora subvelutina</i>	Broad-leaved Apple															✓
MYRTACEAE	<i>Corymbia henryi</i>	Spotted Gum				4	3	1			4						
MYRTACEAE	<i>Corymbia intermedia</i>	Pink Bloodwood			3				4	3				3		3	
MYRTACEAE	<i>Eucalyptus eugenioides</i>	Thin-leaved Stringybark												1		2	
MYRTACEAE	<i>Eucalyptus fibrosa</i>	Broad-leaf Ironbark							1								
MYRTACEAE	<i>Eucalyptus moluccana</i>	Grey Box		4			3	3			1	3					
MYRTACEAE	<i>Eucalyptus propinqua</i>	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	<i>Eucalyptus seeana</i>	Narrow-leaved Red Gum															✓
MYRTACEAE	<i>Eucalyptus siderophloia</i>	Northern Grey Ironbark			4				1	1				3			
MYRTACEAE	<i>Eucalyptus tereticornis</i>	Forest Red Gum						1		1	1	3	3	1			
MYRTACEAE	<i>Lophostemon suaveolens</i>	Swamp Turpentine								2							
MYRTACEAE	<i>Melaleuca irbyana</i>		t														✓ (Adjacent to site)
OLEACEAE	<i>Jasminum suavissimum</i>																✓
ONAGRACEAE	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>	Water Primrose															✓
OXALIDACEAE	<i>Oxalis perennans</i>			2	1	1		1			1	2	1	1		1	
PLANTAGINACEAE	<i>Plantago debilis</i>	Slender Plantain		2	2		1	2			1	1					
PLANTAGINACEAE	<i>Plantago lanceolata</i>	Plantain	i		1								1				
POLYGALACEAE	<i>Polygala japonica</i>	Dwarf Milkwort								1				1			
POLYGONACEAE	<i>Persicaria decipiens</i>	Slender Knotweed															✓
POLYGONACEAE	<i>Persicaria hydropiper</i>	Water Pepper															✓
POLYGONACEAE	<i>Persicaria strigosa</i>	Spotted Knotweed															✓
RANUNCULACEAE	<i>Ranunculus lappaceus</i>	Common Buttercup															✓
RHAMNACEAE	<i>Alphitonia excelsa</i>	Red Ash		1		1		1	1	1	1			1		1	
RUBIACEAE	<i>Asperula gemella</i>	Twin-leaved Bedstraw		1							2	1		1			
RUBIACEAE	<i>Opercularia diphylla</i>	Stinkweed															✓
RUBIACEAE	<i>Richardia stellaris</i>		i	1													
SCROPHULARIACEAE	<i>Gratiola pedunculata</i>														2		
SCROPHULARIACEAE	<i>Veronica plebeia</i>	Trailing Speedwell			1		1	1	2					1			
SOLANACEAE	<i>Solanum chenopodioides</i>	Whitetip Nightshade	i	1	1	1						1	1				
SOLANACEAE	<i>Solanum prinophyllum</i>	Forest Nightshade		1	1											1	
THYMELEACEAE	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	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	<i>Lantana camara</i>	Lantana	i						1					1			
VERBENACEAE	<i>Verbena bonariensis</i>	Purple Top	i														✓
VERBENACEAE	<i>Verbena rigidus</i>	Creeping Verbena	i														✓
VIOLACEAE	<i>Hybanthus stellarioides</i>			1			1	1	2	1				1		1	
VIOLACEAE	<i>Viola betonicifolia</i>	Showy Violet		1													
ANTHERICACEAE	<i>Arthropodium milleflorum</i>	Vanilla Lily					1	1						1		1	
ANTHERICACEAE	<i>Dichopogon strictus</i>	Chocolate Lily			1	2				1	2		1				
ANTHERICACEAE	<i>Laxmannia gracilis</i>	Grass Wire-lily			1	1			2	1				1			
ANTHERICACEAE	<i>Tricoryne elatior</i>	Yellow Rush-lily		1	1					1						1	
COMMELINACEAE	<i>Commelina cyanea</i>	Scurvy Weed		2	2	2	1	2	1		1			1			
COMMELINACEAE	<i>Murdannia graminea</i>	Grass Lily		1	1	1		2			1						
CYPERACEAE	<i>Carex inversa</i>	Knob Tassel-sedge			1	1		1			1	1	1	2			
CYPERACEAE	<i>Cyperus brevifolius</i>	Mullumbimy Couch							1			1					
CYPERACEAE	<i>Cyperus difformis</i>	Dirty Dora															✓
CYPERACEAE	<i>Cyperus flaccidus</i>	Lax Flat-sedge													1		
CYPERACEAE	<i>Cyperus fulvus</i>	Sticky Sedge		1	1												
CYPERACEAE	<i>Cyperus gracilis</i>	Slender Flat Sedge		3	3	1	2	1			1	1	2	1			
CYPERACEAE	<i>Cyperus haspan</i>														2		
CYPERACEAE	<i>Cyperus polystachyos</i>	Bunchy Flat-sedge					2								2	1	
CYPERACEAE	<i>Cyperus trinervis</i>																✓
CYPERACEAE	<i>Eleocharis acuta</i>	Common Spike-rush															✓
CYPERACEAE	<i>Eleocharis dietrichiana</i>	Spike-rush													1		
CYPERACEAE	<i>Eleocharis equisetina</i>	Spike-rush													3		
CYPERACEAE	<i>Eleocharis gracilis</i>	Slender Spike-rush													3		
CYPERACEAE	<i>Eleocharis sphacelata</i>	Tall Spike-rush															✓
CYPERACEAE	<i>Fimbristylis dichotoma</i>	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	<i>Schoenoplectiella mucronata</i>	Angled Club-rush													2		
CYPERACEAE	<i>Scleria mackaviensis</i>			1		1					1					1	
HYPOXIDACEAE	<i>Hypoxis hygrometrica</i> var. <i>villosisepala</i>	Yellow Weather-grass															✓
JUNCACEAE	<i>Juncus polyanthemus</i>	Many-flowered Rush						1					1				
JUNCACEAE	<i>Juncus prismatocarpus</i>	Branching Rush													2		
JUNCACEAE	<i>Juncus usitatus</i>	Common Rush									1			1			
LOMANDRACEAE	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Mat-rush		1	1			1	2				1	1		1	
LOMANDRACEAE	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	Wattle Mat-rush															✓
LOMANDRACEAE	<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	Spiny Mat-rush															✓
LOMANDRACEAE	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush		1	1												
LUZURIAGACEAE	<i>Eustrephus latifolius</i>	Wombat Berry		2	2	2	2	1	1	1	2						
LUZURIAGACEAE	<i>Geitonoplesium cymosum</i>	Scrambling Lily															✓
ORCHIDACEAE	<i>Spiranthes sinensis</i> var. <i>australis</i>	Austral Ladies Tresses															✓
PHILYDRACEAE	<i>Philydrum lanuginosum</i>	Frogsmouth													3		
PHORMIACEAE	<i>Dianella caerulea</i> var. <i>caerulea</i>	Leafy Blue Flax Lily							1								
PHORMIACEAE	<i>Dianella longifolia</i> var. <i>longifolia</i>	Long-leaf Flax Lily			1				1	1							
PHORMIACEAE	<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax Lily															✓
POACEAE	<i>Alloteropsis semialata</i>	Cockatoo Grass												2			
POACEAE	<i>Andropogon virginicus</i>	Whisky Grass	i						1	1						1	
POACEAE	<i>Aristida benthamii</i>	Three-awned spear grass						2									
POACEAE	<i>Aristida ramosa</i>	Three-awned Spear Grass		3	3	3	3	3			3	2	3	3		3	
POACEAE	<i>Aristida vagans</i>	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	<i>Axonopus compressus</i>	Broad-leaved Carpet Grass	i	3	1	3	3	3	2	3	3	4	4	3	2	3	
POACEAE	<i>Axonopus fissifolius</i>	Narrow-leaved Carpet Grass	i														✓
POACEAE	<i>Bothriochloa macra</i>	Red-leg Grass		2	2	2	3	3	2	2	2	2	3	1		1	
POACEAE	<i>Capillipedium spicigerum</i>	Scented-top Grass								1							
POACEAE	<i>Chloris gayana</i>	Rhodes Grass	i														✓
POACEAE	<i>Chloris ventricosa</i>	Tall Windmill Grass		2	3			2			2	2	2				
POACEAE	<i>Cymbopogon refractus</i>	Barbed Wire Grass		3	3	3	3	3	3	3	3	2	3			3	
POACEAE	<i>Cynodon dactylon</i>	Common Couch				1						1					
POACEAE	<i>Deyeuxia quadriseta</i>	Reed Bent-grass															✓
POACEAE	<i>Dichelachne micrantha</i>	Short-hair Plume Grass			1				1				1	1			
POACEAE	<i>Digitaria didactyla</i>	Queensland Blue Couch										3					
POACEAE	<i>Digitaria diffusa</i>	Open Summer-grass			1		3		1							2	
POACEAE	<i>Digitaria parviflora</i>	Small-flower Finger Grass												1			
POACEAE	<i>Echinopogon caespitosus</i>	Hedgehog Grass					1		2					1		3	
POACEAE	<i>Echinopogon ovatus</i>	Hedgehog Grass															✓
POACEAE	<i>Entolasia marginata</i>	Margined Panic															✓
POACEAE	<i>Entolasia stricta</i>	Wiry Panic							2								
POACEAE	<i>Eragrostis brownii</i>	Brown's Lovegrass		1	1				1	2	2						
POACEAE	<i>Eragrostis curvula</i>	African Lovegrass	i			1											
POACEAE	<i>Eragrostis elongata</i>	Narrow Lovegrass															✓
POACEAE	<i>Eragrostis leptostachya</i>	Paddock Lovegrass		1	1		1	2		1	2	2	2	2		2	
POACEAE	<i>Imperata cylindrica</i>	Blady Grass		3	3	3			3	4	5			4			
POACEAE	<i>Lachnagrostis filiformis</i>	Blown Grass															✓
POACEAE	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass		2		1	2	2	2	2	2	3	3			1	
POACEAE	<i>Oplismenus aemulus</i>	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	<i>Opismenus imbecillis</i>	Narrow-leaf Beard-grass		1							2					1	
POACEAE	<i>Panicum decompositum</i>	Native Millet								1							
POACEAE	<i>Panicum effusum</i>	Hairy Panic															✓
POACEAE	<i>Panicum simile</i>	Two-colour panic							1								
POACEAE	<i>Paspalidium criniforme</i>	Paspalidium		1	1	2	2	1		2		2	1	2	2	1	
POACEAE	<i>Paspalidium distans</i>	Paspalidium															✓
POACEAE	<i>Paspalum dilatatum</i>	Paspalum	i	2	1	2	1		1	2	2	4	2		2	2	
POACEAE	<i>Paspalum distichum</i>	Water Couch													2		
POACEAE	<i>Paspalum orbiculare</i>	Ditch Millet								2							
POACEAE	<i>Paspalum urvillei</i>	Vasey Grass	i														✓
POACEAE	<i>Setaria sphacelata</i>	South African Pigeon Grass	i														✓
POACEAE	<i>Sporobolus africanus</i>	Parramatta Grass	i	2		1	1	1	2		1						
POACEAE	<i>Sporobolus creber</i>	Slender Rats Tail Grass			2			1		2			1	1			
POACEAE	<i>Sporobolus elongatus</i>	Slender Rats Tail Grass															✓
POACEAE	<i>Sporobolus fertilis</i>	Giant Parramatta Grass	i														✓
POACEAE	<i>Stenotaphrum secundatum</i>	Buffalo Grass	i														✓
POACEAE	<i>Themeda australis</i>	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 species²sp. 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 Angiosperm 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		
<i>Platycercus adscitus eximius</i>	Eastern Rosella	P				x													
Cuculidae																			
<i>Cacomantis variolosus</i>	Brush Cuckoo	P	x									x							
Centropodidae																			
<i>Centropus phasianinus</i>	Pheasant Coucal	P	x																
Strigidae																			
<i>Ninox boobook</i>	Southern Boobook	P	x		x														
Podargidae																			
<i>Podargus strigoides</i>	Tawny Frogmouth	P																	
Apodidae																			
<i>Aerodramus terraereginae</i>	White-rumped Swiftlet	P										x							
Alcedinidae																			
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	P	x		x							x							
<i>Todiramphus sanctus</i>	Sacred Kingfisher	P	x	x	x							x				x			
Meropidae																			
<i>Merops ornatus</i>	Rainbow Bee-eater	P, M			x							x							
Climacteridae																			
<i>Climacteris picumnus</i>	Brown Treecreeper	V (TSC Act) / Ecosystem Credit										x						x	
Maluridae																			
<i>Malurus cyaneus</i>	Superb Fairy-wren	P			x	x													
<i>Malurus melanocephalus</i>	Red-backed Fairy-wren	P	x	x	x							x							
Pardalotidae																			
<i>Pardalotus striatus</i>	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	
<i>Gerygone olivacea</i>	White-throated Gerygone	P			x		x											
<i>Acanthiza pusilla</i>	Brown Thornbill	P			x													
Meliphagidae																		
<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	P			x													
<i>Lichenostomus fuscus</i>	Fuscous Honeyeater	P	x	x	x						x							
<i>Manorina melanocephala</i>	Noisy Miner	P							x		x							
<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	P				x	x											
<i>Philemon corniculatus</i>	Noisy Friarbird	P	x	x	x	x					x							
<i>Philemon citreogularis</i>	Little Friarbird	P		x							x							
Petroicidae																		
<i>Microeca fascians</i>	Jacky Winter	P	x				x				x							
<i>Eopsaltria australis</i>	Eastern Yellow Robin	P				x												
Pomatostomidae																		
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V (TSC Act) / Ecosystem Credit	x															x
Pachycephalidae																		
<i>Pachycephala pectoralis</i>	Golden Whistler	P				x												
<i>Pachycephala rufiventris</i>	Rufous Whistler	P			x													
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	P					x											
Dicruridae																		
<i>Rhipidura albiscapa</i>	Grey Fantail	P				x												
<i>Rhipidura leucophrys</i>	Willie Wagtail	P	x		x						x							
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	P, M				x												
<i>Myiagra inquieta</i>	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		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	P	x	x											x				
<i>Coracina tenuirostris</i>	Cicadabird	P		x	x										x	x			
<i>Lalage tricolor</i>	White-winged Triller	P	x																
Artamidae																			
<i>Cracticus nigrogularis</i>	Pied Butcherbird	P	x		x						x				x				
<i>Gymnorhina tibicen</i>	Australian Magpie	P	x	x	x						x				x				
Corvidae																			
<i>Corvus orru</i>	Torresian Crow	P	x	x	x										x				
Motacillidae																			
<i>Anthus australis</i>	Australian Pipit	P										x							
Estrildidae																			
<i>Taeniopygia bichenovii</i>	Double-barred Finch	P									x								x
<i>Neochmia temporalis</i>	Red-browed Finch	P			x						x								
Hirundinidae																			
<i>Petrochelidon nigricans</i>	Tree Martin	P	x			x					x								
Cisticolidae																			
<i>Cisticola exilis</i>	Golden-headed Cisticola	P	x												x				
MAMMALS																			
Dasyuridae																			
<i>Antechinus flavipes</i>	Yellow-footed Antechinus	P	x	x															
<i>Antechinus stuartii</i>	Brown Antechinus	P	x	x															
Phalangeridae																			
<i>Trichosurus vulpecula</i>	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		
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V (TSC Act) / Species Credit			x														
Macropodidae																			
<i>Macropus rufogriseus</i>	Red-necked Wallaby	P	x									x							
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	P	x	x	x		x	x	x	x	x								
Pteropodidae																			
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V (TSC Act & EPBC Act) / Ecosystem Credit	x	x	x	x				x	x								
Molossidae																			
<i>Mormopterus</i> sp. 1*		P																	
<i>Mormopterus</i> sp. 2*		P																	
<i>Tadarida australis</i>	White-striped Freetail-bat	P			x							x							
Vespertilionidae																			
<i>Nyctophilus</i> sp.^		P																	
<i>Miniopterus schreibersii oceanensis</i> *	Eastern Bentwing-bat	V (TSC Act) Ecosystem Credit																	
<i>Miniopterus australis</i>	Little Bentwing-bat	V (TSC Act) / Species Credit										x				x			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	P																	
<i>Chalinolobus nigrogriseus</i> ^	Hoary Wattled Bat	V (TSC Act) Ecosystem Credit																	
<i>Scoteanax rueppellii</i> ^	Greater Broad-nosed Bat	V (TSC Act) Ecosystem Credit																	
<i>Scotorepens orion</i> ^	Eastern Broad-nosed Bat	P																	
<i>Falsistrellus tasmaniensis</i> *	Eastern False Pipistrelle	V (TSC Act) Ecosystem Credit																	
<i>Vespadelus pumilus</i> ^	Eastern Forest Bat	P																	
Muridae																			
<i>Rattus fuscipes</i>	Bush Rat	P	x																
<i>Rattus rattus</i>	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	
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	
Hemiaspis damelii	Grey 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		
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: 18/10/2016

Time: 12:59:11PM

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: 0423535420

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) Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171) Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the NSW North Coast Bioregion, (NR216) Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221) Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244) Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245) Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246) Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250)	Clarence Lowlands 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) Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169) Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171) Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the NSW North Coast Bioregion, (NR216) Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221) Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245) Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246) Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250)	Clarence Lowlands 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) Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171) Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the NSW North Coast Bioregion, (NR216) Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221) Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244) Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245) Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246) Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250)	Clarence Lowlands 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) Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169) Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171) Orange Gum (<i>Eucalyptus bancroftii</i>) open forest of the NSW North Coast Bioregion, (NR216) Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221) Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244) Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245) Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250)	Clarence Lowlands 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 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
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