Appendix 10

Biodiversity Assessment Report – Updated Final Report

Prepared by Biosis Pty Ltd - August 2019

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Brandy Hill Quarry Expansion
Biodiversity Assessment Report

Updated Final Report prepared for Hanson Construction Materials Pty Ltd

8 August 2019

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- NSW Office of Environment and Heritage for access to the BioNet Atlas of NSW Wildlife
- NSW Department of Primary Industries for access to the Threatened and protected species – records viewer

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Glossary

AFD	Australian Faunal Directory
ANZECC	Australian and New Zealand Environment and Conservation Council
APZ	Asset Protection Zone
ARMCANZ	Agriculture and Resources Management Council of Australia and New Zealand
BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BMP	Biodiversity Management Plan
BHQ	Brandy Hill Quarry
BOM	Bureau of Meteorology
CMA	Catchment Management Authority
CBD	Central Business District
CkPoM	Comprehensive Koala Plan of Management
DA	Department Application
DBH	Diameter at Breast Height
DO	Dissolved Oxygen
DoE	Department of the Environment
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DGEARs	Director General Environmental Assessment Requirements now called Secretary's Environmental Assessment Requirements (SEARs)
EC	Electrical Conductivity
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement

EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
GDEs	Groundwater Dependent Ecosystems
GIS	Geographic Information System
GPS	Global Positioning System
HBT	Hollow Bearing Tree
IBRA	Interim Biogeographic Regionalisation for Australia
KTP	Key Threatening Process
LEP	Local Environment Plan
LGA	Local Government Area
LHCREMS	Lower Hunter & Central Coast Regional Environmental Management Strategy
Matters of NES	Matters of National Environmental Significance listed under the EPBC Act
NSW	New South Wales
NV Act	*Native Vegetation Act 2003*
NW Act	*Noxious Weed Act 1993*
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
Project area	The Project area comprises the study area and the current Brandy Hill Quarry working and is the subject of the SSD Project Application
PVP	Property Vegetation Plan
REF	Review of Environmental Factors
RoTAP	Rare or Threatened Australian Plants
SEPP 44	State Environmental Planning Policy No. 44 – Koala Habitat Protection
SIC	Significant Impact Criteria

SIS	Species Impact Statement
SIX	Spatial Information eXchange
SPRAT	Species Profile and Threats Database
SSD	State Significant Development
study area	The study area, defined by the extent of vegetation clearance required to support the Project
Tg value	The ability of a species to respond to improvements in site or habitat values, determined by the Office of Environment and Heritage.
TSC Act	*Threatened Species Conservation Act 1995*
TSPD	*Threatened Species Profile Database*
Vegetation Zone	An area of native vegetation on a development site that is the same PCT and has a similar broad condition state
VIS	Vegetation Information System

Foreword

Biosis Pty Ltd was commissioned to undertake a biodiversity assessment and prepare a Biodiversity Assessment Report (BAR) for the Brandy Hill Extension Project (the Project) which would support the Environmental Impact Statement (EIS) and cover the requirements for the Project as set out by the Director General's Environmental Assessment Requirements (DGEARs) (SSD 5899), issued by DPE on 9 July 2015.

As the development is classified as a controlled action, the Project is also being assessed in accordance with the Bilateral Agreement between the NSW State government and the Commonwealth under section 45 of the Commonwealth EPBC Act relating to environmental assessment.

The EIS, incorporating the BAR, was placed on public exhibition from 10 March to 9 April 2017 with submissions relating to biodiversity received from a range of regulatory agency stakeholders and members of the public.

Hanson was provided the opportunity to respond to submissions by DP&E (13 April 2017), following the exhibition period. The submissions relating to biodiversity identified the requirements to provide additional information regarding:

- The occurrence and extent of Rusty Greenhood *Pterostylis chaetophora* within the Project Area.
- The potential impacts of vegetation removal on Koala *Phascolarctos cinereus* movement corridors and impacts to connectivity.
- Quantification of the number of hollow-bearing trees to be removed.

This Biodiversity Assessment Report (BAR) has been updated since its initial exhibition, and presents the findings of the additional assessments undertaken. Additional assessments undertaken, and presented herein, include:

- Targeted surveys for Rusty Greenhood in accordance with the *NSW Threatened Plant Survey Guidelines* (OEH 2016). Surveys were undertaken on 12 October 2017 by Samuel Luccitti (Biosis) and Belinda Pignone (Hanson) on 13 of October 2017 by Samuel Luccitti, Belinda Pignone and Alejandro Barreto (Biosis). Local flowering of Rusty Greenhood was confirmed prior to survey through a visit to a known population in the vicinity of the study area with OEH officers Steve Lewer and Paul Hellier.
- Investigation of the impacts of vegetation removal on connectivity of Koala habitat and liaising with local experts on the species. Biosis liaised with recognised Koala expert, Steve Phillips and Council Ecologist, to obtain the most up to date information available pertaining to the Koala population(s) within and surrounding the study area. This information was provided in response to submissions.

In October 2018 additional information regarding impacts to Commonwealth Matters of National Environmental Significance (MNES) was requested by the NSW Department of Planning and Environment (DPE) and the NSW Office of Environment and Heritage (OEH), which Biosis initially prepared as a separate addendum to the BAR (Biosis 2019).

In addition, Hanson requested Biosis review the biodiversity credits generated for the Project in light of minor adjustments to the Quarry Site layout and to present the impact in a staged manner consistent with the staging of operations. This information was also provided as a separate addendum report to the BAR.

This final consolidated version of the Brandy Hill Quarry BAR incorporates the additional information provided within the two previous addendums.

It should be noted that Plant Community Type (PCT) *HU591 - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin* has been discontinued from the BioBanking Credit Calculator since the first BAR was prepared. As such, this PCT has been replaced throughout the report with *HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast* (PCT1718).

Summary

Hanson Construction Materials Pty Ltd (Hanson) is seeking approval to expand the existing Brandy Hill Quarry (BHQ), located at 979 Clarence Town Road, Seaham (Figure 1) and increase the rate of production to 1.5 million tonnes per annum (the Project). The Project has been deemed a State Significant Development (SSD) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The existing BHQ is a major local supplier of Rhyodacite hard rock aggregates to the region (Hanson 2012). Currently, the site encompasses 561 hectares across 22 lots of land privately owned by Hanson. The proposed BHQ Expansion Project will increase this area by a further 59.7 hectares.

This Biodiversity Assessment Report (BAR) is being prepared to support Hanson's Environmental Impact Statement (EIS). In line with the Director General's Environmental Assessment Requirements issued on 9 July 2015 the Project is being assessed under the *NSW OEH interim policy on assessing and offsetting biodiversity impacts, State significant development (SSD) and State significant infrastructure (SSI) projects* (OEH 2011) and this report has been prepared in accordance with the NSW BioBanking Assessment Methodology (OEH 2014).

The study area encompasses 53.79 hectares of native vegetation, while the remaining 5.90 hectares within the site consists of waterways (dams) and cleared areas i.e. roads, buildings and carparks located within the Hanson Property Boundary (Figure 1). Also within the Hanson Property Boundary features Deadmans Creek which meanders along the north eastern Project area boundary before its confluence with Williams Creek which flows south and joins the Hunter River.

Ecological values

Key ecological values identified within the study area include:

- Presence of Deadman's Creek, a third order stream, immediately adjacent to but outside the study area, and presence of a first order section of Bartie's Creek within the study area.
- A total of six Plant Community Types (PCTs) covering 53.79 hectares.
- The identification of two threatened ecological communities, including:
  - 0.67 hectares of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
  - 1.67 hectares of Hunter lowland Redgum forest in the Sydney Basin and NSW North Coast Bioregions.
- 51.63 hectares of Koala habitat across the study area.

Recommendations

The primary recommendation measure is for the development to minimise impacts to ecological values outlined above where possible and avoid any impact to surrounding adjoining vegetation. Where vegetation losses are unavoidable for the development offsets are proposed in alignment with the interim policy (OEH 2011).

Project specific recommendations include:

- Development of a Biodiversity Management Plan (BMP) to guide; pre-clearance surveys, onsite management of water, threatened fauna such as Koala, noxious weeds, personnel inductions as well management of other native threatened and non-threatened fauna.

- Vegetated boundaries of the Project area to be clearly fenced off and signed posted to exclude access from personnel or equipment. Exclusion fencing to be discussed during all site inductions and routinely checked by an environmental representative.
- Hanson to develop a strict erosion and sediment control plan for the expansion to ensure that erosion and sediment is contained on site.
- Noxious weeds, Fire weed and Pampas Grass to be sprayed and/or removed and appropriately disposed of in an appropriate waste facility as required by NSW DPI through the Port Stephens Council under the NW Act.
- Where possible, implement a minimum 30 metre buffer to Deadmans creek to the east of the study area.
- Minimise the removal of native vegetation adjacent to waterbodies and watercourses.
- Lighting associated with night works to be directed away from adjoining vegetation (to be retained).
- A Biodiversity Offset Strategy has been prepared and is presented in Section 8. Hanson propose to meet their credit requirements by purchasing and retiring credits under the NSW BioBanking scheme. Upon approval Hanson proposes to fulfil its credit obligations.Undertake additional targeted flora surveys at the appropriate time of year for Rusty Greenhood, within the southern extended Project area shown in Avoidance and mitigation measures.

Hanson has endeavoured to avoid and minimise ecological impacts associated with the proposed Project and assessed the feasibility of using alternative quarry material, sites, extraction boundaries, operating hours and operation. The following recommended measures have been accepted by Hanson and would become commitments under a Project Approval. These measures would be described in a Biodiversity Management Plan for the Project.

Extraction boundary

- Avoid and minimise disturbance of key vegetation communities including;
- Disturbance/extraction boundary excludes Deadmans Creek thereby reducing Project imposed impact on this environment.
- Much of the expansion area is regenerated vegetation which was previously cleared and mapped as closed grassland and open forest (see 1983 EIS).
- Reduction in the impact area from a potential 121 hectare extraction area to 59.69 hectares. This area was refined based on geological and ecological constraints, and in particular the need to provide for an on-site biodiversity offset.
- The impact area was refined to minimise net impacts on flora/fauna.

Expansion

The company has chosen to expand the existing quarry thereby maximising the operating capacity at the current site avoiding the need to develop a greenfield site.

Proposed Mitigation Measures to Minimise Impact

- A Biodiversity Management Plan (BMP) to be prepared to outline the clearance procedure, protocols for Koala finds and incidents and include an educational brochure for all workers to review prior to working at BHQ.

- Ecologist to undertake pre-clearance surveys immediately prior to the removal of any vegetation to give the clearance go ahead.
- Progressive vegetative rehabilitation will be completed using indigenous species.
- Weed, sediment and erosion control will be undertaken.
- Environmental Management Plans/Strategies will be developed and implemented.
- Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on threatened fauna displaced or injured during clearing.
- Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on Koalas displaced or injured during clearing.
- Preparation of a Biodiversity Offset Strategy (BOS) to offset the residual impacts to biodiversity arising from the Project (Section 8, Biosis 2017).
- Fencing around remnant native vegetation.
- Comply and enforce site speed limits.
- Maintain general adherence to constructed site haul roads.

Government legislation and policy

An assessment of the Project against key biodiversity legislation and policy is provided and summarised below (Table 1).

Table 1 Key biodiversity legislation and policy

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required
Environment Protection and Biodiversity Conservation Act 1999	Seven Significant Impact Criteria Assessments were prepared for the following species (Appendix 6): • Small-flower Grevillea • Tall Knotweed • Koala • Grey-headed Flying-fox • Spotted-tail Quoll • Regent Honeyeater • Swift Parrot	These assessments determined that a significant impact was unlikely to result from the Project for all species except the Koala. The Koala has been recorded within the study area. The Project was referred to the Commonwealth department of the Environment and Energy and was declared a controlled action. Further assessments of impacts to MNES under the EPBC Act are provided in section 6.3.
Threatened Species Conservation Act 1995	Two EECs: • Hunter Lowland Redgum Forest • Swamp Sclerophyll Forest on Coastal Floodplains Habitat for the Koala.	The Project has been assessed in accordance with the BioBanking Assessment methodology (BBAM) with offsets provided in accordance with the interim policy (OEH 2011). No further permits or approvals are required.
Fisheries Management Act 1994	No habitat for *Fisheries Management Act 1994* (FM Act). listed species was located within the study area.	No further permits or approvals required.

Legislation / Policy	Relevant ecological feature on site	Permit / Approval required
Noxious Weeds Act 1993	The following noxious weeds are present within the study area: • Fireweed (Class 4) • Pampas Grass (Class 3)	Land owners within the study area have an obligation under the *Noxious Weeds Act 1993* to control all noxious weeds on their land according to the specified control class.

Note: Guidance provided in this report does not constitute legal advice.

Stage 1 – Biodiversity assessment

1 Introduction

1.1 Project background

Hanson Construction Materials Pty Ltd (Hanson) is seeking approval to expand the existing Brandy Hill Quarry (BHQ), located at 979 Clarence Town Road, Seaham, and increase the rate of production to 1.5 million tonnes per annum (the Project). The Project has been deemed a State Significant Development (SSD) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Biosis Pty Ltd was commissioned to undertake a biodiversity assessment and prepare a Biodiversity Assessment Report (BAR) for the Project which would support the Environmental Impact Statement (EIS) and cover the requirements for the Project as set out by the Director General's Environmental Assessment Requirements (DGEARs) (SSD 5899), issued by DPE on 9 July 2015.

1.2 Development proposal

The existing BHQ was approved by Port Stephens Shire Council (Development Application No 1920) on the 22 December 1983. The quarry is a major local supplier of Rhyodacite hard rock aggregates to the region (Hanson 2012). Currently, the site encompasses 561 hectares across 22 lots of land privately owned by Hanson. Of this, 18.6 hectares are occupied by the existing quarry, 11.1 hectares by the plant and 5.3 hectares by the stockpile area.

The proposed BHQ Expansion Project, covering a further 59.70 hectares, will involve:

- Expanding the existing quarry to extract and process up to 1.5 million tonnes of hard rock material a year for 30 years.
- Use of blasting (9 am to 5 pm weekdays), consistent with current operations.
- Constructing and operating additional infrastructure including a concrete batching plant (15,000 m^3 per year), mobile pug mill and pre-coat plant.
- Transporting quarry products off-site and receiving 20,000 tonnes of concrete waste for recycling via public roads.
- Progressive and final rehabilitation.

The study area is subject to the Port Stephens Local Environment Plan 2013 (LEP) and is zoned RU2 Rural Landscape. The Project is permissible under the LEP.

1.3 Site description

The study area is located within the Upper Hunter subregion of the North Coast Interim Biogeographic Regionalisation for Australia (IBRA) bioregion in NSW. The development site is situated on a low ridge on the eastern flank of Brandy Hill, approximately 3.5 kilometres west of Seaham and 175 kilometres north of Sydney (Figure 1).

The BHQ is located north of Clarence Town Road on land owned by Hanson, and includes the following lots:

- Lot 100 DP 712886
- Lot 57 DP 752487
- Lot 20 DP 752487

- Lot 101 DP 712886
- Lot 56 DP 752487
- Lot 59 DP 752487
- Lot 58 DP 752487
- Lot 36 DP 752487
- Lot 236 DP 752487
- Lot 19 DP 752487
- Lot 21 DP 752487
- Lot 1 DP 737844
- Lot 2 DP 737844

The study area, which includes the proposed expansion footprint, is located to the south and west of the existing quarry (Figure 2).

Brandy Hill is an elevated suburb of the Port Stephens Local Government Area (LGA) and primarily consists of large, residential blocks overlooking the lower Hunter River floodplain. The Hunter River forms a prominent feature to the south of the study area and is a major river system in NSW joined by ten tributaries upstream and an additional thirty-one tributaries downstream providing significant flora and fauna habitat for the region.

1.4 Information sources

1.4.1 Publications and databases

In order to provide a context for the study area, information about flora and fauna from within 10 kilometres (the 'locality') was obtained from relevant public databases. Aquatic fauna records were searched from Hunter/Central Rivers Catchment Management Authority (CMA) management area.

Records from the following databases were collated and reviewed:

- Department of Environment and Energy (DoEE) Protected Matters Search Tool for matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- NSW BioNet - the database for the Atlas of NSW Wildlife.
- NSW Department of Primary Industries (DPI) Threatened and protected species – records viewer.
- PlantNET (The Royal Botanic Gardens and Domain Trust 2013) for Rare or Threatened Australian Plants (RoTAP).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2013 (BirdLife Australia 2014).
- Groundwater Dependent Ecosystems Atlas. Australian Government's Bureau of Meteorology (Bureau of Meteorology 2014).
- Noxious weed declarations for Port Stephens Council. NSW Department of Primary Industries (DPI 2014a)

Relevant literature and vegetation mapping were reviewed, including:

- OEH Vegetation Information System (VIS) Mapping through the Spatial Information eXchange (SIX) Vegetation Map Viewer.
- Vegetation Survey, Classification and Mapping, Lower Hunter & Central Coast Regional Biodiversity Conservation (LHCCREMS 2003).
- Plant Community Types for the Hunter-Central Rivers Catchment Management Authority – reviewed via the Spatial Information eXchange (SIX) vegetation Map Viewer.
- Port Stephens Comprehensive Koala Plan of Management (Port Stephens Council 2002).

- Seasonal Threatened Plant Survey Brandy Hill Investigation Area (Anderson Environment & Planning 2013).
- NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002).
- Environmental Impact Statement for a hard rock quarry and processing plant at Brandy Hill near Seaham (Resource Planning 1983).
- Policy and Guidelines - Aquatic Habitat Management and Fish Conservation (DPI 2013a).
- Policy and guidelines for fish habitat conservation and management (DPI 2013b).
- Key Fish Habitat maps: Port Stephens LGA. NSW Department of Primary Industries (DPI 2014b).

1.4.2 Spatial data

Spatial data showing the proposed expansion footprint and existing quarry were supplied by Hanson.

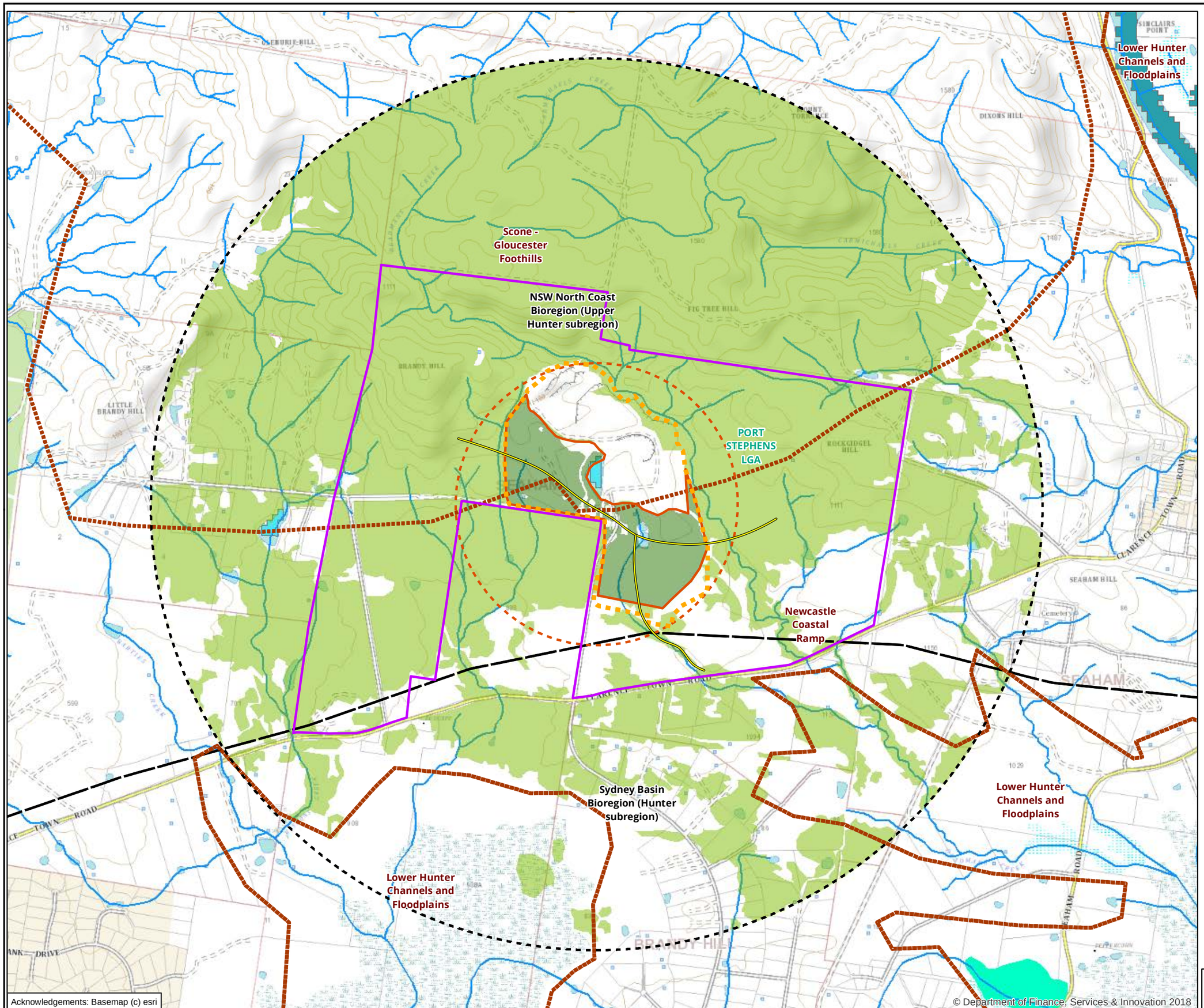
Aerial photography were sourced from NearMap (dated 2019. Mapping was conducted using hand-held (uncorrected) GPS units (GDA94) and aerial photo interpretation of recently captured, high resolution imagery. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

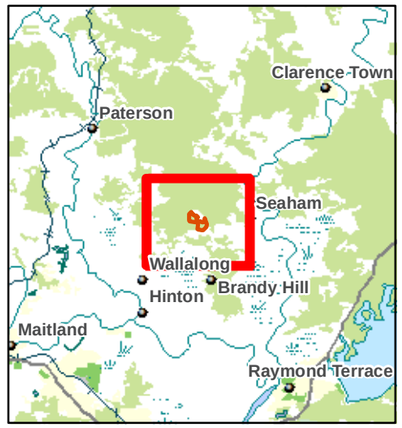
Mapping has been produced using a Geographic Information System (GIS). Electronic GIS files containing the relevant flora and fauna spatial data are available; however this mapping may not be sufficiently precise for detailed design purposes.

1.5 Additional legislative requirements

The Project has been assessed against key biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Fisheries Management Act 1994* (FM Act)
- *Water Management Act 2000* (WM Act)
- *Native Vegetation Act 2003* (NV Act)
- *Noxious Weeds Act 1993* (NW Act)





Legend

- Hanson property boundary
- Study area
- Project area

Assessment circles

- Inner
- Outer

Native vegetation

- Native vegetation (LHCCREMS 2003)
- Native vegetation (Biosis 2016)
- Connective links

Landcsape features

- Mitchell Landscapes
- IBRA Bioregions (and subregions)
- Waterways
- Wetland listed on the DOIW
- SEPP14 Coastal wetlands
- Local Government Area

Figure 1 Location of the study area, Seaham NSW

0 200 400 600 800 1,000

Metres
Scale: 1:20,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 25524
Date: 26 April 2019,
Checked by: RED, Drawn by: LH, Last edited by: lharley
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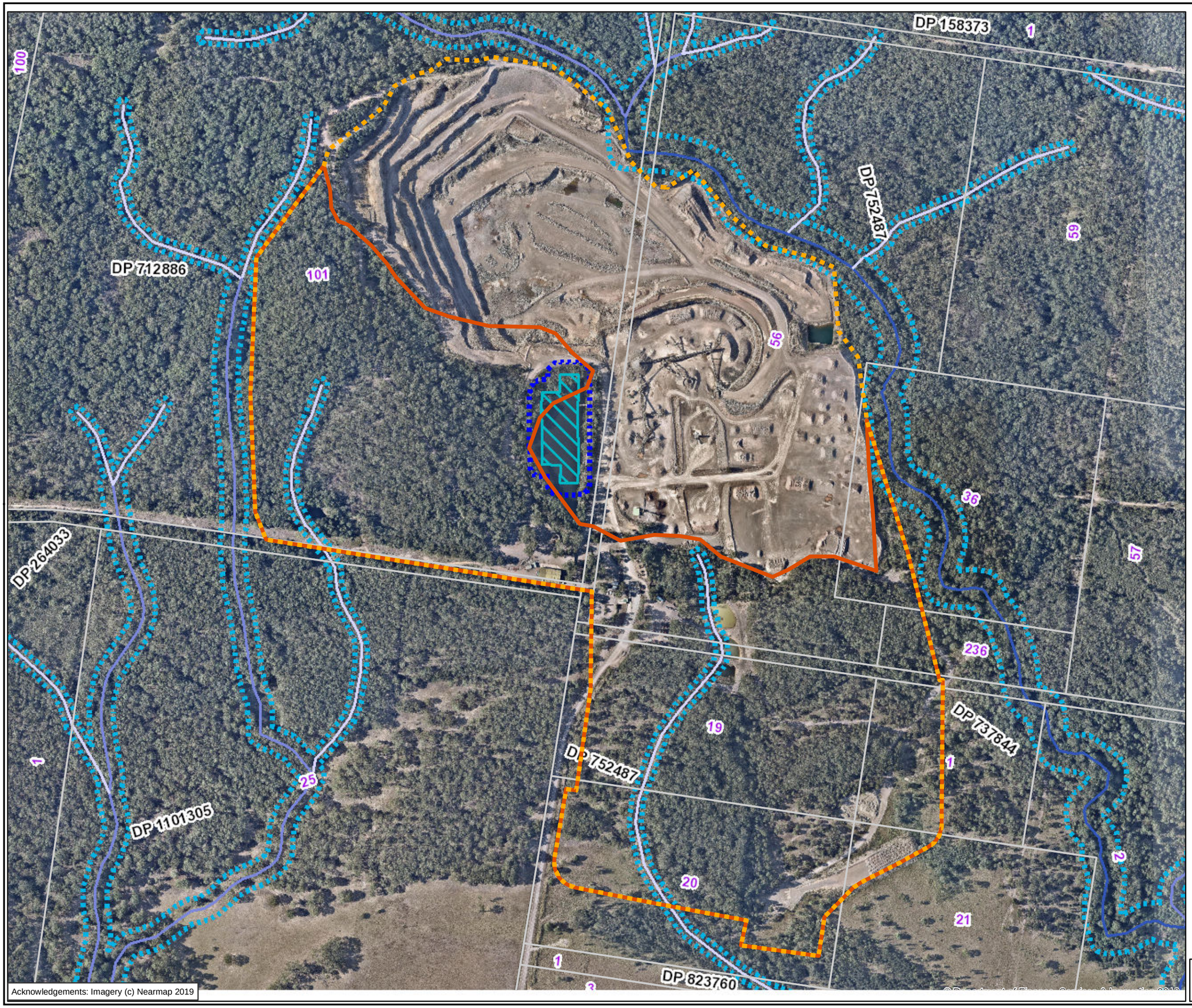


Acknowledgements: Imagery (c) Nearmap 2019

Legend

- Study area
- Project area
- Cadastre

Streams

- 1st Order
- 2nd Order
- 3rd Order
- Stream buffers

Local wetland

- Dam
- Local wetland buffer

Figure 2 Site Map

0 50 100 150 200 250

Metres
Scale: 1:5,800 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 25524
Date: 26 April 2019,
Checked by: ABM, Drawn by: DK, Last edited by: lharley
Location:P:\25500s\25524\Mapping
25524_F2_SiteMap

2 Legislative context

This section provides an overview of key biodiversity legislation and government policy considered in this assessment. Where available, links to further information are provided. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (NES) protected under the Act.

Nine Matters of NES are identified under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (also known as 'Ramsar' wetlands)
- nationally threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on Matters of NES must be referred to the Commonwealth Minister for the Environment for assessment.

Matters of NES relevant to the current Project include nationally threatened species and ecological communities, migratory species and Ramsar wetlands. Threatened communities are discussed in Section 4, while threatened species are outlined in Section 5 and Appendix 5. Ramsar wetlands are considered in Section 3.2. Significant impact criteria (SIC) assessments are provided in Appendix 6.

An assessment of potential impacts to all Matters of NES under the provisions of the EPBC Act, and whether referral of the Project to the Commonwealth Minister for the Environment for assessment is required, is provided in Section 6.3.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DP&E).

The EP&A Act provides the overarching structure for planning in NSW; however is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

Assessment of Significance (Section 5A)

Section 5A of the EP&A Act requires proponents and consent authorities to consider if a development will have a significant effect on threatened species, populations or communities listed under the TSC Act and FM Act. Section 5A (and Section 9A of the TSC Act) outlines seven factors that must be taken into account in an Assessment of Significance (formally known as the "7-part test"). Where any Assessment of Significance (AoS) determines that a development will result in a significant effect to a threatened species, population or community a Species Impact Statement (SIS) is required.

As the Project was assessed in accordance with the BioBanking Assessment Methodology (OEH 2014a), AoS's were not undertaken for the Project.

Local Environment Plans (Part 3 Division 4)

Local Environment Plans (LEP) apply either to the whole, or part of, a Local Government Area and make provision for the protection or utilisation of the environment through zoning of land.

The study area is subject to the Port Stephens LEP and is zoned RU2 Rural Landscape. This zoning provides for:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To maintain the rural landscape character of the land.
- To provide for a range of compatible land uses, including extensive agriculture.

Elements of the LEP objectives are relevant to this assessment and are discussed further in the main EIS.

State Environmental Planning Policies (Part 3 Division 2)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. SEPPs relevant to the current development are discussed below.

State Environmental Planning Policy No 44—Koala Habitat Protection

SEPP 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in councils listed in Schedule 1 to the SEPP.

SEPP 44 does not apply to Projects that are being assessed as SSD. However, SEPP 44 Koala habitat definitions have been used to determine whether potential and/or core Koala habitat areas (as defined under SEPP 44) occur within the study area.

2.2.2 Threatened Species Conservation Act 1995

The TSC Act is the key piece of legislation providing for the protection and conservation of biodiversity in NSW through the listing of threatened species, populations and ecological communities and the declaration and mapping of their critical habitats, as well as the identification of key threatening processes.

The TSC Act also establishes a system for biodiversity certification and establishes the Biodiversity Banking and Offsets Scheme.

Biodiversity Banking and Offsets Scheme

Part 7A of the TSC Act establishes the Biodiversity Banking and Offsets Scheme, which enables the establishment of biodiversity banking sites, the creation and trading of biodiversity credits and the use of credits to offset development otherwise impacting on biodiversity values. Development for which a BioBanking statement is issued is taken to be development that is not likely to significantly affect any threatened species, population or ecological community under this Act, or its habitat.

This assessment was undertaken using the BioBanking Assessment Methodology (OEH 2014a); however, a BioBanking statement is not being sought for the development. As per the input from the NSW Office of Environment and Heritage (OEH) the BioBanking Assessment Methodology has been used to assess the impacts of the Project and to determine required offsets.

Threatened species and communities are discussed in Sections 4 and 5 respectively, with a list of threatened species considered during the assessment and their likelihood of occurrence in the study area provided in Appendix 5. Biodiversity credit requirements are outlined in Section 7.

2.2.3 Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the AoS process under Section 220ZZ of the FM Act and Section 5A of the EP&A Act (see Section2.2.1). There are seven key threatening processes (KTPs) listed under the FM Act.

Two key objectives of the FM Act are to; conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications, Department of Primary Industries (DPI) will assess the likelihood of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS).

Aquatic habitats and threatened species are outlined in Section 5.5. An assessment of the Project against the requirements of the FM Act is provided in Section 9.1.

2.2.4 Native Vegetation Act 2003

The NV Act provides for, encourages and promotes the management of native vegetation on a regional basis and regulates the clearing of native vegetation on land in NSW. Under the NV Act no clearing of native vegetation is allowed except in accordance with prior development consent from the relevant Council or under a Property Vegetation Plan (PVP) approved by the relevant Catchment Management Authority.

The Project is being assessed as SSD under the EP&A Act, and as such the provisions of the NV Act do not apply.

2.2.5 Noxious Weeds Act 1993

The NW Act was enacted to provide for the identification, classification and control of noxious weeds. The NW Act aims to reduce the negative impact of weeds on the economy, community and environment of NSW by:

- Establishing control mechanists to prevent the establishment of significant new weeds in NSW.
- Preventing, eliminating or restricting the spread of particular significant weeds in NSW.
- Effectively managing widespread significant weeds in NSW.

Plants declared as noxious weeds are currently listed under Noxious Weeds (Weed Control) Order 2014 published in the NSW Government Gazette No. 23. The NW Act is supported by a number of regulations and is administered by the DPI. Noxious weeds are discussed further in Section 9.3.

3 Landscape

3.1 Bioregions and landscapes regions

The study area occurs within the North Coast IBRA bioregion and the Upper Hunter IBRA subregion (Figure 1). The Upper Hunter IBRA subregion covers the entire development site and is the subregion used in this assessment. The Hunter IBRA subregion and Sydney Basin IBRA region are located to the south of the study area, and within the inner assessment circle (Figure 1).

The majority of the study area is located within the Newcastle Coastal Ramp Mitchell Landscape and this is the Mitchell Landscape identified in the assessment. The northern portion of the study area is located within the Scone-Gloucester Foothills Mitchell Landscape, while the Lower Hunter Channels and Floodplains Mitchell Landscapes are located to the south of the study area within the outer assessment circle (Figure 1).

3.2 Waterways and wetlands

The study area is located within the Hunter River catchment. The Hunter is the largest coastal catchment in NSW, with an area of about 21,500 square kilometres. Elevations across the catchment vary from over 1,500 metres in the high mountain ranges north of the catchment, to less than 50 metres on the floodplains of the lower valley.

The study area is within the catchment of two local waterways; Deadmans Creek and Barties Creek. Deadmans Creek is a tributary of Williams Creek which flows south to its confluence with the Hunter River approximately 10 kilometres south of the study area. It is located outside of the study area, immediately to the east, where the creek is a third order (Strahler 1957) ephemeral stream flowing from north to south (Figure 1) with a first order tributary of Deadmans Creek located within the eastern section of the study area (Figure 2). The southern downstream portion of Deadmans Creek was flowing during the winter survey (Plate 1); however upstream sections to the north were dry (Plate 2). During the spring survey, the entire creek line was found to be dry, highlighting the ephemeral nature of this minor creek. In the study area, the tributary of Deadmans Creek forms an eroded channel that was dry during the assessment period (Plate 3).

Barties Creek is a tributary of the Hunter River, with the confluence of these two waterways approximately 7 kilometres south of the study area. The headwaters of this waterway are located within and to the west of the study area (Figure 1), with a first order (Strahler 1957) section of the waterway located within the western section of the study area (Figure 2). In the study area this creek is highly ephemeral and was observed to be dry during the survey periods.

Plate 1 **Deadmans Creek adjacent to the study area**

Plate 2 **Deadmans Creek upstream of the study area**

Plate 3 **Deadmans Creek adjacent to the study area**

A large man-made storage dam is located in the centre of the study area. It is bound on all sides by vehicle access roads, with a narrow strip of riparian vegetation. Macrophytes were noted along the edges of the dam which provide breeding and refuge habitat for frogs and fish. Three smaller settlement dams are located to the east of this larger dam.

3.3 Native vegetation extent

In order to encompass the entire impact area, an inner assessment circle of 200 hectares and an outer assessment of 2000 hectares have been used. Vegetation cover is shown in Figure 1 and Table 2.

A large portion of the outer assessment circle to the north of the study area is vegetated, whilst south of Clarence Town Road has been partially cleared. Within the inner assessment circle, the study area contains a number of areas that have been cleared as a part of previous approvals for the Brandy Hill Quarry. These areas include the site office and carpark facility, the workshop and yard, the load inspection area and a number of access roads.

3.4 Assessment of landscape value

Landscape value has been calculated using the method for site-based developments, outlined in Appendix 4 of the BBAM (OEH 2014a).

3.4.1 Assessment of the current extent of native vegetation cover

The amount of native vegetation within the inner and outer assessment circles has been derived from the highest resolution vegetation mapping available. In this instance the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS 2003) mapping was used to determine vegetation extent outside the study area, with irrelevant or exotic vegetation map units discounted. Detailed mapping undertaken for this assessment was used within the study area. The extent of native vegetation shown in Table 2 was derived using GIS.

Table 2 Extent of native vegetation cover before and after development

Assessment Circle	Before Development		After Development	
	Area (ha)	Per cent	Area (ha)	Per cent
Outer assessment circle	1394	70 (66-70)	1340	67 (66-70)
Inner assessment circle	144	72 (71-75)	90	45 (41-45)

3.4.2 Assessment of connectivity value

The study area does not support any of the following:

- An area identified as being part of a state significant biodiversity link.
- A riparian buffer 50 metres either side of a 6th order stream.
- A riparian buffer 50 metres around an important wetland or estuarine area.
- An area identified as being part of a regionally significant biodiversity link.
- A riparian buffer 20 metres either side of a 4th or 5th order stream,

Therefore, the proposed development will not impact on any state significant biodiversity links or regionally significant biodiversity links.

Connectivity is the measure of the degree to which areas of native vegetation are linked to other areas of vegetation. The connectivity value of the study area was assessed in accordance with Appendix 4 of the BBAM. The study area was assessed as being part of two connective links (Figure 1). One connective link runs east to west within the southern portion of the study area and provides connectivity between patches of vegetation to the east and west of the quarry. The connectivity width assessment determined that the most limiting width within this connective link is 340 metres, placing it in the >100-500 metres (wide) linkage width class. A second connective link connects the first connective link to remnant native vegetation to the south of the study area. The most limiting width for this connective link currently occurs outside the study area with a width of approximately 27 metres, placing it in the >5-30 metres (narrow) width class. This is the most limited connective link and was used in the current assessment. It is worth noting that this connective link is transected by Clarencetown Road, south of the quarry, with no connective structures. Following development both connective links will be removed by the Project, reducing the width class to 0-5 metres (very narrow).

Table 3 outlines the linkage condition both before and after development.

Table 3 Connectivity condition classes

Strata	Before Development	After Development
Overstorey condition	PFC at BM	No native overstorey
Midstorey/Ground cover condition	PFC of midstorey/ground cover at BM	No midstorey/groundstorey cover

Based on this assessment the loss of linkage condition/width score is 12.

3.4.3 Assessment of patch size

Patch size was assessed using a Geographic Information System (GIS). All vegetation not defined as low condition and separated by a distance of less than 100 metres (woody vegetation) or less than 30 metres (grasslands) was mapped sequentially using a selection process in ArcGIS software.

Using this method, vegetation within the study area forms part of a large expanse of relatively intact native bushland that extends approximately 14 kilometres north towards the town of Martins Creek. The study area was assessed as having a patch size of > 1001 hectares. All vegetation zones within the study area have a patch size greater than 1000 hectares and therefore sits within the extra large patch size class.

4 Native vegetation

The extent of native vegetation within the study area was determined using Section 5 of the BBAM (OEH 2014a).

General classification of native vegetation in NSW used in this report is based on the Vegetation Information System (VIS) classification. Vegetation communities are separated into Plant Community Types (PCTs) based on the form, floristic composition landscape position, soils and geographical location. Information on the PCTs is accessed through the VIS database which contains all of the information required to positively identify a given community. This system is based on the Keith (2004) system which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type, with vegetation type the finest grouping. Most PCTs have an equivalent vegetation type and both have been referred to in the first instance.

Detailed mapping of vegetation within the study area was undertaken for this assessment. The methodology is outlined in Section 4.1 and results presented in Section 4.2.

4.1 Methods

4.1.1 Site investigation

An initial flora assessment of the study area was undertaken in winter from the 11 to 15 August 2014 by two ecologists. An additional flora assessment was undertaken in spring on the 13 and 14 November 2014 by two ecologists.

Detailed mapping of vegetation communities was undertaken on during the initial assessment with minor revision during the second visit. Vegetation mapping was conducted using hand-held (uncorrected) GPS units and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration. Mapping has been produced using a GIS.

Delineation of PCTs was undertaken by walking the boundaries of these communities. Areas containing dams, sealed roads or no vegetation cover were excluded from the vegetation mapping. Identification of PCTs within the study area was confirmed using descriptions provided in the VIS and through analysis of dominant species.

PCTs were stratified into vegetation zones based on condition (low or moderate/good) and ancillary code (where relevant). Following stratification of vegetation zones, site value was assessed using plot and transect survey data, as per the methodology outlined in Section 5 of the BBAM (OEH 2014a). Surveys included:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes.
- A 20 metre x 20 metre quadrat, nested within the quadrat outlined above, for full floristic survey to determine native plant species richness.

The minimum number of plots/transects per vegetation zone was determined using Table 3 of OEH (2014a). A total of 19 plots/transects were completed within the study area (Figure 3). Spot locations for incidental observations and random meanders (Cropper 1993) were also used to determine the vegetation types present within the study area. The general condition of native vegetation was observed as well as the effects of current seasonal conditions. Notes were made on specific issues such as noxious weed infestations, evidence of management works, current grazing impacts and the regeneration capacity of the vegetation.

A list of flora species was compiled for each vegetation type (Appendix 3). Records of threatened flora species will be submitted to OEH for incorporation into the Atlas of NSW Wildlife.

4.2 Results

4.2.1 Vegetation description

The vegetation of the Project area comprises either grassy, shrub/grassy or shrubby open forest with one swamp forest vegetation community (Table 4).

Table 4 Plant Community Types of the study area and corresponding formation and class (Keith 2004)

Plant community type	Vegetation formation	Vegetation class
HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	Dry Sclerophyll Forest (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	Dry Sclerophyll Forest (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests
HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	Forested Wetlands	Coastal Swamp Forests
HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	Dry Sclerophyll Forest (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests
HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	Forested Wetlands	Coastal Floodplain Wetlands
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)	Wet Sclerophyll Forest (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests

4.2.2 Plant community types

A total of six distinct PCTs were identified in the study area. All native vegetation within the study area was deemed to be in moderate/good condition with all PCTs in the same broad condition. Thus, no ancillary codes were assigned and the six PCTs were identified as individual vegetation zones (Figure 3). A summary of these is provided in Table 5, with a detailed description of each of the identified PCTs in Table 6 to Table 9 below.

In addition to the native PCTs identified two non-vegetated map units were recorded including; *Cleared* and *Water* (Figure 3). The Water map unit is comprised of the man made storage and settlement dams that occur in the central portion of the study area. The Cleared map unit is comprised of access roads, haul roads, carparks and maintenance areas that are devoid of all vegetation.

Table 5 PCT and corresponding vegetation zones mapped within the study area.

Vegetation zone (VZ)	Plant community type	Condition	Ancillary code	Area (ha)
VZ1	HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	Moderate-Good	No ancillary code assigned	22.26
VZ2	HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	Moderate-Good	No ancillary code assigned	25.91
VZ3	HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	Moderate-Good	No ancillary code assigned	0.67
VZ4	HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	Moderate-Good	No ancillary code assigned	1.12
VZ5	HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	Moderate-Good	No ancillary code assigned	1.67
VZ6	HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584).	Moderate-Good	No ancillary code assigned	2.16
TOTAL				53.79

Table 6 Vegetation zone 1 community description

Vegetation zone 1: Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	
PCT ID	1600
Biometric vegetation type ID	HU814
Extent within Project area (hectares)	Approximately 22.26 hectares of HU814 was recorded within the study area, predominantly in the south western portion.
Estimate of percent cleared value of PCT	66%

Description	HU814 is characterized by a canopy of Spotted Gum *Corymbia maculata*, Narrow Leaved Ironbark *Eucalyptus crebra,* Grey Box *Eucalyptus moluccana* and, to a lesser extent, Red Ironbark *Eucalyptus fibrosa* and Forest Red Gum *Eucalyptus tereticornis.* Prickly Leaved Paperbark *Melaleuca nodosa* formed dense thickets through the southern central portion of the study area. Grey Box was more abundant in the eastern portion with Forest Red Gum more prevalent to the west. Where canopy has been historically thinned and cleared in some areas, pockets of derived native grasslands were identified. Given that these areas still meet the threshold of moderate/good condition and these formed small pockets scattered amongst the more intact vegetation, stratification of this vegetation into a separate vegetation zone was not considered appropriate. The shrub strata composition was largely similar to that observed in HU816, with prickly shrubs such as Prickly Beard-heath *Leucopogon juniperinus*, Gorse Bitter Pea *Daviesia ulicifolia*, Prickly Moses *Acacia ulicifolia* and Native Blackthorn *Bursaria spinosa* dominant. Native understory species included Wiry Panic *Entolasia stricta*, Threeawn Speargrass *Aristida vagans*, Forest Hedgehog Grass *Echinopogon ovatus*, Blady Grass *Imperata cylindrica*, Wallaby Grass *Rytidosperma fulva,* Barbed Wire Grass *Cymbopogon refractus,* Weeping Grass *Microlaena stipoides*, Raspwort *Gonocarpus teucrioides*, Leafy Purple-flag *Patersonia glabrata* Spiny-headed Mat-rush *Lomandra longifolia*, Whiteroot *Pratia purpurascens*, Native Geranium *Geranium solanderi*, Kidney Weed, *Goodenia bellidifolia*, Germander *Gonocarpus teucrioides* and *Dianella prunina.*
Vegetation Formation and Class	Dry Sclerophyll Forest (Shrub/grass sub-formation) Hunter-Macleay Dry Sclerophyll Forests
Condition	The community is in moderate/good condition for the purpose of this assessment, and was considered to be in moderate condition overall based on the relatively low level of exotic species recruitment, particularly in the less edge affected areas. At the southern extent of the study area, historic clearing for grazing has led to lower density canopy of lower age class trees. Furthermore, exotic grasses and herbs such as Narrow-leafed Carpet Grass *Axonopus fissifolius*, Scarlet Pimpernel *Anagallis arvensis* and Rhodes Grass *Chloris gayana* were noted.
Justification of evidence used to identify a PCT	The vegetation observed was considered to best fit HU814 based on the co-dominance of Spotted Gum, Narrow-leaved Ironbark Grey Box and Red Ironbark in the canopy, the presence of a suite of characteristic shrub and ground cover species and occurrence on hillslopes.
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed Justification: HU814 was considered to align with the final determination for the EEC Lower Hunter Spotted Gum –Ironbark Forest in the Sydney Basin Bioregion based on the species composition of the canopy, which had a higher influence of Red Ironbark, and the presence of Prickly-leaved Paperbark thickets which are characteristic of the EEC (NSW Scientific Committee 2011a). However, as the study area is located within the North Coast Bioregion it does not align with the final determination of this EEC (NSW Scientific Committee 2011a).

Picture: Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	

Table 7 Vegetation zone 2 community description

Vegetation zone 2: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	
PCT ID	1602
Biometric vegetation type ID	HU816
Extent within Project area (hectares)	Approximately 25.91 ha of HU816 was recorded across the majority of the study area. This PCT extends across the elevated ridges in both the northern and southern section, grading into other Spotted Gum – Ironbark variants on the lower slopes.
Estimate of percent cleared value of PCT	54%
Description	HU816 is characterised by a canopy of Spotted Gum, Narrow-leaved Ironbark and White Mahogany *Eucalyptus acmenoides* which was dominant in a number of locations. Other canopy species were recorded throughout the community; however these three were typically dominant. Other recorded canopy species include White Stringybark *Eucalyptus globoidea*, Sydney Red Gum *Angophora costata*, Red Ironbark and Rough-barked Apple *Angophora floribunda* in the south-eastern portion of the study area and Grey Gum *Eucalyptus punctata* and Grey Ironbark *Eucalyptus siderophloia* in the north-western portion of the study area. Where the influence of exotic species was low, HU816 typically had an open understory of shrubs including Prickly Beard-heath, Gorse Bitter Pea, Prickly Moses, Hickory Wattle *Acacia implexa*, Large Mock-olive *Notelaea longifolia*, Native Blackthorn and Coffee Bush *Breynia oblongifolia.* Native herbs, grasses and graminoids recorded include; Wiry Panic, Brown's Lovegrass *Eragrostis brownii*, Blady Grass, Weeping Grass, Wattle Matt-rush *Lomandra filiformis*, Spiny-headed Mat-rush, Stinkweed *Opercularia diphylla*, Pomax *Pomax umbellata*, Thyme

	Spurge *Phyllanthus hirtellus*, Whiterood and Kidney Weed *Dichondra repens*.
Vegetation Formation and Class	Dry Sclerophyll Forest (Shrub/grass sub-formation) Hunter-Macleay Dry Sclerophyll Forests
Condition	The community is in moderate/good condition for the purpose of this assessment, and was considered to be in moderate condition overall based on the relatively low level of exotic species recruitment. Lantana *Lantana camara* was noted as a problematic weed, forming relatively dense stands in places, particularly in the south-eastern portion of the study area.
Justification of evidence used to identify a PCT	The vegetation observed was considered to best fit HU816 based on the dominance of Spotted Gum and Narrow-leaved Ironbark in the canopy, and the presence of a suite of characteristic shrub and ground cover species.
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed Justification: the VIS database notes that HU816 can form a part of the endangered ecological community (EEC) Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion. However, since the study area is located within the North Coast Bioregion it does not align with the final determination of this EEC (NSW Scientific Committee 2011a).
Picture: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	

Table 8 Vegetation zone 3 community description

Vegetation zone 3: Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	
PCT ID	1718
Biometric vegetation type ID	HU932

Extent within Project area (ha)	Approximately 0.67 ha of HU932 was recorded within the study area, immediately upstream of the three settlement dams in the south-eastern portion of the study area. The patch is bisected by a small drainage channel the flows north to south, into the first settlement dam.
Estimate of percent cleared value of PCT	75%
Description	HU932 was characterized by a canopy of Swamp Oak *Casuarina glauca* and Forest Red Gum with scattered Narrow-leaved Ironbark and White Stringybark on the outer fringes. Prickly-leaved Tea Tree *Melaleuca styphelioides* was characteristic of the midstorey along with Cheese Tree *Glochidion ferdinandi* , Hickory Wattle *Acacia falcata,* Golden Wattle *Acacia longifolia*, Native Blackthorn, Prickly Moses and Hairy Clerodendrum *Clerodendrum tomentosum.* The understory was typically comprised of native grassed forbs and vines including; Wiry Panic Grass, Blady Grass, Two-colour Panic Grass *Panicum simile*, Old Man's Beard *Clematis aristata,* Whiteroot, Wombat Berry *Eustrephus latifolius*, Scrambling Lily *Geitonoplesium cymosum*, Snake vine *Stephania japonica*, Small St John's Wort *Hypericum gramineum*, Indian Pennywort *Centella asiatica* and Common Silkpod *Parsonsia straminea.* Sedges were common throughout the drainage channel with recorded species including Rough Saw-sedge *Gahnia aspera,* Bare Twigrush *Baumea juncea, Eleocharis acuta* and *Schoenoplectus validus.*
Vegetation Formation and Class	Forested Wetlands Coastal Swamp Forests
Condition	HU932 is in moderate to good condition for the purpose of the FBA, and was considered to be in moderate condition overall based on the edge affected nature of the patch. The community was recorded adjacent to the heavily disturbed stockpile area which has allowed recruitment of exotic species within this wetter, more nutrient enriched community. Species recorded include Fireweed *Senecio madagascariensis,* Fleabane *Conyza* sp., Common Sowthistle *Sonchus oleraceus,* Cobbler's Pegs *Bidens pilosa,* Catsear *Hypochaeris radicata* and the grasses Pampas Grass *Cortaderia selloana,* Rhodes Grass and Slender Pigeon Grass *Setaria gracilis.*
Justification of evidence used to identify a PCT	This vegetation community was determined to align with HU932based on the presence of Swamp Oak and Forest Red Gum in the canopy and the dominance of Prickly-leaved Tea Tree in the midstorey. Additionally, the landscape position is consistent with poorly drained sites along creek banks. The patch of HU932 was relatively small and it graded into the HU816 as the soils became drier away from the drainage line. As such species composition shifted towards a higher influence of Ironbarks and Spotted Gum in this transitional zone.
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Endangered Justification: HU932 was considered to align with the final determination for the EEC Swamp Sclerophyll Forest On Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (NSW Scientific Committee 2004). This was based on the species composition of the canopy which had a high influence of Swamp Oak and Forest Red Gum with a dominance of Prickly-leaved Tea Tree in the midstorey and Blady Grass as a ground cover.

Picture: Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	

Table 9 Vegetation zone 4 community description

Vegetation zone 4: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	
PCT ID	1592
Biometric vegetation type ID	HU806
Extent within Project area (ha)	Approximately 1.12 hectares of HU806 was recorded within the study area, along the northern boundary of the south-eastern portion of the study area. This community forms a small patch that adjoins HU816 but that is floristically distinct.
Estimate of percent cleared value of PCT	44%
Description	HU806 was characterized by an overstorey dominated by Red Ironbark with scattered Spotted Gum. Red Ironbark was recorded as an associated canopy species elsewhere in the study area but not at the same abundance that was noted within HU806. Shrub and understory stratum species composition was similar to other grassy woodlands within the study area. Species recorded include Prickly Beard-heath, Prickly-leaved Paperbark, Downy Dodder-laurel *Cassytha pubescens*, Many-flowered Mat-rush *Lomandra multiflora*, Coffee Bush, Wiry Panic, Blady Grass, Threeawn Speargrass, Barbed Wire Gras, Wiry Panic, Blady Grass, Kangaroo Grass *Themeda australis,* Narrow-leaved Geebung *Persoonia linearis*, Sandfly Zieria *Zieria smithii* and Kurrajong *Brachychiton populneus*.
Vegetation Formation and Class	Dry Sclerophyll Forest (Shrub/grass sub-formation) Hunter-Macleay Dry Sclerophyll Forests

Condition	HU806 is in moderate/good condition for the purpose of this assessment, and was considered to be in moderate condition overall based on the edge affected nature of the patch. The community was recorded adjacent to a recently expanded access track along the north-eastern edge of the study area. Exotic species recorded were limited to patches of Lantana scattered throughout.
Justification of evidence used to identify a PCT	The dominance of Red Ironbark in the canopy was the driving factor in the delineation of HU806. Elsewhere in the study area Narrow-leaved Ironbark has been more dominant; however this was far less abundant within this community.
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed Justification: HU806 was considered to align with the final determination for the EEC Lower Hunter Spotted Gum –Ironbark Forest in the Sydney Basin Bioregion based on the species composition of the canopy which had a high influence of Red Ironbark in the canopy and Prickly-leaved Paperbark in the shrub strata. However, as the study area is located within the North Coast Bioregion it does not align with the final determination of this EEC (NSW Scientific Committee 2011a).
Picture: Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	

Table 10 Vegetation zone 5 community description

Vegetation zone 5: Forest Red Gum grassy open forest on floodplains of the lower Hunter	
PCT ID	1598
Biometric vegetation type ID	HU812
Extent within Project area (ha)	Approximately 1.67 hectares of HU812 was recorded within the study area, predominantly fringing the bank of the large dam in the centre of the study area. This community occurred on lower slopes on soils where alluvial deposits are more prevalent.

Estimate of percent cleared value of PCT	Unknown
Description	HU812 was characterized by a tall canopy of Forest Red Gum, Rough-barked Apple and Grey Ironbark with scattered Grey Gum intergrade *Eucalyptus punctata X canaliculata* and Broad-leaved White Mahogany *Eucalyptus umbra.* Species composition of the shrub strata was similar to the grassy woodland communities within the study area, species include; Prickly Beard-heath, Prickly Moses, Dolly Bush *Cassinia aculeata*, Swamp Wattle *Acacia elongata*, Large Mock-olive, Sandfly Zieria, Coffee Bush, Cheese Tree, Native Blackthorn, Narrow-leaved Geebung and Kurrajong. Native grasses were common in the understorey, including Bordered Panic, Wiry Panic and Blady Grass in addition to the native forbs, vines and gaminoids Small-leaf Glycine *Glycine microphylla*, Whiteroot, Wattle Matt-rush, Wombat Berry, *Dianella caerulea* var. *cinerascens* and Water Vine.
Vegetation Formation and Class	Forested Wetlands Coastal Floodplain Wetlands
Condition	HU812 is in moderate to good condition for the purpose of this assessment, and was considered to be in moderate condition overall based on the edge affected nature of the patch. The community was recorded between an existing dam and a haul road leading to the quarry. As such, weed recruitment has led to patches of Lantana scattered throughout.
Justification of evidence used to identify a PCT	This community was considered to be consistent with HU812 based on the species composition, particularly in the canopy, in conjunction with the landscape position on low slopes adjacent to a permanent waterbody.
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Endangered Justification: HU812 was considered to align with the final determination for the EEC Hunter lowland Redgum forest in the Sydney Basin and NSW North Coast Bioregions (NSW Scientific Committee 2002). The justification for this was the dominance of Forest Red Gum in the canopy, in addition to other characteristic species in each stratum. Landscape position attributes were also equivalent, with HU812 occurring on the lower slopes and flats adjacent to a permanent water body.

Picture: Forest Red Gum grassy open forest on floodplains of the lower Hunter	

Table 11 Vegetation zone 6 community description

Vegetation zone 6: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	
PCT ID	1584
Biometric vegetation type ID	HU798
Extent within Project area (ha)	Approximately 2.16 ha of HU798 was recorded within the study area, in the north-western portion. This community was recorded within moist gullies between ridgelines, typically adjacent to ephemeral drainage lines and seepage points.
Estimate of percent cleared value of PCT	42%
Description	HU798 was characterized by a dense canopy of Grey Myrtle *Backhousia myrtifolia* with an understory of mesic shrubs, vines and epiphytes. Emergent sclerophyllous canopy species including White Mahogany, Grey Gum and Spotted Gum were scattered amongst the community. Dominant shrubs included Creek Sandpaper Fig *Ficus coronate*, Large Mock-olive, Cheese Tree, White Supplejack *Ripogonum album*, Willow Bottlebrush *Callistemon salignus,* Rough Fruit Pittosporum *Pittosporum revolutum* and *Myrsine variabilis*. Vines and scramblers were common throughout HU798, with recorded species including Water Vine *Cissus Antarctica*, Lawyer Vine *Smilax australis*, Milk Vine *Marsdenia rostrata,* Giant Water Vine *Cissus hypoglauca*, Settler's Twine *Gymnostachys anceps*, Scrambling Lily and Sweet Morinda *Morinda jasminoides.* The understory also contained a large number of ferns and their allies, including Elkhorn Fern *Platycerium bifurcatum*, Common Maidenhair *Adiantum aethiopicum, Pellaea paradoxa*, Giant Maidenhair *Adiantum formosum,* Rough Maidenhair *Adiantum hispidulum,* Swamp Water Fern

	Blechnum indicum and Prickly Rasp Fern *Doodia aspera.*
Vegetation Formation and Class	Wet Sclerophyll Forest (Grassy sub-formation) Northern Hinterland Wet Sclerophyll Forests
Condition	The community is in moderate/good condition for the purpose of this assessment, and was considered to be in good condition overall based on the low level of exotic species recruitment. The area of HU798 recorded on the western boundary was less edge affected than that recorded closer to the existing quarry on the northern boundary. Species richness was below benchmark, potentially indicating some level of historic disturbance.
Justification of evidence used to identify a PCT	The observed vegetation community was determined to align with this PCT based on the close correlation of the floristics, in conjunction with the landscape position (gullies and lower slopes of the Central and Lower Hunter Valley).
Threatened ecological community	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed Justification: HU798 was assessed against the profile and final determination for the vulnerable ecological community (VEC) Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions. Close consideration of these documents determined that HU798 is not consistent based on the canopy and shrubstorey floristics. Furthermore, the study area is outside of the typical range of this community, which typically occurs further north on the carboniferous sediments of the Barrington footslopes.
Picture: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	

4.2.3 Site value scores

Plots and transect survey data was entered into the BioBanking credit calculator to determine site value scores. Plot and transect survey data is presented in Appendix 2. Current site value for each vegetation zone is outlined in Table 12.

Table 12 Site value scores for all Vegetation Zones.

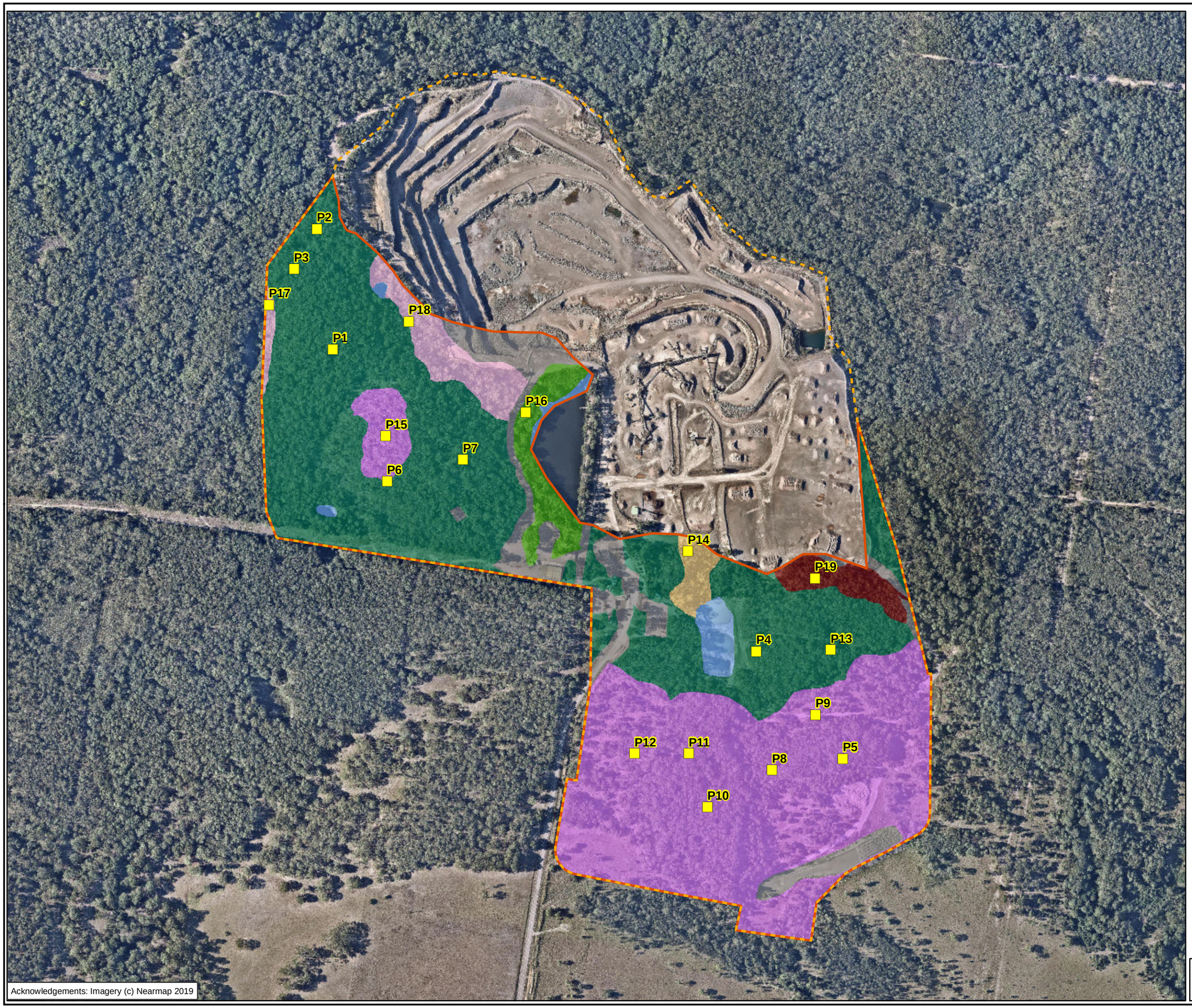
Vegetation zone	Plant community type	Area (ha)	Site score
01	HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	22.26	69.27
02	HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	25.91	69.27
03	HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	0.67	84.67
04	HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	1.12	68.23
05	HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	1.67	81.33
06	HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)	2.16	55.90

4.3 Threatened Ecological Communities

Two endangered ecological communities (EECs) listed under the TSC Act have been identified within the study area, including:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (0.67 hectares).
- Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions (1.67 hectares).

Justification for the determination of these EECs is provided in Table 8 and Table 10 respectively.



Legend

- Study area
- Project area
- Flora plot and transect

Plant Community Types

- VZ1 - HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)
- VZ2 - HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)
- VZ3 - HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT1718)
- VZ4 - HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)
- VZ5 - HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)
- VZ6 - HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)
- Cleared
- Water

Figure 3 Vegetation Zones and BioBanking Plots/Transects

0 60 120 180 240 300

Metres
Scale: 1:6,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 25524
Date: 20 May 2019,
Checked by: ABM, Drawn by: DK, Last edited by: lharley
Location:P:\25500s\25524\Mapping
25524_F3_VegMapping

5 Threatened species

5.1 Methods

Initial flora and fauna assessments of the study area were undertaken in winter from the 11 to 15 August 2014 and in spring on the 13 and 14 November 2014. Additional targeted flora survey was completed on 12 – 13 October 2017.

Targeted surveys included survey within and adjacent to the study area to provide a context for any identified local populations. Targeted survey methods and survey effort are outlined in Appendix 1.

A targeted Koala habitat assessment and survey was undertaken in accordance with the *EPBC Act Referral Guidelines for the vulnerable koala* (DoE 2014) using the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011).

Weather observation for each survey data are shown in Table 13.

Table 13 Weather observations during flora and fauna surveys (Williamtown RAAF)

Survey date	Temperature (°C)		Rain (mm)
	Minimum	Maximum	
11 August 2014	4.6	15.3	0.2
12 August 2014	4.1	16.1	0
13 August 2014	8.8	17.2	0
14 August 2014	3.4	18.0	0
15 August 2014	6.3	18.5	0
13 November 2014	12.9	27.0	0
14 November 2014	14.9	40.1	0
12 October 2017	18.6	32.2	1.6
13 October 2017	12.5	27.9	0.2

5.1.1 Targeted threatened flora survey

Flora surveys have included a variety of survey techniques, including 20 x 20 metre quadrats, BioBanking plots/transect surveys, spot locations, random meanders and parallel transects. Targeted flora survey effort is shown in Figure 4.

The method for undertaking 20 x 20 metre quadrats and plots/transect surveys is outlined in Section 4.1.1. In addition, the site was traversed by random meander and included 14 person days across the entire study area.

Targeted survey for Rusty Greenhood *Pterostylis chaetophora* were undertaken on 12 October 2017 by Samuel Luccitti (Biosis) and Belinda Pignone (Hanson) and on 13 of October 2017 by Samuel Luccitti, Belinda Pignone and Alejandro Barreto (Biosis). Local flowering of Rusty Greenhood was confirmed prior to survey through a visit to a known population in the vicinity of the study area with OEH officers Steve Lewer and Paul Hellier.

Potential Rusty Greenhood habitat was identified based on a review of existing vegetation plot data, desktop review of the extent and topographic position of PCTs within the study area and subsequent field validation by Biosis ecologists. In consultation with OEH Assessment Officer Steve Lewer, a targeted survey plan covering areas of highest habitat potential was developed in accordance with NSW threatened plant survey guidelines (OEH 2016). Targeted surveys consisted of closely spaced (approximate 10 metres) parallel transects through suitable habitat in accordance with *NSW Threatened Plant Survey Guidelines* (OEH 2016).

In March 2019 an extended development footprint was adopted to include an additional area of 6.08 hectares in the southern portion of the study area. At this time an additional survey for Rusty Greenhood could not be undertaken due to the flowering time of the species. It is a recommendation of this BAR that future Conditions of Consent for the Project include additional targeted flora surveys at the appropriate time of the year for Rusty Greenhood in the small additional area immediately within the southern boundary.

5.1.2 Targeted threatened fauna survey

A habitat-based fauna assessment of the study area was undertaken in winter from the 11 to 15 August 2014, with an additional fauna assessment undertaken in spring on the 13 and 14 November 2014, to determine its values for fauna. These values were determined primarily on the basis of the types and qualities of habitat(s) present. All species of fauna observed during the assessment were noted and active searching for fauna was undertaken. This included direct observation, searching under rocks and logs, examination of tracks and scats and identifying calls. Particular attention was given to searching for threatened species and their habitats. Fauna species were recorded with a view to characterising the values of the study area.

Targeted surveys for fauna were undertaken in both August and November 2014, and included a wide variety of survey techniques consistent with the BBAM and the draft NSW *Threatened Biodiversity Survey and Assessment Guidelines* (DECC 2004). Targeted surveys were stratified on the basis of mapped vegetation zones and faunal habitats across the study area. Trap lines were located in the most suitable habitat for fauna (i.e. largest areas of intact forest/woodland with understorey vegetation, shelter habitat etc).

This stratification method was considered adequate to achieve the objective of detecting targeted threatened fauna that may occur within the study area given:

- Trap lines were located in what was determined during initial habitat assessment as the habitat available for these species within the study area.
- The total areas covered by trap lines, spotlighting transects, biobanking transects (which were also diurnal bird survey points) and incidental traverses during the course of 3 surveys were considered to comprehensively assess all fauna habitat available within the study area.

Targeted surveys included survey within and adjacent to the study area to provide a context for any identified local populations given connectivity with larger areas of vegetation. Targeted survey methods and survey effort are outlined in Table 14, with survey locations shown in Figure 4.

Given a known Koala population occurs in the locality, and individuals and scats were located during the winter and spring survey periods, a targeted Koala habitat assessment and survey was undertaken in accordance with the *EPBC Act Referral Guidelines for the vulnerable koala* (DoE 2014) using the Spot Assessment technique (SAT [Phillips and Callaghan 2011]). This assessment report is provided in Appendix 8.

Terrestrial fauna records will be submitted to OEH for incorporation into the NSW BioNet Wildlife Atlas and aquatic fauna records will be submitted to NSW DPI Fisheries.

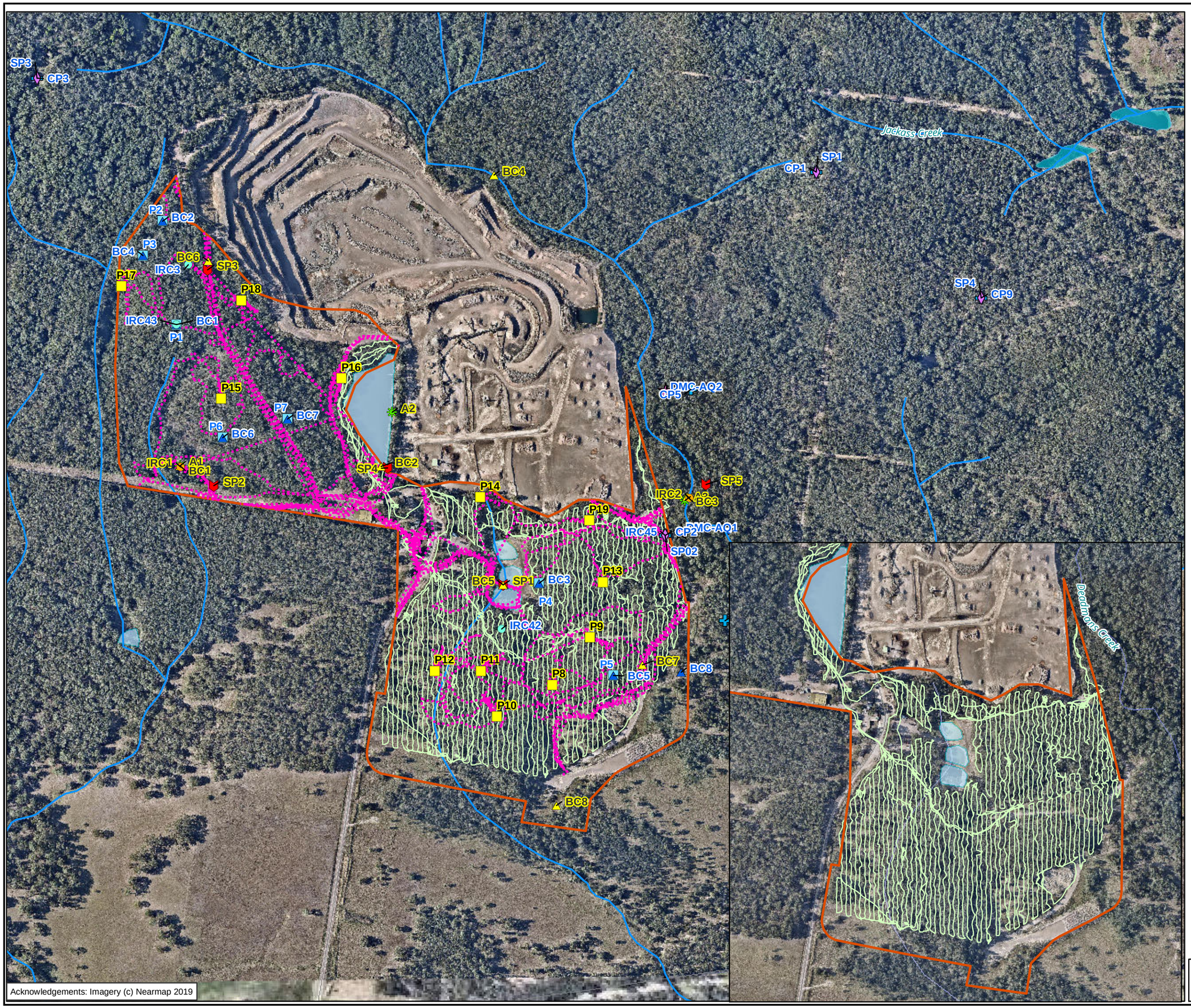
Table 14 Summary of fauna survey effort.

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
Elliot trapping	Brush-tailed Phascogale, Eastern Chestnut Mouse, Eastern Pygmy-possum, Common Planigale	A total of 25 small Elliot traps were placed approximately 10 metres apart along each of three transects, resulting in a total of 300 trap nights (75 traps x four nights). Elliot traps were baited with a mixture of peanut butter, rolled oats and honey.	11 to 15 August 2014	4 nights	In accordance with the recommended survey effort and methods outlined in the Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004).
Motion-triggered cameras	Brush-tailed Phascogale, Eastern Chestnut Mouse, Eastern Pygmy-possum, Common Planigale, Spotted-tailed Quoll	A total of six cameras were deployed for four nights during winter surveys (at each end of three Elliot trapping transects). A total of three cameras were deployed for two nights at various locations within the study area adjacent to dams (two cameras) and ephemeral drainage lines (1 camera). Cameras were baited with chicken carcasses.	11 to 15 August 2014	4 nights	Method used as an ethical alternative to cage trapping in accordance with the recommended survey effort and methods outlined in the Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004).
Diurnal bird surveys	Red-backed Button-quail, Regent Honeyeater, Swift Parrot, White-bellied Sea Eagle, Rainbow Bee-eater	A total of eight locations were surveyed in winter and eight locations (four of which were surveyed on two separate days) were surveyed in spring. Each diurnal bird survey was conducted for 0.5 hours by one ecologist. All birds seen and/or heard were recorded.	11 to 15 August 2014 and 12 to 14 November 2014	8 days	In accordance with the recommended survey effort and methods outlined in the following guidelines: • Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004) • Survey guidelines for Australia's threatened birds (Commonwealth of Australia 2010)

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
Nocturnal fauna surveys	Green and Golden Bell Frog, Barking Owl, Sooty Owl, Masked Owl, Powerful Owl, Bush Stone-curlew, Squirrel Glider, Yellow-bellied Glider, Koala, Spotted-tailed Quoll, Grey-headed Flying fox	Nocturnal fauna surveys consisted of spotlight transects and call playback. Spotlight searches for nocturnal amphibians, reptiles, birds and mammals were carried out along a total of three transects (surveyed from a moving vehicle) and at nine points (surveyed on foot). Spotlighting was undertaken by two ecologists using powerful (maximum 700 lumen) focused-beam hand-held torches. Call playback was employed at a total of 14 separate locations. Call playback involved playing of recorded calls of target threatened fauna species over a period of five minutes through a 10 watt minimum output megaphone. The broadcasting of calls was followed by a five minute listening period. Spotlighting was conducted following the final listening period.	12 and 13 August 2014 and 12 and 13 November 2014	6 nights	In accordance with the recommended survey effort and methods outlined in the following guidelines: • Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004) • Threatened species survey and assessment guidelines: field survey methods – Amphibians (DECC 2009) • Survey guidelines for Australia's threatened amphibians, birds and mammals (Commonwealth of Australia 2010)
Ultrasonic call recording	Microbat species	Calls recorded were then analysed by a qualified and experienced ecologist, using appropriate software and call reference libraries.	12 and 13 November 2014	2 nights	In accordance with the recommended survey effort and methods outlined in the following guidelines: • Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004)

Targeted Koala Surveys	Koala	Surveys were conducted by one ecologist with two field assistants for a maximum of eight hours per day. Points were selected systematically by overlaying a 200 metre interval grid over an aerial image of the study area. The intercept points of the grid were selected as potential survey sites. Potential survey points were discarded if they occurred in cleared land or within the quarry workings. A total of 29 points were surveyed. At each survey point searches for Koala scats within 1 metre of the trunk were undertaken of a central tree and the closest 29 surrounding trees with a diameter at breast height (DBH) for a maximum of two minutes. Each survey site was given a score based on the presence/absence of Koala scats at each tree. A map was then generated using this data showing relative levels of Koala activity as "High", "Medium" and "Low". In addition to scat searches, the central tree and all trees within a 25 metre radius (providing a total search area of 0.125 hectares) were surveyed for individual Koalas for a maximum of 5 minutes. The results of the Koala searches were used to determine a Koala population density estimate for the study area. The timing of the surveys was considered appropriate for detecting both Koalas and signs of Koala activity, as stipulated in the EPBC Act Referral Guidelines for the vulnerable koala (DoE 2014). The targeted survey was guided by key documents: • EPBC Act Referral Guidelines for the vulnerable koala (DoE 2014).	9 to 11 December 2014.	3 days	In accordance with the recommended survey effort and methods outlined in the following guidelines: • EPBC Act referral guidelines for the vulnerable koala (DoE 2014).

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
		• The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus* (Phillips and Callaghan 2011). • DRAFT NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004).			
Hollow-bearing tree and fallen log assessment	Pale-headed Snake	The relative abundance of hollow-bearing trees and fallen logs was obtained from within a total of 19 representative 20 x 50 metre plots across the study area using the BioBanking methodology. This methodology counts the total number of hollow-bearing trees within the plot, where hollows were visible from the ground. Fallen logs were recorded as the total length of logs ≥ 10 centimetre diameter within the plot. Active searching under rocks and logs and in hollows was undertaken to determine if any species were using these habitats.	11 to 15 August 2014 and 13 to 14 November 2014	7 days	In accordance with the BioBanking Assessment Methodology



Acknowledgements: Imagery (c) Nearmap 2019

Legend

Study area

Flora survey effort

Random meanders

Winter flora survey effort

Flora plot and transect

Pterostylis chaetophora survey transects

Spring flora survey effort

Flora plot and transect

Fauna survey effort

Winter fauna survey effort

Bird Census

Call Playback

IR Camera

Spotlight Point

Spring fauna survey effort

Anabat

Bird Census

IR Camera

Spotlight Point

Aquatic survey effort

Aquatic survey locations

Figure 4 Flora and fauna survey effort

0 70 140 210 280 350

Metres

Scale: 1:7,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

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Date: 20 May 2019,
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5.2 Geographic /habitat features

An assessment of the occurrence of geographic habitat features, in accordance with Section 6.3 of the BBAM (OEH 2014a), was undertaken along with a determination of whether impacts to these habitat features will result from the proposed development. The species generated by the calculator, along with the results of this assessment, are outlined in Table 15.

Table 15 Assessment of geographic habitat features within the study area.

Common name	Scientific name	Geographic feature present in study area	Feature	Justification
Green and Golden Bell Frog	*Litoria aurea*	Yes	land within 100 m of emergent aquatic or riparian vegetation	Suitable habitat present. Several permanent dams and Deadmans Creek support emergent and/or riparian vegetation.
Large-eared Pied Bat	*Chalinolobus dwyeri*	No	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	The study area does not support cliffs, caves, deep crevices or mine shafts suitable as roosting habitat for the Large-eared Pied Bat. The species was not recorded during targeted surveys in spring.
Heath Wrinklewort	*Rutidosis heterogama*	No	heath on sandy soils, or moist areas in open forest	The study area does not support heath on sandy soils or most areas in open forest.
Pale-headed Snake	*Hoplocephalus bitorquatus*	Yes	land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	Suitable habitat present. Riparian areas along Deadmans Creek to the east of the study area support hollow-bearing trees, loose bark and fallen timber.
Comb-crested Jacana	*Irediparra gallinacea*	No	land within 40 m of permanent wetlands with a good surface cover of floating vegetation	Although permanent waterbodies are present, these settling ponds do not support a good surface cover of floating vegetation.
Black Bittern	*Ixobrychus flavicollis*	No	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation	The study area does not support permanent wetlands with dense emergent aquatic vegetation

Common name	Scientific name	Geographic feature present in study area	Feature	Justification
Charmhaven Apple	*Angophora inopina*	No	land within 5 km of Wallaroo Nature Reserve in Upper Hunter CM	The study area is not located within 5km of Wallaroo Nature Reserve in Upper Hunter CMA. Not historically recorded within 5 kilometres of the study area.
Rusty Greenhood	*Pterostylis chaetophora*	Yes	land within seasonally moist, dry sclerophyll forest with a grass and shrub understorey.	Suitable habitat present. Several PCTs within the study area are dry sclerophyll forest with a grass and shrub understorey.

5.3 Ecosystem credit species

A list of ecosystem credit species predicted to occur within the study area, based on the PCTs present and generated by the calculator associated with the BBAM (OEH 2014a), along with an assessment of whether they occur within the study area is provided in Table 16. The potential for these species to occur within the study area was assessed in accordance with Section 6.3 of the BBAM (OEH 2014a).

Table 16 Assessment of ecosystem credit species within the study area.

Scientific Name	Common Name	TS offset multiplier	Habitat on site
Ninox connivens	Barking Owl	3	Yes
Melithreptus gularis* subsp. *gularis	Black-chinned Honeyeater (eastern subspecies)	1.3	Yes
Climacteris picumnus subsp. victoriae	Brown Treecreeper (eastern subspecies)	2	Yes
Stagonopleura guttata	Diamond Firetail	1.3	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	2.2	Yes
Mormopterus norfolkensis	Eastern Freetail-bat	2.2	Yes
Petroica phoenicea	Flame Robin	1.3	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo	2	Yes
Calyptorhynchus lathami	Glossy Black-Cockatoo	1.8	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	2.2	Yes
Pomatostomus temporalis* subsp. *temporalis	Grey-crowned Babbler (eastern subspecies)	1.3	Yes
Melanodryas cucullata* subsp. *cucullata	Hooded Robin (south-eastern form)	1.7	Yes
Hieraaetus morphnoides	Little Eagle	1.4	Yes
Glossopsitta pusilla	Little Lorikeet	1.8	Yes
Tyto novaehollandiae	Masked Owl	3	Yes
Ninox strenua	Powerful Owl	3	Yes
Ptilinopus regina	Rose-crowned Fruit-dove	1.3	Yes
Petroica boodang	Scarlet Robin	1.3	Yes
Tyto tenebricosa	Sooty Owl	3	Yes
Chthonicola sagittata	Speckled Warbler	2.6	Yes
Dasyurus maculatus	Spotted-tailed Quoll	2.6	Yes
Petaurus norfolcensis	Squirrel Glider	2.2	Yes
Lathamus discolor	Swift Parrot	1.3	Yes

Scientific Name	Common Name	TS offset multiplier	Habitat on site
Neophema pulchella	Turquoise Parrot	1.8	Yes
Daphoenositta chrysoptera	Varied Sittella	1.3	Yes
Petaurus australis	Yellow-bellied Glider	2.3	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	2.2	Yes

The TS offset multiplier (or Tg value) for ecosystem credit species represents the ability of these species to respond to improvements in site or habitat values. Based on this assessment, all of the predicted ecosystem credit species are considered to have at least one habitat feature present within the study area, therefore the TS offset multipliers for each vegetation zone remain unchanged.

5.4 Species credit species

5.4.1 Flora species

A list of species credit species (flora) predicted to occur within the study area, based on the PCTs present, along with an assessment of whether the study area provides suitable habitat and whether the species will be impacted by the development is provided in Table 17. The potential for a species to occur within the study area was assessed in accordance with Section 6.5 of the NSW BBAM (OEH2014a).

A number of flora species were identified as candidate species for further assessment, in accordance with Section 6.5 of the NSW BBAM (OEH2014a). Targeted surveys for these species carried out as outlined in Section 5.1.No threatened flora species were recorded within the Project Area, however the addition of the extended project area after survey completion warrants additional targeted surveys be undertaken for the Rusty Greenhood, in suitable season and climatic conditions, prior to any vegetation clearance being undertaken in that location.

Table 17 Species credit species (flora) and status within the study area

Common name	Scientific name	Habitat present in the study area	Justification	Recorded during targeted surveys	Impacted by development
Black-eyed Susan	*Tetratheca juncea*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Netted Bottle Brush	*Callistemon linearifolius*	No	Typically occurs in dry sclerophyll shrubby forest on sandstone. This associated vegetation was not present within the study area.	N/A	No
Slaty Red Gum	*Eucalyptus glaucina*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
White-flowered Wax Plant	*Cynanchum elegans*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Rusty Greenhood	*Pterostylis chaetophora*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No

5.4.2 Fauna species

A list of species credit species (fauna) predicted to occur within the study area, based on the PCTs present, along with an assessment of whether the study area provides suitable habitat and whether the species will be impacted by the development is provided in Table 18. The potential for a species to occur within the study area was assessed in accordance with Section 6.5 of the BBAM (OEH 2014a).

A number of fauna species were identified as candidate species for further assessment, in accordance with Section 6.6 of the NSW BBAM (OEH 2014a). Targeted surveys for these species recorded the presence of Koala within the study area (refer to Appendix 8).

Table 18 Species credit species (fauna) and status within the study area

Common name	Scientific name	Habitat present in the study area	Justification	Recorded during targeted surveys	Impacted by development
Brush-tailed Phascogale	*Phascogale tapoatafa*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	No	Suitable habitat in the form of heathlands, wet heath or swamps, does not occur within the study area.	N/A	No
Eastern Pygmy-possum	*Cercartetus nanus*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Golden Tipped Bat	*Kerivoula papuensis*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Green and Golden Bell Frog	*Litoria aurea*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Koala	*Phascolarctos cinereus*	Yes	Species recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	Yes	Yes
Pale-headed Snake	*Hoplocephalus bitorquatus*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No
Red-backed Button-quail	*Turnix maculosus*	No	Suitable habitat in the form of grasslands or grassy woodlands with an open ground layer near water are not present in the study area.	N/A	No
Regent Honeyeater	*Anthochaera phrygia*	Yes	Species not recorded during targeted survey in accordance with Section 6.6 of BBAM (OEH 2014a). No further assessment required.	No	No

5.4.3 Species polygon

The Koala was recorded within the study area during targeted surveys (see Appendix 8) and will be impacted by the Project. A species polygon was created in accordance with Section 6.5.1.19 of BBAM (OEH 2014a).

The Koala species polygon was determined using a combination of the Threatened Species Profile Database (TSPD) and targeted Koala survey results. Any PCTs where the Koala is predicted to occur by the TSPD, or any PCTs where more than 15 percent of the trees at any SAT location are considered Koala feed trees under State Environmental Planning Policy 44 – Koalas and Koala habitat (SEPP) or Port Stephens Council (2002) were mapped as Koala habitat.

The Koala species polygon is shown in Figure 5 and totals 51.63 hectares. This area was used to determine species credit requirements.

5.5 Aquatic habitat and threatened species

5.5.1 Aquatic survey methods

An aquatic habitat assessment (including *in situ* water quality measurement) was undertaken at two sites located along Deadmans Creek, adjacent to and downstream from the study area (Figure 4). The details of each site surveyed and the methods utilised are outlined below and shown in Table 19.

Water Quality Assessments

Water quality sampling was undertaken at two locations adjacent to the study area, one at the upstream extent and one immediately adjacent to the study area. The sampling site locations are outlined in Table 19. Sampling was carried out using a Horiba Multiparameter Water Probe, calibrated prior to sampling. Where possible, measurements were taken between 15 to 30 centimetres below the surface. Variables measured within Deadmans Creek included; pH, dissolved oxygen (DO), temperature, turbidity and electrical conductivity (EC). Water quality sampling provides an insight into current baseline conditions of aquatic habitats and assists in determining the suitability of habitats for fish and other aquatic biota.

Table 19 Water quality site codes and locations

Site Code	Location (decimal degrees)	Site Description
DMC-AQ1	-32.663236, 151.694585	Deadmans Creek at the upstream extent of the study area.
DMC-AQ2	-32.660686, 151.694286	Deadmans Creek alongside the study area.

Stream Order

The Strahler (1957) method was used to determine the stream order of Deadmans Creek flowing adjacent to the study area. The Maitland topographic map 1:25,000 (second edition 9232-4-S) was referred to when calculating stream order using the Strahler method.

HABSCORE

A HABSCORE assessment was completed at Deadmans Creek to provide a measure of the relative health of aquatic habitat. Barbour et al. (1999) describes HABSCORE as a 'visually based habitat assessment that

evaluates the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community'.

HABSCORE assessments utilise visually based habitat characteristics to classify the quality of the water resource and the condition of the resident aquatic community. HABSCORE's range from Poor to Optimal condition and reflect the current category condition of the water resource. Categories are derived from the sum of scores divided by the sum of the characters assessed. This provides an ecological indicator that produces information on the water resources available.

HABSCORE assessments are based on the presence and condition of the following features:

- Pool substrate characterisation.
- Pool variability.
- Channel flow status.
- Bank vegetation (score for each bank).
- Bank stability (score for each bank).
- Width of riparian zone (score for each bank).
- Epifaunal substrate / available cover.

The aquatic habitat within the study area was described in terms of four category types (Fairfull and Witheridge 2003, Barbour et al. 1999). The four categories used to evaluate habitat value were Optimal, Suboptimal, Marginal or Poor, as detailed below:

Optimal: watercourses that contain numerous large, permanent pools and generally have flow connectivity except during prolonged drought. They provide extensive and diverse aquatic habitat for aquatic flora and fauna;

Suboptimal: watercourses that contain some larger permanent and semi-permanent refuge pools, which would persist through prolonged drought although, become greatly reduced in extent. These watercourses should support a relatively diverse array of aquatic biota including some fish, freshwater crayfish and aquatic macroinvertebrates. There may also be some aquatic plant species present;

Marginal: watercourses that contain some small semi-permanent refuge pools which are unlikely to persist through prolonged drought. Flow connectivity would only occur during and following significant rainfall. These pools may provide habitat for some aquatic species including aquatic macroinvertebrates and freshwater crayfish; and,

Poor: water courses or drainages that only flow during and immediately after significant rainfall. Permanent or semi-permanent pools that could provide refuge for aquatic biota during prolonged dry weather are absent.

General observations were also recorded, including water characteristics such as flow rates and colour, the presence of spawning areas (e.g. gravel beds, riparian vegetation, snags), refugia (e.g. deep pools) and presence of natural or artificial barriers to fish passage and the type of existing waterway crossing (roads/culverts) if present.

5.5.2 Aquatic results

Site description

Deadmans Creek is ephemeral in nature and measured approximately two metres in width from bank to bank and 25 centimetres in depth from top of bank at the sampling locations adjacent to the study area. The creek was also assessed approximately 1.5 kilometres upstream of the study area but was found to be dry. The channel contained little in the way of true macrophytes; however large tussocks of Spiny-headed Mat-rush were recorded along the banks and in the channel. The substrate was predominantly sandy with a small amount of gravel and pebble material throughout. Some larger pools were scattered along the creek, however the channel was predominantly shallow with little flow at the time of survey. The riparian vegetation was dense in all strata, with an overstorey per cent foliage cover of approximately 60 per cent. Native Blackthorn formed a dense shrub stratum, with some large infestations of Lantana throughout the riparian corridor. Seasoned snags were uncommon; however, there were some leaf packs and smaller woody debris recorded. Undercut banks and overhanging vegetation provide sheltering habitat for fish, along the majority of the wetted creek.

Plate 4 DMC-AQ1 facing downstream

Plate 5 DMC AQ2 facing upstream

Fish habitat

The aquatic assessment focused on Deadmans Creek, a third order tributary (Strahler 1957) of Williams Creek which flows south to its confluence with the Hunter river approximately 10 kilometres south of the study area. Deadmans Creek is considered to provide Key Fish Habitat as defined by the NSW DPI (2014b) and is classified as a Class 3 minimal fish habitat, being a third order creek sustaining ephemeral flow and semi - permanent pools providing habitat for aquatic species (Fairfull and Witheridge 2003).

Aquatic fauna

Given that the survey effort focused on a habitat-based aquatic assessment, with no targeted surveys, aquatic fauna encounters were limited to incidental observations. As such, no aquatic fauna was recorded during the field survey. However, the survey resulted in general observations on the availability of limited habitat for aquatic fauna. Some shelter and nursery habitat was found to be available in the surveyed reach; however this is considered to be of limited value given the ephemeral nature of the creek. At the time of the spring survey, Deadmans Creek was found to be dry. Further, there were no disconnected pools to provide fish habitat during these drier months.

There are no FM Act listed threatened fish species previously recorded or are predicted to occur within the study area, therefore, a targeted aquatic habitat assessment was not required or undertaken. Instead, a more general habitat assessment was completed to determine any particular aquatic constraints and condition of Deadmans Creek as well as the manmade storage and settlement dams. It is important to note that Deadmans Creek falls outside the expansion area and flow impacts on the stream were already assessed in an aquatic ecological impacts and mitigation advice.

HABSCORE

The habitat features at both the upstream and downstream sampling locations are considered to be Optimal as assessed using the HABSCORE habitat assessment methodology (Barbour et al. 1999). The summary of results for the HABSCORE analysis is shown in Table 20.

Table 20 HABSCORE results for the surveyed reach

Characteristic	Score	
	DMC-AQ1	DMC-AQ2
Low Gradient		
Pool substrate characterisation	17	17
Pool variability	16	12
High and Low Gradient		
Channel Flow Status	16	14
Bank vegetation – Left	9	9
Bank vegetation – Right	8	8
Bank Stability – Left	9	9
Bank Stability – Right	9	9
Width of riparian zone – Left	10	10
Width of riparian zone – Right	9	8
Epifaunal substrate / available cover	17	15
HABSCORE Result	86%	79%
Rating	Optimal	Optimal

1 < 25 – Poor, 26 to 50 – Marginal, 51 to 75 – Suboptimal, >76 – Optimal

High scores were recorded for the majority of parameters at both sampling locations. The riparian vegetation score was high due to the presence of relatively undisturbed remnant bush land to the east of Deadmans Creek (left bank). The banks were generally well vegetated with few areas of bare ground. These well vegetated banks were generally stable with a looser sand substrate causing instability in some areas, particularly where erosion was evident. The pool variability score was lower at DMC-AQ2 where the reach was characterised by shallower sections of slow flow. The presence of some snags and leaf litter in conjunction with some overhanging riparian vegetation provides habitat for epifauna. The pool substrate composition was also generally high owing to the good mix of substrate sizes and the presence of cobble, pebble and gravels at both sites.

Water Quality

The physio-chemical water quality results for this survey are detailed in Table 21. The water quality data is compared with guideline values including ANZECC guidelines for the Protection of Aquatic Ecosystems (ANZECC 2000).

The weather during the survey was seasonally warm and sunny with cool water temperature of around 11 degrees. Oxygenation, turbidity and electrical conductivity levels were found to be within the ANZECC guidelines for lowland rivers. The pH values were within ANZECC guidelines for DMC-AQ1 but very slightly higher for DMC-AQ2.

Table 21 ANZECC guidelines and water quality data for the two assessment sites

Parameter	ANZECC Guideline	DMC-AQ1	DMC-AQ2
Temp (°C)	-	11.15	10.96
pH	6.5 – 8	7.97	8.06
Conductivity (mS/cm)	0.125-2.2	0.897	1.03
D.O. (ppm)	-	11.65	10.17
Saturation (%)	85– 110	109.6	95.2
Turbidity (NTU)	6 – 50	15.9	7.4

The water quality parameters measured provide a snapshot of conditions at a given point in time. Some of these parameters typically exhibit a high degree of temporal variation and can change substantially over small periods of time such as weeks, days and even hours, particularly in response to significant rainfall events. A second replicate of both the water chemistry data and HABSCORE was due to be collected during the spring survey effort; however Deadmans Creek was found to be dry along the entire length of the study area. It is likely that this was due to environmental factors as rainfall was below average for September, October and November.

Stage 2 – Impact assessment (biodiversity values)

6 Impact assessment (biodiversity values)

This section identifies the potential impacts of proposed development on the ecological values of the study area and includes recommendations to assist Hanson to design and construct a development that minimises impacts on biodiversity within and surrounding the study area.

This impact assessment is based on clearing of native vegetation and fauna habitat. It includes an assessment of all potential impacts arising from the Project, during construction and ongoing operation.

6.1 Avoidance and minimisation

6.1.1 Recommendations to avoid, minimise and mitigate impacts

Hanson has endeavoured to avoid and minimise ecological impacts associated with the proposed Project. Hanson has assessed the feasibility of using alternative quarry material, sites, extraction boundaries, operating hours and operation, and has endeavoured to avoid or minimise Project impacts, whilst maximising the economic recovery associated with material extraction. Table 22 outlines the recommended measures to be implemented before, during and after construction to avoid, minimise and mitigate the impacts of the Project, including action, outcome, timing and responsibility.

Table 22 Recommendations to minimise ecological impacts

Ecological Values	Project Impacts	Recommendations / Mitigation Measures	Responsibility
Native vegetation clearance	Removal of 53.79 hectares of native vegetation.	• Biodiversity Management Plan (BMP) to be prepared to outline the clearance procedure. • Pre clearance surveys will be conducted prior to any vegetation clearance in areas of identified threatened species habitat to ensure that threatened species are not present prior to vegetation removal. • Vegetated boundaries of the Project area to be clearly fenced off and signposted to ensure no access from personnel or equipment. • Exclusion fencing to be discussed during all site inductions. • Exclusion fencing to be routinely checked by quarry personnel. • Exclusion fence footings to be free of stockpiles soils and vegetation to allow routine checks and to ensure that the boundary fence and adjoining vegetation e.g. root zones of trees to be retained does not get smothered with soil. • A Biodiversity Offset Strategy has been prepared to offset the residual impacts to biodiversity arising from the Project (Section 8).	Environmental representative Project Ecologist
Impacts to Threatened Ecological Communities and threatened species habitat	• Removal of 0.67 hectares of Swamp Sclerophyll Forest. • Removal of 1.67 hectares of Hunter Lowland Redgum Forest. • Removal of 51.63 hectares of Koala habitat.	• BMP to be prepared to outline measures to avoid or mitigate impacts to EECs. • Pre clearance surveys will be conducted prior to any vegetation clearance to confirm presence/absence of EEC's prior to removal • A Biodiversity Offset Strategy has been prepared to offset the residual impacts to biodiversity arising from the Project (Section 8).	Environmental representative Project Ecologist
Adjoining vegetation and waterways	Erosion and sedimentation	• Hanson to develop a strict erosion and sediment control plan for the expansion to ensure that erosion and sediment is contained on site. • Sediment fencing to be placed inside the exclusion fencing and routinely checked for sediment breeches and to ensure structural integrity is maintained through vegetation clearance activities.	Environmental representative

Ecological Values	Project Impacts	Recommendations / Mitigation Measures	Responsibility
Koala	Displacement, loss of habitat and fatality of Koalas during construction and operation.	• BMP to be prepared to outline the clearance procedure, protocols for Koala finds and incidents and include an educational brochure for all workers to review prior to working at BHQ. • Ecologist to undertake pre-clearance surveys immediately prior to the removal of any vegetation to give the clearance go ahead. • Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on Koalas displaced or injured during clearing. • A Biodiversity Offset Strategy has been prepared to offset the residual impacts to biodiversity arising from the Project (Section 8). • Fencing around remnant native vegetation. • Comply and enforce site speed limits. • Maintain general adherence to constructed site haul roads.	Environmental representative/Project Ecologist
Threatened fauna	Displacement, loss of habitat and fatality of threatened fauna during construction and operation.	• BMP to be prepared to outline the clearance procedure, protocols for threatened fauna finds and incidents and include an educational brochure for all workers to review prior to working at BHQ. • Ecologist to undertake pre-clearance surveys in accordance with the BMP immediately prior to the removal of any vegetation to give the clearance go ahead. • Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on threatened fauna displaced or injured during clearing. • A Biodiversity Offset Strategy has been prepared to offset the residual impacts to biodiversity arising from the Project (Section 8).	Environmental representative Project Ecologist
Threatened Flora	Potential loss of habitat and destruction of Rusty Greenhood during construction and operation.	• Undertake targeted flora surveys at the appropriate time of year for Rusty Greenhood, within the extended Project area, potential to incorporate into project Conditions of Consent. • Undertake preclearance surveys for flora within the extended Project area, potential to incorporate into project Conditions of Consent.	Environmental representative Project Ecologist

Ecological Values	Project Impacts	Recommendations / Mitigation Measures	Responsibility
Pests and pathogens	Spread of noxious weeds due to soil disturbance and equipment movement. Spread of pathogens to adjoining native vegetation or fauna.	• Noxious weeds, including Fire weed and Pampas Grass recorded within vegetation clearance areas to be removed and management outlined in a BMP. These noxious weeds must be removed and appropriately disposed of in an appropriate waste facility as required by NSW DPI through the Port Stephens Council under the NW Act. • BMP to outline pathogen management controls associated with vehicle movements and vegetation clearance	Environmental representative
In stream / aquatic habitat	Loss of, or alterations to, aquatic / in-stream habitat within and in the vicinity of the study area via hydrological change, deterioration in water quality, sedimentation and creation of threatened barriers to fish and other aquatic biota. Changes to aquatic fauna community structures due to alterations degradation/loss of riparian and in stream habitat.	• Within a relevant management plan, develop water management actions to prevent or mitigate the discharge of contaminated water arising from increased quarrying operations and manage potential water quality associated with new infrastructure. • Where possible, implement a minimum 30 metre buffer to Deadmans creek to the east of the study area. • Minimise the removal of native vegetation adjacent to waterbodies and watercourses. The existing dams to be developed would be excluded.	Environmental representative
Water quality downstream	Downstream impacts to the Hunter River.	• It is recommended for the appropriate plan for the site to include water quality management strategies in accordance with the ANZECC and ARMCANZ Guidelines (2000). • Water quality management strategies to cover management of water storage, dewatering and discharge of water to Deadmans Creek.	Environmental representative
Adjoining vegetation and fauna	24-hour operation causing noise, dust, vibration and lighting impact	• Lighting associated with night works to be directed away from adjoining vegetation. • Heavy vehicle/machinery use to be limited to standard hours of operation as per Project Approval conditions.	Environmental representative

6.1.2 The final Project footprint (impact area) is the entire study area, as shown in

6.1.3 Residual impacts

Following the implementation of the aforementioned mitigation measures, the residual impacts to biodiversity include:

- The removal of 53.79 hectares of native vegetation.
- The permanent removal of 1.67 hectares of HU812 – Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598), equivalent to Hunter Lowland Redgum Forest EEC (TSC Act only).
- The permanent removal of 0.67 hectares of HU932- Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718), equivalent to Swamp Sclerophyll Forest on Coastal EEC (TSC Act).
- Removal of 51.63 hectares of Koala habitat.

6.2 Impact summary

6.2.1 Impact to Red Flag areas

This section identifies red flag areas in accordance with Section 9.2 of the NSW Biobanking Assessment Methodology (OEH 0214). Red flag areas are mapped in Figure 5.

Landscape features

The study area does not support any 4th, 5th or 6th order streams, estuarine areas, important wetlands, or state or regional biodiversity links.

Native vegetation

HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718) and HU812 – Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598) have been mapped within the study area. HU932 and HU812 are equivalent to Swamp Sclerophyll Forest on Coastal Floodplain Forest and Hunter Lowland Redgum Forest respectively and both TECs under the TSC Act. Furthermore these PCTs are estimated to be more than 70 per cent cleared within the Hunter/Central Rivers CMA and are therefore eligible for red flag status for both of these criteria.

No other PCTs are considered red flags.

Threatened species and populations

The study area does not support threatened species or populations that cannot withstand further loss, a threatened species not previously recorded in the IBRA subregion or critical habitat listed under Section 55 of the TSC Act.

6.2.2 Highly cleared vegetation types

The BBAM defined highly cleared vegetation types as any PCT that is more than 90 per cent cleared within the relevant major catchment area. All PCTs identified on site are less than 75 per cent cleared within Hunter/Central Rivers major catchment area, therefore the Project will not impact on any highly cleared vegetation types.

6.2.3 Impacts to Plant Community Types

This section provides an assessment of PCTs requiring offsets in accordance with Section 9.3 of the BBAM (OEH2014a). PCTs requiring offsets are mapped in Figure 5. Six Management Zones (identical to the Vegetation Zones) have been delineated (Table 23), based on the PCT, condition and future land use.

Table 23 Impacts to Plant Community Types, including Management Zones

Management zone	Vegetation zone	Total area (ha)	Plant Community Type	Condition	Ancillary code
MZ01	1	22.26	HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	Moderate/ Good	No ancillary code assigned
MZ02	2	25.91	HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	Moderate/ Good	No ancillary code assigned
MZ03	3	0.67	HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	Moderate/ Good	No ancillary code assigned
MZ04	4	1.12	HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	Moderate/ Good	No ancillary code assigned
MZ05	5	1.67	HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	Moderate/ Good	No ancillary code assigned
MZ06	6	2.16	HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584).	Moderate/ Good	No ancillary code assigned

All vegetation within the development site and associated management zones (Figure 5) will be cleared, with all site attribute scores set to 0 to represent total loss.

6.2.4 Impacts to threatened species

This section provides an assessment of threatened species requiring offsets in accordance with Section 9.3 of the BBAM (OEH2014a).

Based on the outcomes of Section 5.4, offsets are required for loss of 51.63 hectares of known habitat for Koala. The quantum of credits is outlined in Section 7. No other threatened species were determined to require offsets.

6.2.5 Areas not requiring assessment

This section provides an assessment of those areas that do not require an offset in accordance with Section 9.4 of BBAM (OEH 2014a). These areas include the following:

- Cleared areas that have been subject to varying levels of disturbance.
- Water bodies are considered areas not requiring assessment.
- These areas are shown in Figure 5 and do not require further assessment.

6.3 Assessment of Matters of National Environmental Significance (MNES)

This section provides detail on the assessment of MNES relevant to this project. There were no ecological communities listed as MNES recorded within the study area. Threatened species are addressed in Section 6.3.1.

6.3.1 Threatened species

Targeted surveys for threatened species included survey within and adjacent to the study area to provide a context for any identified local populations. Targeted survey methods and survey effort for MNES are outlined in Table 14. A targeted Koala habitat assessment and survey was undertaken in accordance with the *EPBC Act Referral Guidelines for the vulnerable koala* (DoE 2014) using the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011).

A list of MNES species predicted to occur within the study area, based on the PCTs present, along with an assessment of whether the study area provides suitable habitat is provided in Table 3.

An assessment of the significance of impacts to MNES is provided Appendix 6.

Table 24 Summary of fauna survey effort

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
Motion-triggered cameras	Spotted-tailed Quoll	A total of six cameras were deployed for four nights during winter surveys (at each end of three Elliot trapping transects). A total of three cameras were deployed for two nights at various locations within the study area adjacent to dams (two cameras) and ephemeral drainage lines (1 camera). Cameras were baited with chicken carcasses.	11 to 15 August 2014	4 nights	Method used as an ethical alternative to cage trapping in accordance with the recommended survey effort and methods outlined in the Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004).
Diurnal bird surveys	Swift Parrot, Regent Honeyeater, White-bellied Sea Eagle, Rainbow Bee-eater	A total of eight locations were surveyed in winter and eight locations (four of which were surveyed on two separate days) were surveyed in spring. Each diurnal bird survey was conducted for 0.5 hours by one ecologist. All birds seen and/or heard were recorded.	11 to 15 August 2014 and 12 to 14 November 2014	8 days	In accordance with the recommended survey effort and methods outlined in the following guidelines: • Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004) • Survey guidelines for Australia's threatened birds (Commonwealth of Australia 2010)

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
Nocturnal fauna surveys	Koala, Spotted-tailed Quoll, Grey-headed Flying fox	Nocturnal fauna surveys consisted of spotlight transects and call playback. Spotlight searches for nocturnal amphibians, reptiles, birds and mammals were carried out along a total of three transects (surveyed from a moving vehicle) and at nine points (surveyed on foot). Spotlighting was undertaken by two ecologists using powerful (maximum 700 lumen) focused-beam hand-held torches. Call playback was employed at a total of 14 separate locations. Call playback involved playing of recorded calls of target threatened fauna species over a period of five minutes through a 10 watt minimum output megaphone. The broadcasting of calls was followed by a five minute listening period. Spotlighting was conducted following the final listening period.	12 and 13 August 2014 and 12 and 13 November 2014	6 nights	In accordance with the recommended survey effort and methods outlined in the following guidelines: • Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004) • Survey guidelines for Australia's threatened amphibians, birds and mammals (Commonwealth of Australia 2010)
Targeted Koala Surveys	Koala	Surveys were conducted by one ecologist with two field assistants for a maximum of eight hours per day. Points were selected systematically by overlaying a 200 metre interval grid over an aerial image of the study area. The intercept points of the grid were selected as potential survey sites. Potential survey points were discarded if they occurred in cleared land or within the quarry workings. A total of 29 points were surveyed. At each survey point searches for Koala scats within 1 metre of the trunk were undertaken of a central tree and the closest 29 surrounding trees with a diameter at breast height (DBH) for a maximum of two minutes. Each survey site was	9 to 11 December 2014.	3 days	In accordance with the recommended survey effort and methods outlined in the following guidelines: • EPBC Act referral guidelines for the vulnerable Koala (DoE 2014).

Survey method	Target species	Description of survey methodology	Date	Survey effort	Adequacy against relevant guidelines
		given a score based on the presence/absence of Koala scats at each tree. A map was then generated using this data showing relative levels of Koala activity as "High", "Medium" and "Low". In addition to scat searches, the central tree and all trees within a 25 metre radius (providing a total search area of 0.125 hectares) were surveyed for individual Koalas for a maximum of 5 minutes. The results of the Koala searches were used to determine a Koala population density estimate for the study area. The timing of the surveys was considered appropriate for detecting both Koalas and signs of Koala activity, as stipulated in the EPBC Act Referral Guidelines for the vulnerable koala (DoE 2014). The targeted survey was guided by key documents: • EPBC Act Referral Guidelines for the vulnerable koala (DoE 2014). • The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus* (Phillips and Callaghan 2011). • DRAFT NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004).			

Table 25 Threatened fauna and EPBC Act status within the study area

Common name	Scientific name	Migratory Species	Habitat present in the study area	Suitable habitat within the study area	Recorded during targeted surveys
Koala	*Phascolarctos cinereus*	No	Yes	Most of the vegetation of the study area (51.63 ha) consists of Koala habitat, with the exemption of 2.16 ha of HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584).	Yes
Grey-headed Flying fox	*Pteropus poliocephalus*	No	No	Despite one individual recorded within the study area and the foraging potential of the study area for the species, the absence of Grey-headed flying-fox camps within the study area make the Project unlikely to require referral under the EPBC Act in accordance with the Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps (DoE 2015).	Yes
Spotted-tailed Quoll	*Dasyurus maculatus*	No	No	Despite the foraging potential of the study area, no Spotted-tail quoll individuals were recorded during targeted surveys in accordance with the *Australia's threatened mammals EPBC Act survey guidelines 6.5* (DSEWPaC 2011). Therefore, the species is not considered present within the study area and is unlikely to require referral under the EPBC Act.	No
Regent Honeyeater	*Anthochaera phrygia*	Yes	Yes	53.79 hectares of native vegetation communities with high abundance of Spotted Gum *Corymbia maculata* within the study area are considered to be Regent Honeyeater foraging habitat.	No
Swift Parrot	*Lathamus discolor*	Yes	Yes	53.79 hectares of native vegetation communities with high abundance of Spotted Gum and Forest Red Gum *Eucalyptus tereticornis* within the study area are considered to be Swift Parrot foraging habitat.	No

Table 26 Direct, indirect, cumulative and consequential impacts relevant to Matters of National Environmental Significance (MNES)

MNES	Direct impacts	Indirect impacts	Cumulative and consequential impacts	Discussion
Koala	51.63 hectares of habitat.	Potential loss of habitat due to erosion and sedimentation of adjoining native vegetation and waterways; Increase in noise, vibration and light pollution on the boundaries of the adjoining vegetation.	• Long term reduction and fragmentation of koala habitat within the locality. • Increase of vehicular traffic may lead to an increase in Koala collisions. Increased risk of pathogen exposure (*Chlamydia, retrovirus*) through transport of invertebrate vectors or livestock carrying the Chlamydia pathogens.	Based on these impacts and confirmed presence of Koala during targeted surveys (Biosis 2017) it is likely that Koalas will be significantly impacted by the Project and as such, a Referral under the provisions of the EPBC Act was submitted for this species.
Grey-headed Flying-fox	No direct impact on existing camps.	Increase in noise, vibration and light pollution on the boundaries of the study area could deter migrating Grey-headed Flying-fox to setup roosting or breeding camps in the surrounding area.	• Reduction of foraging habitat in the locality.	Since no Grey-headed flying-fox camps were identified within the study area, the Project is unlikely to require further assessment in accordance with the Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps (DoE 2015).

MNES	Direct impacts	Indirect impacts	Cumulative and consequential impacts	Discussion
Spotted Tailed Quoll	No direct impact on Spotted Tailed Quoll populations.	• Erosion and sedimentation of adjoining native vegetation could impact key habitat features for the species such as gullies, rocky outcrops and vegetation densities in adjacent areas. • Increase in noise, vibration and light pollution on the boundaries of the study area could disrupt the nocturnal cycles and foraging patterns of the species (DoE 2019b).	• Reduction and fragmentation of Spotted Tailed Quoll potential habitat within the locality (DoE 2019b). • Reduction of potential Spotted Tailed Quoll habitat features such as forested areas with hollow logs and rocky outcrops, as well as areas with thick understorey or dense vegetation along drainage lines (DoE 2019b).	The Project will result in a 3% reduction of the native vegetation extent within the 2000 hectares around the study area (Biosis 2017). Given the species was not recorded within the study area, the highly mobile nature of the species and the availability of other suitable habitat within the broader area (DoE 2015e), the Spotted-tailed Quoll is not considered to be present in the study area in accordance with survey guidelines (DSEWPaC 2011). Therefore, the species is unlikely to be significantly impacted by the Project.
Swift Parrot	53.79 hectares of Swift Parrot foraging habitat	Increase in noise, vibration and light pollution on the boundaries of the subject land could disturb roosting and feeding behaviour of the species (Threatened Species Scientific Committee 2016).	• Long term reduction and fragmentation of Swift Parrot potential foraging habitat within the locality (Biosis 2017). • Reduction of Swift Parrot potential foraging habitat such as dry sclerophyll eucalypt forests and woodlands in New South Wales (DoE 2019d).	The project would result in the removal of 53.79 hectares of Swift Parrot potential foraging habitat. Since the species is a highly mobile blossom nomad with its breeding limited to Tasmania (DoE 2019d), the Swift Parrot is unlikely to be significantly impacted by the Project.
Regent Honeyeater	53.79 hectares of Regent Honeyeater foraging habitat	Increase in noise, vibration and light pollution on the boundaries of the subject land could disturbed migratory and foraging behaviour of the species (DoE 2015f).	• Long term reduction and fragmentation of Regent Honeyeater foraging habitat within the locality (Biosis 2017). • Reduction of Regent Honeyeater foraging habitat features such as nectar from a wide range of *Eucalyptus* species and mistletoes (DoE 2015f).	The project would result in the removal of 53.79 hectares of Regent Honeyeater foraging habitat. Since key breeding habitat is not present (identified in DoE 2016a) , the species is highly nomadic and the closest record of the Regent Honeyeater is located

MNES	Direct impacts	Indirect impacts	Cumulative and consequential impacts	Discussion
				approximately 4.5 kilometres from the study area, Regent Honeyeater is unlikely to be significantly impacted by the Project.

The expansion of the existing Brandy Hill Quarry (BHQ) will involve:

- Direct impact and removal of:
  - 53.79 hectares of native vegetation.
  - 53.79 hectares of Swift Parrot foraging habitat.
  - 53.79 hectares of Regent Honeyeater foraging habitat.
  - 51.63 hectares of Koala habitat.

A detailed description of the nature and scale of the impact on the species and their habitats is included inAppendix 6.

Table 27 Quantum and nature of the impacts on MNES, populations and the extent of the habitat

MNES	Quantum and nature of the impacts	Scale of impact			Discussion
		National	**State**	**Regional/local**	
Koala	Direct loss of 51.63hectares of foraging and breeding habitat.	Koalas had a largely continuous distribution throughout much of coastal and inland Queensland and New South Wales, throughout the majority of Victoria and in the south-eastern portion of South Australia. However, as a result of habitat loss, drought, hunting and disease, koala numbers rapidly declined and by the 1930s koalas were present in less than 50% of their previous distribution (NSW DECC 2008). Given the disjunct populations across the nation, the loss of 51.63hectares of habitat is likely to be significant to the national population.	Surveys in NSW indicate that since 1949 populations of koalas have been lost from many localities, particularly on the southern and western edges of their distribution. Most populations in NSW now survive in fragmented and isolated habitat and many of the areas in which koalas are most abundant are subject to intense development pressures such as agriculture and urban expansion. Koalas continue to be absent in some areas of suitable koala habitat, demonstrating the difficulty of species recovery when faced with high levels of fragmentation and the ongoing pressure from a number of threats (NSW DECC 2008). Given the continued loss of habitat across the State for the Koala, the loss of 51.63hectares is considered likely to be significant.	On the NSW North Coast important koala populations have been identified at Port Stephens, Port Macquarie, Coffs Harbour, Ballina, Lismore and Tweed. In addition to these populations, numerous small koala populations occur along the coast but many are separated as a result of urban and rural development, roads and other forms of fragmentation (NSW DECC 2008). Therefore, the local impact of the Project is considered likely to be significant.	Within the locality, the clearing of 51.63 hectares of Koala habitat will adversely affect habitat critical to the survival of the species.

Grey-headed Flying-fox	No direct impact on existing camps.	The distribution of the species is not precarious for the survival of the species nor limited, the range of the species extending from Bundaberg in Queensland to Melbourne in Victoria and from the coast inland to the western slopes of New South Wales. There have also been recent reports of Grey-headed Flying-fox present in South Australia. (Threatened Species Scientific Committee 2001).	The Grey-headed Flying-fox is a highly mobile, migratory species that relies on food sources with largely irregular patterns of production. Patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. However, broad trends in the distribution of plants with similar flowering and fruiting schedules support regular annual cycles of migration that are apparent at regional scales. The metropolitan areas of Newcastle is occupied continuously. Elsewhere, during spring Grey-headed Flying-foxes are uncommon south of Nowra and widespread in other areas of their range. They are widespread throughout their range in summer. In autumn, they occupy coastal lowlands and are uncommon inland. In winter they congregate in coastal lowlands north of the Hunter Valley and are occasionally found on the south coast of New South Wales and the northwest slopes (DECCW 2009).	The closest Grey-headed Flying-fox camp to the study area is located approximately 12 kilometres east (undetermined numbers), the other three are located 14 kilometres west near Maitland (<500 individuals), 13 kilometres south near Raymond Terrace (<2,500 individuals) and 15 kilometres north near Clarence Town (undetermined numbers) (DoE 2019a). The individual (one) sighting of the species during the whole survey period and the presence of four Grey-headed Flying-fox camps within 15 kilometres from the study area confirms that, at a local scale, the species is generally present intermittently and irregularly. Therefore, the species is not making significant use of the study area, and the proposal will not result in a significant impact to Grey-headed Flying-fox.	The Project will remove 53.79 hectares of native vegetation. However, given the extent of suitable forage habitat in the locality, the mobility of the species and the absence of roost or breeding camps within or in proximity to the study area **(**Figure 5**)** it is unlikely that this species will require further assessment in accordance with the Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps (DoE 2015).

MNES	Quantum and nature of the impacts	Scale of impact			Discussion
		National	**State**	**Regional/local**	
Spotted-tailed Quoll	No direct impact on Spotted Tailed Quoll populations	The Spotted-tailed Quoll is widely but patchily distributed in eastern Australia, occurring from north-eastern Queensland to Tasmania (DoE 2016b). Given the continuous population across eastern Australia, the loss of 53.79 hectares of native vegetation is unlikely to be significant to the national population.	Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey. However, the threshold densities of these critical components required to support quoll populations are unknown. Consequently it is currently not possible to define or map habitat critical to the survival of the Spotted-tailed Quoll. In NSW, there are several populations considered to be of particular importance based on their high abundance including the Northern tablelands Greater Blue Mountains, South Coast, Kosciuszko National park and North Coast regions (DoE 2016b). Given the large patches of forest available for the species in NSW and absence of high density populations within the study are, the loss of 53.79 hectares is considered unlikely to be significant	Within the North Coast Region, important populations of Spotted-tailed Important Quoll populations are located at Yuragir, Mariah and Limeburners Creek (DoE 2016b). With the Limeburners Creek one located approximately 20 kilometres north east of the study area. Therefore, the Project will not result in a significant local impact to the species.	Within the locality, the removal of 53.79 hectares of native vegetation will result in a 3.92% reduction of the native vegetation extent within 2000 hectares around the study area (Figure 1 Biosis 2017). Given the species was not recorded, its highly mobile nature and availability of other suitable habitat within the broader area (DoE 2019b), the Spotted-tailed Quoll is unlikely to be significantly impacted by the Project.

MNES	Quantum and nature of the impacts	Scale of impact			Discussion
		National	**State**	**Regional/local**	
Swift Parrot	53.79hectares of Swift Parrot foraging habitat	The Swift Parrot breeds in Tasmania during the austral summer and the entire population migrates north to mainland Australia for the austral winter. They occupy habitats across all tenures, with the majority of habitats occurring outside formal conservation reserves. The breeding range of the Swift Parrot is largely restricted to the east and south-east coast of Tasmania (Saunders et al 2011). Given the restricted breeding in Tasmania and large areas of occupation across eastern Australia, the loss of 50.45 hectares of foraging habitat is unlikely to be significant to the national population.	In New South Wales, Swift Parrots forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought (Saunders et al 2011). Given the large patches of forest available for the species foraging in NSW, the loss of 50.45 hectares is considered unlikely to be significant.	Within the Hunter-Central region, the Swift Parrot is associated with a range of vegetation formations, classes and types with extensively recorded 'known' distributions outside the study area (OEH 2019a). Therefore, the local impact of the Project is not considered to be significant.	Given that the species was not recorded during targeted surveys, proximity of recent records and absence of breeding habitat, the Project is unlikely to significantly impact the Swift Parrot.

MNES	Quantum and nature of the impacts	Scale of impact			Discussion
		National	**State**	**Regional/local**	
Regent Honeyeater	53.79 hectares of Regent Honeyeater foraging habitat	The regent honeyeater is endemic to mainland south-east Australia. It has a patchy distribution which extends from south east Queensland, through New South Wales (NSW) and the Australian Capital Territory (ACT) to central Victoria. However, it is highly mobile, occurring only irregularly in most sites, and in variable numbers, often with long periods with few observation anywhere (DoE 2016a). Given their wide distribution along eastern Australia and high mobility of the species, the loss of 53.79 hectares of habitat is unlikely to be significant to the species.	Habitat critical to the survival of the Regent Honeyeater occurs in a wide range of land ownership arrangements, including on private land, travelling stock routes, reserves, state forests and National Parks. Habitat critical to the survival for the species within NSW include the Bundarra-Barraba, Pilliga Woodlands, Mudgee-Wollar and the Capertee Valley and Hunter Valley areas (DoE 2016a). Given the absence of mapped critical habitat for the species within the study area (Figure 5)the loss of 49.23 hectares on native vegetation is considered unlikely to be significant.	Within the Hunter valley, key breeding habitat to the species is located approximately 20 kilometres south-west of the study area **(**Figure 5**)** (DoE 2016a). Therefore, the removal of 49.23 hectares of Regent Honeyeater foraging habitat not will directly impact on the key breeding area within the locality.	Given that the species was not recorded during targeted surveys, its highly mobile nature and availability of other suitable habitat within the broader area, the Regent Honeyeater is unlikely to be significantly impacted by the Project.

Table 28 provides additional information and discussion about the nature and significance of the project impacts in the context of any relevant Approved Conservation Advice for the species, as well as a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible.

Table 28 Impacts consistent with Approved Conservation Advice and indentification of unknown and unpredictable impacts

MNES	Nature and significance of impacts	Unknown/unpredictable impacts
Koala	The removal of 51.63 hectares of Koala habitat is consistent with the identified threats to this species listed on the Approved Conservation Advice such as: • Loss and fragmentation of habitat. • Increase risk of vehicle strike. • Increased risk of disease.	Most Koalas carry Chlamydia but do not always show clinical symptoms, however for those that do, the symptoms include; eye, urinary tract, respiratory tract and reproductive tract infections, most often leading to death if not treated(DoE 2015c). The disease is often expressed as a result of environmental stressors, including habitat loss. Therefore, the indirect impact of habitat loss is unpredictable. Another unpredictable outcome of the project is the displacement and fatalities of Koalas during construction and operation. However, these impacts could be reduced if the recommended mitigation measures described in Section 6.3.2 are implemented.
Grey-headed Flying-fox	There is no Approved Conservation Advice for this species. However, the removal of 53.79 hectares of native vegetation is consistent with the identified threats to the species listed on the species Commonwealth profile (DoE 2019a) such as: • Loss of foraging resources around the existing camps. • Decrease in the variety of flowering and fruiting feed tree species around the existing camps. Despite the identified impacts listed above, it is important to note that suitable forage habitat is abundant throughout the wider locality.	It is difficult to predict if the Project impacts could contribute to the reduction of spring foraging resources. In addition, the effects of the pathogens, Australian Bat Lyssavirus (ABL), and Bat Paramyxovirus and Menangle Pig virus on the Grey-headed Flying-fox are unknown. However, the incidence of ABL in the species is very low whilst approximately 25% of wild flying-foxes carry antibodies to Menangle Pig virus (DoE 2019a). These impacts could be reduced if the mitigation measures listed in Section 6.3.2 are implemented.
Spotted Tailed Quoll	There is no Approved Conservation Advice for this species. However, the removal of 53.79 hectares of native vegetation is consistent with the identified threats to the species listed on the Commonwealth profile (DoE 2019b) such as: • The loss, fragmentation, disturbance and degradation of habitat through clearing of native vegetation.	The genetic diversity between populations is unknown (DoE 2016b), meaning that is difficult to define populations potentially impacted by the Project within the locality.

MNES	Nature and significance of impacts	Unknown/unpredictable impacts
	• The large home ranges of the Spotted Tailed Quoll, particularly males, makes them susceptible to road mortality in forested areas fragmented by roads. Despite the identified impact listed above, it is important to note that native suitable breeding and foraging habitat is abundant throughout the wider locality.	
Swift Parrot	The removal of 53.79 hectares of Swift Parrot foraging habitat is consistent with the identified threats to this species listed on the Approved Conservation Advice such as: • Habitat loss and alteration: Land clearing has dramatically reduced landscape cover of foraging habitat for Swift parrots. • Competition: Swift parrots can experience increased competition for resources from large, aggressive honeyeaters within altered habitats. Despite the identified impact listed above, suitable forage habitat is abundant throughout the wider locality.	Increases in fire frequency pose a significant threat to avian communities. Where fire intervals are too regular, flowering events and maturation of nectar rich plant species may be reduced, resulting in a reduction of foraging resources for nectivorous birds (Saunders et al 2011). The Project would not directly increase the risk of fires. However, it is unknown if increased operations near the adjacent vegetation could increase the frequency of fires within the locality.
Regent Honeyeater	The removal of 53.79 hectares of Regent Honeyeater foraging habitat is consistent with the identified threats to this species listed on the Approved Conservation Advice such as: • The clearing, fragmentation and degradation of its habitat. • Removal of large mature trees which are important feeding and breeding habitat. • Fragmentation exposes woodlands to increased degradation. Despite the identified impact listed above, suitable forage habitat and large mature trees are abundant throughout the wider locality.	Honeybees may compete with regent honeyeaters for nectar, although the significance of this for the Regent Honeyeater is unknown and requires further investigation. Competition from feral honeybees *Apis mellifera* is listed as a 'Threatening Process' for nectivorous species in NSW and Victoria (DoE 2016a). It is unknown if the Project could contribute to the increase in feral honeybees within adjacent native vegetation.

6.3.2 Avoidance and mitigation measures

Hanson has endeavoured to avoid and minimise ecological impacts associated with the proposed Project and assessed the feasibility of using alternative quarry material, sites, extraction boundaries, operating hours and operation. The following recommended measures have been accepted by Hanson and would become commitments under a Project Approval. These measures would be described in a Biodiversity Management Plan for the Project.

Extraction boundary

Avoid and minimise disturbance of key vegetation communities including;

- Disturbance/extraction boundary excludes Deadmans Creek thereby reducing Project imposed impact on this environment.
- Much of the expansion area is regenerated vegetation which was previously cleared and mapped as closed grassland and open forest (see 1983 EIS).
- Reduction in the impact area from a potential 121 hectare extraction area to 59.69 hectares. This area was refined based on geological and ecological constraints, and in particular the need to provide for an on-site biodiversity offset.
- The impact area was refined to minimise net impacts on flora/fauna.

Expansion

The company has chosen to expand the existing quarry thereby maximising the operating capacity at the current site avoiding the need to develop a greenfield site.

Proposed Mitigation Measures to Minimise Impact

- A Biodiversity Management Plan (BMP) to be prepared to outline the clearance procedure, protocols for Koala finds and incidents and include an educational brochure for all workers to review prior to working at BHQ.
- Ecologist to undertake pre-clearance surveys immediately prior to the removal of any vegetation to give the clearance go ahead.
- Progressive vegetative rehabilitation will be completed using indigenous species.
- Weed, sediment and erosion control will be undertaken.
- Environmental Management Plans/Strategies will be developed and implemented.
- Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on threatened fauna displaced or injured during clearing.
- Ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on Koalas displaced or injured during clearing.
- Preparation of a Biodiversity Offset Strategy (BOS) to offset the residual impacts to biodiversity arising from the Project (Section 8, Biosis 2017).
- Fencing around remnant native vegetation.
- Comply and enforce site speed limits.
- Maintain general adherence to constructed site haul roads.

6.3.3 Summary

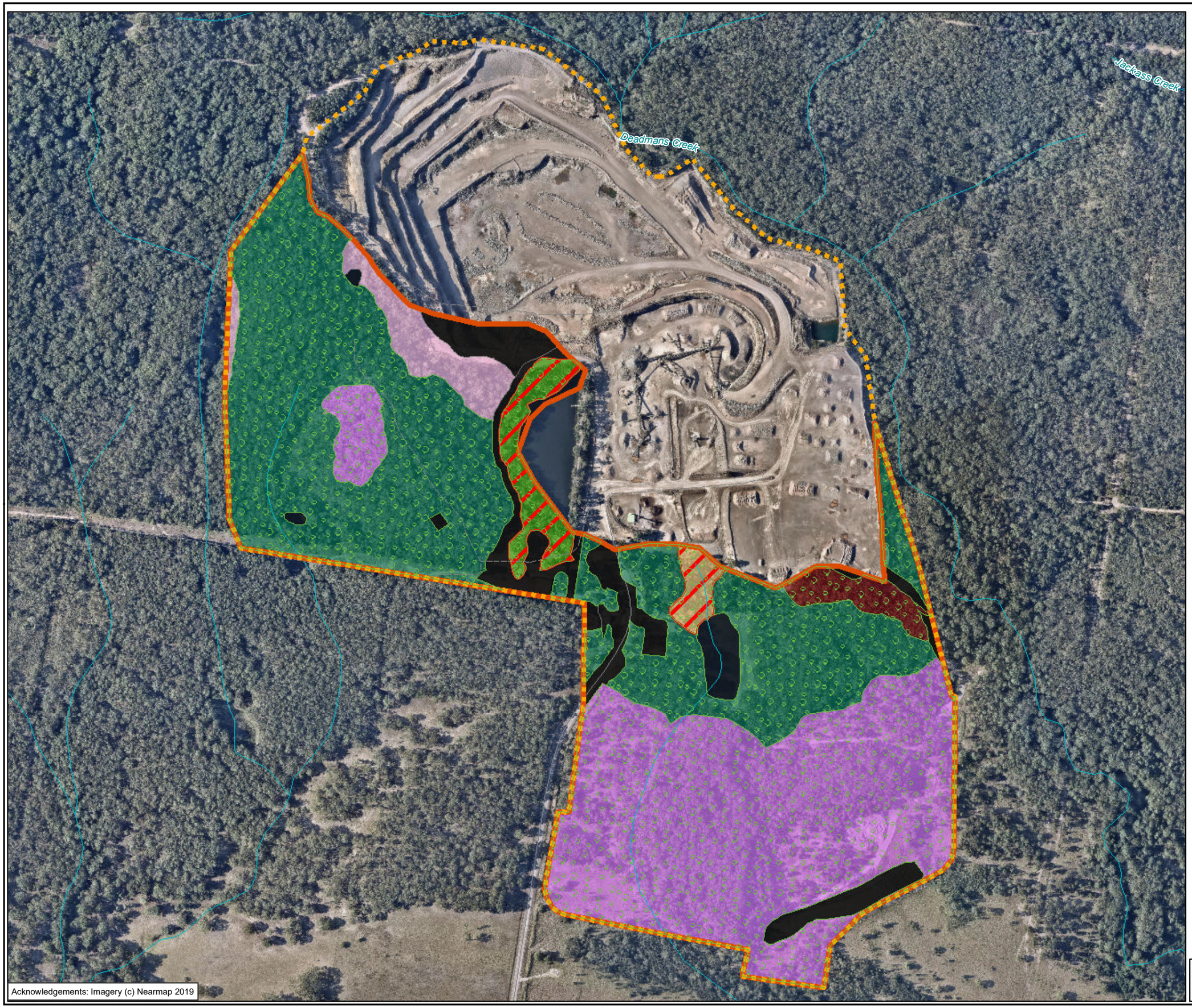
An assessment of the impacts of the proposed development on Matters of NES, against heads of consideration outlined in *Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013), was prepared to determine whether referral of the Project to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the Project are summarised in Table 29.

Table 29 Assessment of the Project against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species (fauna)	Background research indicates that 17 fauna species have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area was provided in Appendix 5, Table 36 (Biosis 2017). This assessment determined that four fauna had a moderate likelihood of occurrence in the study area, with one additional fauna species having a high likelihood of occurrence in the study area. The Koala was considered to have a high likelihood to occur and was recorded within the study area. The rest of these species are not considered to have a medium or high likelihood of occurrence within the study area.	The following threatened fauna are considered to have the potential to occur within the study area: • Regent Honeyeater • Spotted-tailed Quoll • Swift Parrot • Grey-headed Flying-fox Previously prepared SIC assessments (Biosis 2017) and additional information within this addendum report, determined that a significant impact was unlikely to result from the Project. The Koala was recorded within the study area and a SIC assessment was prepared (Biosis 2017). This assessment concluded a significant impact was likely; hence an EPBC Referral has been prepared and submitted to DoEE and the project has been declared a controlled action. In accordance with the EPBC Act Offsets Policy (DSEWPaC 2012), offsets will be provided for this species.
Threatened ecological communities	No EPBC Act EECs were recorded within the study area.	N/A
Migratory species	Thirty-one migratory species have been recorded or are predicted to occur in the locality. One bird species listed as migratory bird and two previously listed as migratory under the EPBC Act were found to be potentially impacted by the project; White-bellied Sea-eagle, Black-face Monarch, and Rainbow Bee-eater.	The following migratory species are considered to have the potential to occur within the study area: • White-bellied Sea-eagle • Black-face Monarch • Rainbow Bee-eater SIC assessments were prepared for these species (2). These assessments determined that a significant impact was unlikely to result from the Project.
Wetlands of international importance (Ramsar sites)	There are 12 Ramsar sites in NSW, the closest to the study area being the Hunter Estuary Wetlands within the estuary at the mouth of the Hunter River.	The study area is located approximately 18 kilometres northwest of this Ramsar site and Deadmans Creek is a tributary of the Hunter River. However, as an ephemeral creek line, it is considered unlikely that the Project will have any direct impacts on this Ramsar Site. Deadmans Creek is also considered to provide only a minor contribution of flow into this Ramsar Site.

The Project will result in impacts to 51.63hectares of Koala habitat. The primary measure for the development to minimise impacts to ecological values outlined above is to avoid, where possible, any impact to surrounding adjoining vegetation and offset remaining residual impacts. Residual impacts, following implementation of recommendations to avoid and minimise impact are outlined in Section 6.3.2.

Impacts are summarised in Section 6.2**.** Species credits for the Koala will be required to offset the residual impacts of the Project. The impacts to species habitat will require retirement of 1324 Koala credits. Since the rest of the MNES were not considered to be significantly impacted by the Project, they will not require the retirement of species credits.



Legend

- Study area
- Project area
- Red flag area
- Areas not requiring assessment

Plant Community Types

- VZ1 - HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)
- VZ2 - HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)
- VZ3 - HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT1718)
- VZ4 - HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)
- VZ5 - HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)
- VZ6 - HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)
- Cleared
- Water

Species polygon

- Koala

Figure 5 Impact summary for the Project

0 50 100 150 200 250

Metres
Scale: 1:5,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 25524
Date: 08 August 2019,
Checked by: RED, Drawn by: LH, Last edited by: lharley
Location:P:\25500s\25524\Mapping
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7 Biodiversity credits

This section provides a summary of biodiversity credits required to impact on the biodiversity values within the study area, following consideration of measures to avoid, minimise and mitigate impacts.

Table 30 provides a summary of ecosystem credits resulting from the proposed development while Table 31 provides a summary of species credits resulting from the proposed development. The full credit profile is provided in Appendix 7.

Table 30 Summary of ecosystem credits for all management zones

Vegetation Zone	PC type code	Plant community type name	Red flag	Management zone area (ha)	Loss in landscape value	Loss in site value score	EEC offset multiplier	Credits req for TS	TS with highest credit req	TS offset multiplier	Ecosystem credits required
VZ1	HU814	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	No	22.26	22.40	69.27	1	1281	Barking Owl	3	1281
VZ2	HU816	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	No	25.91	22.40	69.27	1	1491	Barking Owl	3	1492
VZ3	HU932	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	Yes	0.67	22.40	84.67	3	46	Sooty Owl	3	46
VZ4	HU806	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	No	1.12	22.40	68.23	1	63	Barking Owl	3	63
VZ5	HU812	Forest Red Gum grassy open forest on floodplains of the lower Hunter	Yes	1.67	22.40	81.33	3	111	Barking Owl	3	111
VZ6	HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	No	2.16	22.40	55.90	1	103	Barking Owl	3	103

Table 31 Summary of species credits for all management zones

Scientific name	Common name	Species polygon area (ha)	Red flag	TS offset multiplier	Species credits required
Phascolarctos cinereus	Koala	51.63	No	2.6	1342

8 Biodiversity Offset Strategy

8.1 Credit requirements

A total of 3096 ecosystem credits would be required to offset the impacts of the Project, as shown in Table 32.

Table 32 Ecosystem credits required to offset impacts of the Project

PC type code	Plant community type name	Management zone area (ha)	Ecosystem credits required
HU814	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	22.26	1281
HU816	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	25.91	1492
HU932	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	0.67	46
HU806	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	1.12	63
HU812	Forest Red Gum grassy open forest on floodplains of the lower Hunter	1.67	111
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	2.16	103
TOTAL			**3096**

A total of 1342 Koala species credits would be required to offset the impacts of the Project, as shown in Table 33.

Table 33 Species credits required to offset impacts of the Project

Common name	Scientific name	Extent of impact (individuals)	Species credits required
Koala	*Phascolarctos cinereus*	51.63	1342
TOTAL			**1342**

8.2 Offset strategy

The Biodiversity Offset Strategy for the proposal would include the purchase and retirement of the required biodiversity credits. In line with the Director General's Requirements issued on 11 November 2014 the Project is being assessed under the *NSW OEH interim policy on assessing and offsetting biodiversity impacts, State significant development (SSD) and State significant infrastructure (SSI) projects* (OEH 2011). Using these criteria credits are available for all PCTs within the study area. Credit requirements and proposed offset options are shown in Table 34. This includes an assessment of which tier of the OEH (2011) policy is being met.

Table 34 Required biodiversity credits and proposed offset options

PCTs requiring offset credits Credit				Offset options available			
Ecosystem credits							
PCT code	**PCT name**	**Red flag?**	**Credits required**	**PCT code**	**PCT name**	**Credits available**	**Tier**
HU814	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	No	1281	HU802	Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast	422	1
				HU803	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	42	1
				HU804	Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	817	1
HU816	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	No	1492	HU804	Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	1492	1
HU932	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast,	Yes	46	HU932	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	46	1
HU806	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	No	63	HU806	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	63	1
HU812	Forest Red Gum grassy open forest on floodplains of the lower Hunter	Yes	111	HU812	Forest Red Gum grassy open forest on floodplains of the lower Hunter	63	1
				HU532	Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	48	1
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	No	103	HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	103	1
Species credits							
Koala		No	1342	Koala		1342	1

Preliminary offset investigations have identified available credits that satisfy the Project's offsetting requirements as shown in Table 34. Where possible, credits will be sourced to meet Tier 1 (improve or maintain) outcomes, achieved by providing credits as per the offset options outlined in the BioBanking credit report. The potential credit options summarised above for this offset strategy will fulfil the Tier 1 requirements for five of the six PCTs recorded within the Project area. Part of the credit requirement for PCT1600 (HU814) may need to be fulfilled by applying a variation to the offsets, depending on whether more credits become available closer to the purchase stage.

Koala credits are available and can be purchased, fulfilling a Tier 1 outcome. However, the Commonwealth Government has not accredited the use of the NSW Biodiversity Conservation Fund (BCF) for retirement of credits required for MNES. Alternative offset options for MNES will need to be sought.

All credit requirements can be fulfilled by purchasing and retiring credits. The table above reflects credits available at the time of reporting on the OEH BioBanking Public Register. Should the required credits not be available when required Hanson will need to consult with DoEE regarding the use of variation rules or other means to meet their credit requirement. Upon approval Hanson proposes to fulfil its credit obligations using a staged offset approach, as detailed in Section 5.2.

8.3 Staged offset approach

Hanson proposes clearing of the Project area (including the extended project area) using a three staged approach. Consequently the credit requirements for the Project have been calculated to be consistent with this approach, so that offsets can be aligned with the three stages. The clearing approach and offset staging proposed are summarised in Table 35 and Table 36. Credit requirements for the three staged approach are provided in Table 36 to Table 38

Table 35 Staged clearing approach - PCTs

PCT	Vegetation Clearing Area (ha)			
	Offset Stage 1	Offset Stage 2	Offset Stage 3	Total Area (ha)
HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	7.54	14.59	0.13	**22.26**
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	11.24	7.64	7.03	**25.91**
HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	0	0.27	0.85	**1.12**
HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	0	1.67	0	**1.67**
HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on	0	0	0.67	**0.67**

PCT	Vegetation Clearing Area (ha)			
	Offset Stage 1	Offset Stage 2	Offset Stage 3	Total Area (ha)
coastal lowlands of the Central Coast (PCT1718).				
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)	2.01	0.15	0	**2.16**
TOTAL (Native Vegetation)	20.79	24.32	8.68	**53.79**
Cleared Land				**4.89**
Water				**1.02**

Table 36 Staged clearing approach – Koala habitat

Species Type	Vegetation Clearing Area (ha)			
	Offset Stage 1	Offset Stage 2	Offset Stage 3	Total Area (ha)
Koala (*Phascolarctos cinereus*)	18.78	24.17	8.63	**51.63**

Table 37 Staged offset requirements – Offset Stage 1

Credit	Offset Stage 1 (ha)	Credit requirement
HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	7.54	434
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	11.24	647
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)	2.01	96
Koala	18.78	488

Table 38 Staged offset requirements – Offset Stage 2

Credit	Offset Stage 2 (ha)	Credit requirement
HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	14.59	840
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	7.64	440

Credit	Offset Stage 2 (ha)	Credit requirement
HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	0.27	15
HU812 Forest Red Gum grassy open forest on floodplains of the Lower Hunter (PCT 1598)	1.67	111
HU798 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley (PCT 1584)	0.15	7
Koala	24.17	628

Table 39 Staged offset requirements – Offset Stage 3

Credit	Offset Stage 3 (ha)	Credit requirement
HU814 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (PCT 1600)	0.13	7
HU816 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1602)	7.03	405
HU806 Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter (PCT 1592)	0.85	48
HU932 Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT1718)	0.67	46
Koala	8.68	226

9 Assessment of biodiversity legislation

9.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of NES, against heads of consideration outlined in Matters of National Environmental Significance - Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013), was prepared to determine whether referral of the Project to the Commonwealth Minister for the Environment is required (see Section 6.3). Matters of NES relevant to the Project are summarised in Table 40.

Table 40 Assessment of the Project against the EPBC Act.

Matter of NES	Project specifics	Potential for significant impact
Threatened species (flora and fauna)	Background research indicates that 15 flora species and 17 fauna species have been recorded or are predicted to occur in the locality. An assessment of the likelihood of these species occurring in the study area is provided in Appendix 5; Table 46 (flora) and Table 47 (fauna). This assessment determined that two flora species and three fauna had a moderate likelihood of occurrence in the study area, with one additional fauna species having a high likelihood of occurrence in the study area. The Koala was considered to have a high likelihood to occur and was recorded within the study area. The rest of these species are not considered to have a medium or high likelihood of occurrence within the study area.	The following threatened biota are considered to have the potential to occur within the study area: • Small-flower Grevillea • Tall Knotweed • Regent Honeyeater • Spotted-tailed Quoll • Swift Parrot • Grey-headed Flying-fox SIC assessments were prepared for these species (Appendix 6). These assessments determined that a significant impact was unlikely to result from the Project. The Koala was recorded within the study area and a SIC assessment was prepared (Appendix 6). This assessment concluded a significant impact was likely; hence an EPBC Referral was prepared and submitted to DoEE and the Project was declared a controlled action. In accordance with the EPBC Act Offsets Policy (DSEWPaC 2012), offsets will be provided for this species as detailed in Table 34 . Credits are not required for any other species as the Project will not result in a significant impact.
Threatened ecological communities	No EPBC Act EECs were recorded within the study area.	N/A
Migratory species	Thirty-one migratory species have been recorded or are predicted to occur in the locality (Table 48). One bird species listed as migratory bird and two previously	The following migratory species are considered to have the potential to occur within the study area: • White-bellied Sea-eagle

Matter of NES	Project specifics	Potential for significant impact
	listed as migratory under the EPBC Act were found to be potentially impacted by the Project; White-bellied Sea-eagle, Black-face Monarch, and Rainbow Bee-eater.	• Black-face Monarch • Rainbow Bee-eater SIC assessments were prepared for these species (Appendix 6). These assessments determined that a significant impact was unlikely to result from the Project.
Wetlands of international importance (Ramsar sites)	There are 12 Ramsar sites in NSW, the closest to the study area being the Hunter Estuary Wetlands within the estuary at the mouth of the Hunter River.	The study area is located approximately 18 kilometres northwest of this Ramsar site and Deadmans Creek is a tributary of the Hunter River. However, as an ephemeral creek line, it is considered unlikely that the Project will have any direct impacts on this Ramsar Site. Deadmans Creek is also considered to provide only a minor contribution of flow into this Ramsar Site.

On the basis of potential for significant impacts on the Koala, the EPBC Act was triggered and referral of the proposed action to the Australian Government Minister for the Environment was undertaken. The Project was deemed a controlled action and is currently being assessed by DoEE.

The Project will result in impacts to approximately 51.63 hectares of Koala habitat. The primary measure for the development to minimise impacts to ecological values outlined above is to avoid, where possible, any impact to surrounding adjoining vegetation and offset remaining residual impacts. Residual impacts, following implementation of recommendations to avoid and minimise impact are outlined in Table 22, Section 6.1.1.

Impacts are summarised in Section 6.3. Species credits for the Koala will be required to offset the residual impacts of the Project. The impacts to species habitat will require retirement of 1342 Koala credits. Since the rest of the MNES were not considered to be significantly impacted by the Project, they will not require the retirement of species credits.

Further assessment of the Project against the EPBC Act is provided in section 6.3.

9.2 Fisheries Management Act 1994

Based on the proposed impact area, and the lack of impact on waterways, no FM Act KTPS were considered to be relevant to the Project.

9.3 Noxious Weeds Act 1993

Exotic species were recorded across the entire study area and were particularly abundant at the southern extent. Two weeds listed as noxious within the Port Stephens LGA were recorded, the class and legal requirements of which are outlined in Table 41. Treatment for the noxious weeds listed above is recommended within NSW DPI (2011).

Table 41 Noxious weeds recorded within the study area.

Common Name	Scientific Name	Class	Legal Requirement
Pampas grass	*Cortaderia species*	3	*The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed*
Fireweed	*Senecio madagascariensis*	4	*The plant must not be sold, propagated or knowingly distributed*

10 Conclusion

This assessment has been completed in accordance with the BBAM (OEH 2014a) on behalf of Hanson.

The biodiversity assessment report of the BHQ SSD Project found that a total of 53.79 hectares native vegetation, comprising six PCTs and two EECs, and associated ecological values are likely to be impacted as result of the Project. The Project will result in impacts to 51.63 hectares of Koala habitat. In addition, the Project area falls close to one of the creek meanders of Deadmans Creek outside the study area, which ultimately joins with the Hunter River. Ecological values of the study area are outlined in Section 4.2, 5.3, 5.4, and 5.5.

The primary measure for the development to minimise impacts to ecological values outlined above is to avoid, where possible, any impact to surrounding adjoining vegetation and offset remaining residual impacts. Residual impacts, following implementation of recommendations to avoid and minimise impact are outlined in Section 6.1.

Impacts are summarised in Section 6.2. Ecosystem credits for all PCTs and species credits for the Koala will be required to offset the residual impacts of the Project. The impacts to native vegetation and species habitat will require retirement of 3096 ecosystem credits across six PCTs, and 1342 Koala credits, as summarised in Table 42.

Table 42 Summary of biodiversity credit requirements

PCT code	Plant community type name	Ecosystem credits required
HU814	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	1281
HU816	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	1492
HU932	Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718)	63
HU806	Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	46
HU812	Forest Red Gum grassy open forest on floodplains of the lower Hunter	111
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	103
Koala	Koala	1342

A Biodiversity Offset Strategy has been prepared and is presented in Section 8. Hanson proposes to meet their credit requirements by purchasing and retiring credits under the NSW BioBanking scheme. Upon approval Hanson proposes to fulfil its credit obligations.

An assessment of the Project against the requirements of key biodiversity legislation concluded that the Project will result in a significant impact to the Koala. Since the Project has been deemed a controlled action under the EPBC Act, the Project will require approval from the Commonwealth Department of Environment and Energy.

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Appendices

Appendix 1 Survey methods

A1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1990, Harden 1991, Harden 1992, Harden 1993, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 3.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the Commonwealth Department of Environment (DoE) (DEWHA 2009a). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

A1.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by the Office of Environment and Heritage under the National Parks and Wildlife Act 1974 (SL100758, expiry date 31 March 2017). Fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2017). The BioBanking Assessment was carried out by Accredited BioBanking Assessor Nathan Garvey (No. 0103).

Aquatic fauna survey was conducted under NSW DPI Fisheries - Licence Numbers PO05/0016 & OUT10/4198, NSW National Parks and Wildlife Act 1974 - License Number S10318 and a Certificate of Approval under the NSW Animal Research Act 1985.

A1.3 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, ephemeral status of waterbodies and migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The current flora and fauna assessment was conducted in winter and spring during typical seasonal conditions considered adequate for the detection of target threatened species.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

Appendix 2 Native vegetation data (BioBanking)

A2.1 Plot and transect summary

Table 43 Plot scores for each vegetation zone within the development site

Benchmark details	Site value score	Site attributes											
		Native plant species	Native over-storey cover	Native mid-storey cover	Native ground cover (grass)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over-storey regen	Total length of fallen logs	Degraded (yes/no)	Out of benchmark
Vegetation zone 1													
Benchmark	N/A	>=38	15.0 to 40.0	4.0 to 40.0	30.0 to 60.0	3.0 to 15.0	10.0 to 25.0	N/A	>=1	1.00	>=10		
Plot 5	72.4	29	27.5	8.5	64	0	10	0	0	1	0		
Plot 8		26	30.5	1	74	2	18	0	0	1	0		
Plot 9		25	18	1	80	0	24	0	0	1	6		
Plot 10		28	32	3	62	10	28	11	0	1	54		
Plot 11		29	32.5	26.5	68	24	14	28	0	1	37		
Plot 12		20	23.5	0	90	2	26	6	0	1	6		
Plot 15		41	22.5	17.5	80	18	16	7	1	1	6		
Vegetation zone 2													
Benchmark	N/A	>=38	15.0 to 40.0	4.0 to 40.0	30.0 to 60.0	3.0 to 15.0	10.0 to 25.0	N/A	>=1	1.00	>=10		
Plot 1	76.56	36	52	16	62	36	78	14	0	1	6		
Plot 2		22	46	5	62	6	58	6	3	1	3		

Benchmark details	Site value score	Site attributes											
		Native plant species	Native over-storey cover	Native mid-storey cover	Native ground cover (grass)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over-storey regen	Total length of fallen logs	Degraded (yes/no)	Out of benchmark
Plot 3		27	20	18	56	14	34	0	0	1	54		
Plot 4		26	27.5	2.5	24	8	48	30	0	1	6		
Plot 6		36	27.5	15	64	24	58	20	1	1	24		
Plot 7		35	30.5	8	22	24	42	6	2	1	40		
Plot 13		39	29.5	6.5	56	28	32	5	0	1	14		
Vegetation zone 3													
Benchmark	N/A	>=24	15.0 to 70.0	10.0 to 60.0	5.0 to 50.0	5.0 to 30.0	5.0 to 40.0	N/A	>=0	1.00	>=5		
Plot 14	84.67	31	15.0	19.5	34.0	6.0	32.0	28.50	0	0.50	3		
Vegetation zone 4													
Benchmark	N/A	>=38	15.0 to 40.0	4.0 to 40.0	30.0 to 60.0	3.0 to 15.0	10.0 to 25.0	N/A	>=1	1.00	>=10		
Plot 19	68.23	29	33.0	7.0	62.0	8	22.0	1.50	0	1.00	22		
Vegetation zone 5													
Benchmark	N/A	>=15	15.0 to 65.0	0.0 to 50.0	0.0 to 90.0	1.0 to 15.0	2.0 to 90.0	N/A	>=0	1.00	>=10		
Plot 16	81.33	33	29.5	15.0	54.0	10.0	34.0	8	1	0.75	56		
Vegetation zone 6													

Benchmark details	Site value score	Site attributes											
		Native plant species	Native over-storey cover	Native mid-storey cover	Native ground cover (grass)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over-storey regen	Total length of fallen logs	Degraded (yes/no)	Out of benchmark
Benchmark	N/A	>=5 1	22.0 to 45.0	5.0 to 40.0	5.0 to 25.0	10.0 to 20.0	5.0 to 20.0	N/A	>=1	1.00	>=20		
Plot 17	55.90	28	70.0	17.0	0.00	18.0	68.0	0.00	13	0.66	0.00		
Plot 18		15	75.0	64.0	6.00	26.0	20.0	3.0	0	0.66	8		

Red cells indicate the site attributes that are below 50% of the benchmark, while blue cells represent those site attributes that are greater than 150% of the benchmark

Appendix 3 Flora

A3.1 Flora species recorded from the study area

Table 44 Flora species recorded from the study area

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Acanthaceae	*Brunoniella australis*	Blue Trumpet		X					
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair						X	
Adiantaceae	*Adiantum formosum*	Giant Maidenhair						X	
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair						X	
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	X	X					
Adiantaceae	*Pellaea paradoxa*							X	
Anthericaceae	*Dichopogon strictus*	Chocolate Lily	X	X					
Anthericaceae	*Thysanotus sp*	Fringe-lily	X						
Apiaceae	*Centella asiatica*	Indian Pennywort			X				
Apocynaceae	*Marsdenia rostrata*	Milk Vine						X	
Apocynaceae	*Parsonsia straminea*	Common Silkpod		X	X		X		
Araceae	*Gymnostachys anceps*	Settler's Twine						X	
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax					X		

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Asteraceae	*Brachyscome multifida*	Cut-leaved Daisy	X						
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	X						
Asteraceae	*Cassinia aculeata*	Dolly Bush					X		
Asteraceae	*Cassinia arcuata*	Sifton Bush		X					
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting	X						
Asteraceae	*Epaltes australis*	Spreading Nut-heads	X						
Asteraceae	*Lagenophora gracilis*	Slender Lagenophora	X						
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine	X	X		X			
Blechnaceae	*Blechnum indicum*	Swamp Water Fern			X				
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern						X	
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak	X						
Casuarinaceae	*Casuarina glauca*	Swamp Oak			X				
Celastraceae	*Maytenus silvestris*	Narrow-leaved Orangebark		X		X		X	
Clusiaceae	*Hypericum gramineum*	Small St John's Wort			X				
Convolvulaceae	*Dichondra repens*	Kidney Weed	X	X	X				

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Cyperaceae	*Baumea juncea*				X				
Cyperaceae	*Carex appressa*	Tall Sedge						X	
Cyperaceae	*Eleocharis acuta*				X				
Cyperaceae	*Gahnia aspera*	Rough Saw-sedge	X	X	X	X			
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge	X	X		X		X	
Cyperaceae	*Schoenoplectus validus*				X				
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	X	X					
Dioscoreaceae	*Dioscorea transversa*	Native Yam						X	
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	X	X		X	X		
Ericaceae	*Trochocarpa laurina*	Tree Heath						X	
Fabaceae (Faboideae)	*Chorizema parviflorum*	Eastern Flame Pea	X						
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	X	X					
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*			X					

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil	X	X					
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine	X	X					
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine	X				X		
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	X	X					
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla		X					
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood		X					
Fabaceae (Faboideae)	*Pultenaea flexilis*			X					
Fabaceae (Mimosoideae)	*Acacia elongata*	Swamp Wattle	X				X		
Fabaceae (Mimosoideae)	*Acacia falcata*		X	X	X	X		X	
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	X				X		

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle		X					
Fabaceae (Mimosoideae)	*Acacia longifolia*			X	X				
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses	X	X	X		X		
Flacourtiaceae	*Scolopia braunii*	Flintwood						X	
Geraniaceae	*Geranium solanderi*	Native Geranium		X					
Goodeniaceae	*Goodenia bellidifolia*		X						
Goodeniaceae	*Goodenia heterophylla*		X	X					
Haloragaceae	*Gonocarpus teucrioides*	Germander Raspwort		X					
Iridaceae	*Patersonia glabrata*	Leafy Purple-flag	X						
Iridaceae	*Patersonia sericea*	Silky Purple-Flag		X					
Juncaceae	*Juncus usitatus*		X						
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum			X				
Lauraceae	*Cassytha glabella*			X					

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Lauraceae	*Cassytha pubescens*	Downy Dodder-laurel		X		X	X		
Lobeliaceae	*Pratia purpurascens*	Whiteroot	X	X	X		X		
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush	X	X			X		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		X		X			
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	X	X		X	X		
Loranthaceae	*Amyema spp.*	Mistletoe	X	X					
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	X	X	X		X	X	
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	X	X	X	X		X	
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine						X	
Menispermaceae	*Stephania japonica*	Snake vine			X				
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea						X	
Moraceae	*Ficus coronata*	Creek Sandpaper Fig						X	
Myrsinaceae	*Myrsine variabilis*			X				X	
Myrtaceae	*Angophora costata*	Sydney Red Gum	X	X					
Myrtaceae	*Angophora floribunda*	Rough-barked Apple					X		X

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle						X	
Myrtaceae	*Baeckea diosmifolia*	Fringed Baeckea				X			
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush						X	
Myrtaceae	*Corymbia maculata*	Spotted Gum	X	X		X		X	
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany	X	X				X	
Myrtaceae	*Eucalyptus canaliculata*	Large-fruited Grey Gum		X					
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	X	X	X	X	X		
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark	X	X		X	X		
Myrtaceae	*Eucalyptus globoidea*	White Stringybark		X	X				
Myrtaceae	*Eucalyptus moluccana*	Grey Box	X						
Myrtaceae	*Eucalyptus paniculata*	Grey Ironbark		X					
Myrtaceae	*Eucalyptus punctata*	Grey Gum		X				X	
Myrtaceae	*Eucalyptus punctata X canaliculata intergrade*						X		
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark	X	X			X		

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	X		X		X		
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany		X			X		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon		X				X	
Myrtaceae	*Leptospermum sp*			X					
Myrtaceae	*Melaleuca nodosa*		X	X		X	X		
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree			X				
Oleaceae	*Notelaea longifolia*	Large Mock-olive	X	X			X		
Oleaceae	*Notelaea longifolia*	Large Mock-olive		X		X		X	
Oleaceae	*Notelaea ovata*			X					
Oleaceae	*Notelaea venosa*	Veined Mock-olive		X					
Orchidaceae	*Acianthus sp*			X					
Orchidaceae	*Corybas aconitiflorus*	Spurred Helmet Orchid		X					
Orchidaceae	*Cryptostylis sp*	Tartan Tongue Orchid		X					
Orchidaceae	*Cyanicula caerulea*	Blue Caladenia		X					
Orchidaceae	*Petalochilus curtisepalus*		X						

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Orchidaceae	*Pterostylis concinna*	Trim Greenhood		X					
Orchidaceae	*Pterostylis sp*			X					
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		X					
Phormiaceae	*Dianella caerulea var. cinerascens*		X	X	X		X		
Phormiaceae	*Dianella caerulea var. producta*		X	X	X	X	X	X	
Phormiaceae	*Dianella prunina*		X	X		X			
Phormiaceae	*Dianella revoluta*	Blueberry Lily	X	X	X	X			
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	X	X		X	X		
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree	X	X	X		X		
Phyllanthaceae	*Phyllanthus gunnii*			X					
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge		X					
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry	X	X					
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	X	X	X		X		
Pittosporaceae	*Citriobatus pauciflorus*	Orange Thorn		X					
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum		X				X	

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Poaceae	*Aristida vagans*	Threeawn Speargrass	X	X		X			
Poaceae	*Austrostipa pubescens*			X					
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	X	X		X			
Poaceae	*Cynodon dactylon*	Common Couch	X						X
Poaceae	*Dichelachne crinita*	Longhair Plumegrass	X						
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	X						
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	X	X					
Poaceae	*Entolasia marginata*	Bordered Panic		X			X		
Poaceae	*Entolasia stricta*	Wiry Panic	X	X	X	X	X		
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	X	X					X
Poaceae	*Imperata cylindrica*	Blady Grass		X	X	X	X		
Poaceae	*Microlaena stipoides*	Weeping Grass	X	X					
Poaceae	*Oplismenus aemulus*		X	X					
Poaceae	*Oplismenus imbecillis*			X					
Poaceae	*Panicum simile*	Two-colour Panic	X	X	X				

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Poaceae	*Rytidosperma fulva*	Wallaby Grass	X	X					
Poaceae	*Themeda australis*	Kangaroo Grass	X	X		X			
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn Fern						X	
Proteaceae	*Hakea sericea*	Needlebush	X	X					
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung	X	X		X	X		
Ranunculaceae	*Clematis aristata*	Old Man's Beard			X				
Ranunculaceae	*Clematis glycinoides*	Headache Vine		X					
Rhamnaceae	*Alphitonia excelsa*	Red Ash		X					
Ripogonaceae	*Ripogonum album*	White Supplejack						X	
Rubiaceae	*Galium sp*	Goosegrass		X					
Rubiaceae	*Morinda jasminoides*	Sweet Morinda						X	
Rubiaceae	*Opercularia diphylla*	Stinkweed	X						
Rubiaceae	*Pomax umbellata*	Pomax	X						
Rutaceae	*Asterolasia correifolia*			X					
Rutaceae	*Crowea exalata*		X	X				X	

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Rutaceae	*Zieria smithii*	Sandfly Zieria	X	X		X	X		
Santalaceae	*Exocarpos strictus*	Dwarf Cherry		X					
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush	X						
Smilacaceae	*Smilax australis*	Lawyer Vine						X	
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla		X					
Solanaceae	*Solanum brownii*	Violet Nightshade	X	X		X			
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	X	X			X	X	
Sterculiaceae	*Brachychiton populneus*	Kurrajong	X	X		X	X		
Vitaceae	*Cayratia clematidea*	Native Grape		X					
Vitaceae	*Cissus antarctica*	Water Vine		X			X	X	
Vitaceae	*Cissus hypoglauca*	Giant Water Vine		X				X	
Xanthorrhoeaceae	*Xanthorrhoea macronema*		X			X		X	
Xanthorrhoeaceae	*Xanthorrhoea minor*			X					
Apiaceae	*Ciclospermum leptophyllum*	Slender Celery			X				
Asteraceae	*Bidens pilosa*	Cobbler's Pegs			X				

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Asteraceae	*Conyza spp.*	A Fleabane		X	X				
Asteraceae	*Erechtites valerianifolia*	Brazilian Fireweed			X				
Asteraceae	*Hypochaeris radicata*	Catsear			X				
Asteraceae	*Senecio madagascariensis*	Fireweed	X		X				X
Asteraceae	*Sonchus oleraceus*	Common Sowthistle			X				
Gentianaceae	*Centaurium erythraea*	Common Centaury			X				
Juncaceae	*Juncus acutus*				X				X
Myrsinaceae	*Anagallis arvensis*	Scarlet Pimpernel			X				
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive							
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	X						
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	X						
Poaceae	*Chloris gayana*	Rhodes Grass			X				
Poaceae	*Cortaderia selloana*	Pampas Grass			X				
Poaceae	*Digitaria sp*			X					
Poaceae	*Panicum maximum*	Guinea Grass			X				

Family	Scientific Name	Common Name	VZ1	VZ2	VZ3	VZ4	VZ5	VZ6	Incidental
Poaceae	*Setaria gracilis*	Slender Pigeon Grass			X				
Poaceae	*Stenotaphrum secundatum*	Buffalo Grass							X
Verbenaceae	*Lantana camara*	Lantana	X	X	X	X	X	X	
Verbenaceae	*Verbena bonariensis*	Purpletop		X					
Vitaceae	*Vitis vinifera*	Grape Vine		X					

Appendix 4 Fauna

Fauna species in these tables are listed in alphabetical order within their taxonomic group.

A4.1 Fauna species recorded from the study area

Below is a list of fauna species recorded from the study area during the present assessment and a list of significant fauna species recorded or predicted to occur within 10 kilometres of the study area.

Notes to table:

EPBC Act:
EX - Extinct
CR - Critically Endangered
EN - Endangered
VU - Vulnerable
CD - Conservation dependent

TSC Act:
C1 – critically endangered
E1 – endangered species (Part 1, Schedule 1)
E2 – endangered population (Part 2, Schedule 1)
E4 – presumed extinct (Part 4, Schedule 1)
V1 – vulnerable (Part 1, Schedule 2)

FM Act:
C1 – critically endangered
E1 – endangered
E2 – endangered
E4 – presumed extinct
V1 – vulnerable

* - introduced species

Table 45 Vertebrate fauna recorded from the study area (current assessment)

Status	Scientific Name	Common Name	Quarry workings	Study area	Offset
Amphibians					
	Crinia signifera	Common Eastern Froglet		x	
	Litoria fallax	Eastern Sedge Frog		x	
	Litoria latopalmata	Broad-palmed Rocket-frog		x	
	Litoria nasuta	Striped Rocket-frog		x	
	Litoria peroni	Peron's Tree Frog		x	
	Litoria tyleri	Tyler's Tree Frog		x	
	Litoria wilcoxi	Stony Creek Frog		x	
	Pseudophryne bibroni	Bibron's Toadlet		x	
	Uperoleia laevigata	Smooth Toadlet		x	
Reptiles					
	Eulamprus quoyii	Eastern Water Skink		x	

Status	Scientific Name	Common Name	Quarry workings	Study area	Offset
	Morelia spilota	Carpet Python		x	
	Myzomela sanguinolenta	Scarlet Honeyeater		X	X
Birds					
	Acanthiza lineata	Striated Thornbill		X	X
	Acanthiza nana	Yellow Thornbill		x	
	Acanthiza pusilla	Brown Thornbill		x	
	Acanthiza reguloides	Buff-rumped Thornbill			
	Acanthorhynchus tenuirostris	Eastern Spinebill			X
	Accipiter cirrocephalus	Collared Sparrowhawk		X	
	Accipiter fasciatus	Brown Goshawk			
	Anas superciliosa	Pacific Black Duck		x	
	Anthochaera carunculata	Red Wattlebird		x	
Mi	*Ardea ibis*	Cattle Egret		x	
	Ardea intermedia	Intermediate Egret		x	
	Aythya australis	Hardhead		x	
	Cacomantis flabelliformis	Fan-tailed Cuckoo		X	
	Cacomantis flabelliformis	Fan-tailed Cuckoo		x	
	Chalcites lucidus	Shining Bronze-cuckoo		x	
	Chenonetta jubata	Australian Wood Duck		x	
	Colluricincla harmonica	Grey Shrike-thrush		X	X
	Coracina novaehollandiae	Black-faced Cuckoo-shrike		x	
	Coracina tenuirostris	Cicadabird		x	
	Cormobates leucophaea	White-throated Treecreeper		X	
	Corvus coronoides	Australian Raven	X	X	
	Cracticus nigrogularis	Pied Butcherbird		x	
	Cracticus tibicen	Australian Magpie	X	X	
	Cracticus torquatus	Grey Butcherbird	X	X	
	Dacelo novaeguineae	Laughing Kookaburra		X	
V	*Daphoenositta chrysoptera*	Varied Sittella		x	
	Dicaeum hirundinaceum	Mistletoebird		x	

Status	Scientific Name	Common Name	Quarry workings	Study area	Offset
	Egretta novaehollandiae	White-faced Heron		x	
	Eopsaltria australis	Eastern Yellow Robin		X	X
V	*Falco subniger*	Black Falcon	X	X	
	Geopelia humeralis	Bar-shouldered Dove		X	X
	Gerygone mouki	Brown Gerygone		X	X
V	*Glossopsitta pusilla*	Little Lorikeet		X	X
Mi	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	X	X	
	Hirundo neoxena	Welcome Swallow	X	X	
	Leucosarcia picata	Wonga Pigeon		X	
	Lichenostomus chrysops	Yellow-faced Honeyeater		x	
	Lichenostomus melanops	Yellow-tufted Honeyeater		x	
V	*Lophoictinia isura*	Square-tailed Kite		X	
	Malurus cyaneus	Superb Fairy-wren		X	
	Malurus lamberti	Variegated Fairy-wren		X	
	Meliphaga lewinii	Lewin's Honeyeater		X	X
	Melithreptus brevirostris	Brown-headed Honeyeater		X	
	Melithreptus lunatus	White-naped Honeyeater		X	X
Mi	*Monarcha melanopsis*	Black-faced Monarch		x	
	Myiagra rubecula	Leaden Flycatcher		x	
	Neochmia temporalis	Red-browed Finch		X	X
	Ninox novaeseelandiae	Southern Boobook			X
	Oriolus sagittatus	Olive-backed Oriole		x	
	Pachycephala pectoralis	Golden Whistler		X	X
	Pachycephala rufiventris	Rufous Whistler		x	
	Pardalotus punctatus	Spotted Pardalote		X	X
	Pardalotus striatus	Striated Pardalote		x	
	Petrochelidon nigricans	Tree Martin		x	
	Petroica rosea	Rose Robin		x	
	Phalacrocorax sulcirostris	Little Black Cormorant		x	
	Philemon corniculatus	Noisy Friarbird		X	
	Podargus strigoides	Tawny Frogmouth		X	X
	Psophodes olivaceus	Eastern Whipbird		X	X

Status	Scientific Name	Common Name	Quarry workings	Study area	Offset
	Rhipidura albiscapa	Grey Fantail		X	X
	Scythrops novaehollandiae	Channel-billed Cuckoo		x	
	Sericornis frontalis	White-browed Scrubwren		X	
	Smicrornis brevirostris	Weebill		X	
	Strepera graculina	Pied Currawong		x	
	Trichoglossus haematodus	Rainbow Lorikeet		x	
	Zosterops lateralis	Silvereye		X	X
Mammals					
	Acrobates pygmaeus	Feathertail Glider			X
	Antechinus stuartii	Brown Antechinus		X	X
*	*Canis lupus familiaris/dingo*	Dog/Dingo		x	
	Chalinolobus gouldii	Gould's Wattled Bat		x	
	Chalinolobus morio	Chocolate Wattled Bat		x	
	Macropus giganteus	Eastern Grey Kangaroo		x	x
	Macropus robustus	Euro		x	
	Macropus rufogriseus	Red-necked Wallaby	X	X	X
V	*Miniopterus australis*	Little Bentwing-bat		x	
V	*Miniopterus orianae oceanensis*	Eastern Bentwing-bat		x	
VU, V, E2	*Phascolarctos cinereus*	Koala	X	x	
	Pseudocheirus peregrinus	Common Ringtail Possum		x	
V, V	*Pteropus poliocephalus*	Grey-headed Flying-fox		x	
	Rattus fuscipes	Bush Rat			X
	Rhinolophus megaphyllus	Eastern Horseshoe Bat		x	
	Tachyglossus aculeatus	Short-beaked Echidna	x	x	x
	Tadarida australis	White-striped Freetail-bat	X	X	X
	Trichosurus vulpecula	Common Brushtail Possum		x	
	Vespadelus vulturnus	Little Forest Bat		x	
*	*Vulpes*	Red Fox		x	
	Wallabia bicolor	Swamp Wallaby		x	x

Appendix 5 Threatened species

A5.1 Threatened flora species

The following table includes a list of the threatened flora species and ecological communities that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas (OEH 2014f) and the Protected Matters Search Tool (DoE 2014), accessed on 06/08/2014.

Examples of criteria for determining the likelihood of occurrence for threatened biota as a guide for writing the rationale for likelihood have been listed below.

Likelihood of occurrence	Potential criteria
High	• Species/ecological communities recorded in study area during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. • Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). • Study area is within species natural distributional range (if known). • Species has been recorded within 10 kilometres or from the relevant catchment/basin.
Medium	• Records of terrestrial biota within 10 kilometres of the study area or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 10 kilometres of the study area or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat present (low quality and extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present in study area • Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 46 Threatened flora species recorded/predicted within 10 kilometres of the study area

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Allocasuarina defungens	Dwarf Heath Casuarina	EN	E1	#	Low	Not typically observed in grassy woodland communities and no tall heath on sandy soils within the study area. Also not historically recorded within 5 kilometres of the study area.	*Allocasuarina defungens* is found only in the Hunter/Central Rivers, and Northern Rivers Catchments, ranging from the Nabiac area, north-west of Forster, to Byron Bay on the NSW north coast. *Allocasuarina defungens* 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. Vegetation communities associated with the species, includes: Dry Scleropyhll Forests, Forested Wetlands, Grassy Woodlands, and Heathlands.
Angophora inopina	Charmhaven Apple	VU	V	#	Low	No potential habitat or associated species within the study area. Also not historically recorded within 5 kilometres of the study area.	Occurs in the Hunter/Central Rivers Catchment, endemic to the Central Coast region of NSW. Occurs in open woodland with a dense shrub understorey on deep white sandy soils over sandstone. Most frequently occurring in four main vegetation communities: (i) *Eucalyptus haemastoma*, *Corymbia gummifera*, *Angophora inopina* woodland/forest; (ii) *Hakea teretifolia, Banksia oblongifolia* wet heath; (iii) E*ucalyptus resinifera, Melaleuca sieberi, Angophora inopina* sedge woodland; (iv) *Eucalyptus capitellata, Corymbia gummifera, Angophora inopina* woodland/forest. Is lignotuberous, allowing vegetative growth to occur following disturbance. Flowering appears to take place principally between mid-December and mid-January, but is generally poor and sporadic.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Asperula asthenes	Trailing Woodruff	VU	V	2009/#	Low	A single recent record is located approximately 8 kilometres southwest of the study area. Typically this species is found in riparian vegetation along creek banks. There are no creeklines within the study area, and Deadmans Creek, adjacent to the study area is a minor ephemeral creekline.	Found in damp areas often found growing along river banks.
Asterolasia elegans		EN	E1	#	Low	The study area is outside of the typical range for this species and none of the associated vegetation occurs within the study area.	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford LGA. Known from only six populations in the catchments of the Colo and Hawkesbury Rivers, only one of which is wholly within a conservation reserve. Found in sheltered forests on mid- to lower slopes and valleys which support sheltered forest on Hawkesbury Sandstone. The canopy at known sites includes *Syncarpia glomulifera, Angophora costata, Eucalyptus piperita, Allocasuarina torulosa* and *Ceratopetalum gummiferum*. The species is considered to be fire sensitive and reliant on seed germination after disturbance to maintain populations. A soil seedbank appears to be established by this species, so

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							for a number of years following fire or other disturbance the species may not be apparent, but be present only as seed in the soil. The size of the seedbank depends not only on the amount of seed contributed by mature plants each season, but on the level of dormancy of the seed which can vary from year to year. The longevity of each crop of seed in the soil is perhaps 5 - 10 years.
Cryptostylis hunteriana	Leafless Tongue Orchid	VU	V	#	Low	Not previously recorded within 10 kilometres of the study area and none of the typical habitat preferences for this species were noted within the study area.	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts but has also been recorded on steep bare hillsides. Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland. This species does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by *Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera* and *Allocasuarina littoralis*; appears to prefer open areas in the understorey of this community and is often found in association with the *Cryptostylus subulata*. It occurs in the following Catchment Management Regions Hawkesbury/Nepean, Hunter/Central Rivers, Northern Rivers and Southern Rivers. Inconsistent flowering times Dec-February; Jan-February (in Victoria)
Cymbidium canaliculatum	Tiger Orchid		E2	1926	Low	Outside of known range, this species is associated with the central and upper	Epiphytic orchid found in dry sclerophyll forest or woodland where it grows in tree hollows, in clumps of fern or sometimes on rocks.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						Hunter and not with the vegetation communities of the study area.	
Eucalyptus glaucina	Slaty Red Gum	VU	V	1998/#	Low	Typically found further west in the Central Hunter. Some marginal potential habitat occurs at the southern, flatter section of the study area however based on location and soil preferences it is considered unlikely to occur.	Occurs near Casino and from Taree to Broke where it is locally common but very sporadic. Found in grassy woodland on deep, moderately fertile and well watered soil.
Eucalyptus parramattensis subsp. decadens		VU	V	#	Low	No associated species or habitat within the study area and the species is not typically found this far north.	There are two separate meta-populations of *E. parramattensis subsp. decadens*. The Kurri Kurri meta-population is bordered by Cessnock/Kurri Kurri in the north and Mulbring/Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, *E. parramattensis subsp. decadens* is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the TSC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS. Flowers from November to January.
Euphrasia arguta		CE	E4A	#	Low	The study area is south and east of the range of this species.	Grows in grassy areas near rivers.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	VU	V	2005/#	Medium	Potential habitat and associated species were recorded within the study area.	Located in Hawkesbury/Nepean, Hunter/Central Rivers and Sydney Metropolitan Catchment. Sporadically distributed throughout the Sydney Basin with the main occurrence centred in Picton, Appin, Wedderburn and Bargo. Northern populations are found in the Lower Hunter Valley. To the west of Sydney, small populations occur at Kemps Creek & Voyager Point. *Grevillea parviflora ssp. parviflora* grows on sandy clay loam soils, often with ironstone gravels. Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. *Grevillea parviflora subsp. parviflora* is found on crests, upper slopes or flat plains in both low-lying areas and on higher topography. The plant prefers open habitat conditions with the largest populations in open woodland and along exposed roadside areas.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							G. parviflora subsp. parviflora has been recorded in a range of vegetation types from heath and shrubby woodland to open forest. Canopy species vary greatly with community type but generally are species that favour soils with a strong lateritic influence including *Eucalyptus fibrosa, E. parramattensis, Angophora bakeri* and *Eucalyptus sclerophylla*. Flowering has been recorded between July - December as well as April-May.
Maundia triglochinoides			V	2009	Medium	Previously recorded close to the study area and potential habitat in the form of dams and a creek.	*Maundia triglochinoides* is restricted to Coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct. Catchment Regions include Hunter/Central Rivers, Northern Rivers and Sydney Metro
Melaleuca biconvexa	Biconvex Paperbark	VU	V	#	Low	Not previously recorded within 10 kilometres of the study area and limited habitat present within the study area.	Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Catchment regions include: Hunter/Central Rivers, Hawkesbury/Nepean, Southern Rivers, and Northern River Catchments. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October.
Persicaria elatior	Tall Knotweed	VU	V	1996/#	Medium	Previously recorded close to the study area and potential	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						habitat in the form of dams and a creek.	Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace and the Grafton area (Cherry Tree and Gibberagee State Forests). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.
Phaius australis	Southern Swamp Orchid	EN	E1	#	Low	Not previously recorded within 10 kilometres of the study area and no potential habitat was recorded.	Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. Found in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.
***Prasophyllum* sp. Wybong**	A Leek Orchid	CE		#	Low	Not previously recorded within 10 kilometres of the study area and no potential habitat was recorded.	Leek orchids are generally found in shrubby and grassy habitats in dry to wet soil. *Prasophyllum* sp. Wybong is known to occur in open eucalypt woodland and grassland. *Prasophyllum* sp. Wybong is endemic to NSW. It is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. *Prasophyllum* sp. Wybong occurs within the Border Rivers (Gwydir, Namoi, Hunter), Central Rivers and Central West Natural Resource Management Regions. The species occurs within the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes Interim Biogeographic Regionalisation for Australia Bioregions.
Pterostylis gibbosa	Illawarra Greenhood	EN	E1	#	Low	This species has not historically been recorded	Known from a small number of populations in the Hunter region, the Illawarra region and the Shoalhaven region. It is apparently extinct in western Sydney which is the area

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by *Eucalyptus tereticornis, E. longifolia* and *Melaleuca decora*. Near Nowra, the species grows in an open forest of *Corymbia maculata, E.tereticornis* and *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by *E. crebra*, Forest Red Gum and *Callitris endlicherii*. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer/spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber late summer, followed by the flower stem in winter. The Illawarra Greenhood can survive occasional burning/grazing because of its capacity to reshoot from an underground tuber.
Streblus pendulinus	Whalebone Tree	EN		#	Low	No suitable rainforest habitat within the study area.	The species is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest.

* - habitat descriptions have been adapted by qualified ecologists (botanists) from the DoE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

A5.2 Threatened fauna species

The following table includes a list of the threatened fauna species that have potential to occur within the study area. The list of species is sourced from the NSW BioNet Wildlife Atlas (OEH 2014f), BirdLife Australia data search (Birdlife Australia 2014) and the Protected Matters Search Tool (DoE 2014), accessed on 06/08/2014.

Notes to table:

#	species predicted to occur by the DoE database (not recorded on other databases)
##	species predicted to occur based on natural distributional range and suitable habitat despite lack of records in the databases searched
Year	recorded on databases listed above
2014	recorded during current survey

Likelihood of occurrence	Potential criteria
High	• Species recorded in study area during current or previous assessment/s. • Aquatic species recorded from connected waterbodies in close proximity to the study area during current or previous assessment/s. • Sufficient good quality habitat is present in study area or in connected waterbodies in close proximity to the study area (aquatic species). • Study area is within species natural distributional range (if known). • Species has been recorded within 10 kilometres or from the relevant catchment/basin.
Moderate	• Records of terrestrial species within 10 kilometres of the study area or of aquatic species in the relevant basin/neighbouring basin. • Habitat limited in its capacity to support the species due to extent, quality, or isolation.
Low	• No records within 10 kilometres of the study area or for aquatic species, the relevant basin/neighbouring basin. • Marginal habitat presents (low quality and extent). • Substantial loss of habitat since any previous record(s).
Negligible	• Habitat not present in study area • Habitat for aquatic species not present in connected waterbodies in close proximity to the study area. • Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded.

Table 47 Threatened fauna species recorded/predicted within 10 kilometres of the study area

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Birds							
Anseranas semipalmata	Magpie Goose		V	2013	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. They are often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level. Nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW. Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation.
Anthochaera phrygia	Regent Honeyeater	EN	E4A	2012/#	Medium	Not recorded during targeted surveys in winter and spring. Suitable forage habitat present. Recorded from the locality of the study area.	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: *E. microcarpa*, E. *punctata, E. polyanthemos, E. mollucana, Corymbia robusta, E. crebra, E. caleyi, C. maculata, E. mckieana, E. macrorhyncha, E. laevopinea* and *Angophora floribunda*. Nectar and fruit from the *mistletoes A. miquelii, A. pendula, A. cambagei* are also eaten during the breeding season. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and sheoaks. Also nest in mistletoe haustoria. An open cup-shaped nest is constructed of bark, grass, twigs and wool by the female.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Botaurus poiciloptilus	Australasian Bittern	EN	E1	2004/#	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	The Australasian Bittern is distributed across south-eastern Australia. Often found in terrestrial and estuarine wetlands, generally where there is permanent water with tall, dense vegetation including *Typha* spp. and *Eleoacharis* spp.. Typically this bird forages at night on frogs, fish and invertebrates, and remains inconspicuous during the day. The breeding season extends from October to January with nests being built amongst dense vegetation on a flattened platform of reeds.
Burhinus grallarius	Bush Stone-curlew		E1	2006	Low	Not recorded during targeted surveys in winter/spring. Suitable habitat present but impacts from feral predators (cats and foxes) likely to be high.	Lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present.
Calidris ferruginea	Curlew Sandpiper		E1	2013	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.
Callocephalon fimbriatum	Gang-gang Cockatoo		V	1993	Low	Not recorded during targeted surveys. No	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	2010	Low	Not recorded during targeted surveys in winter and spring. No stands of Allocasuarina sp. were recorded within the study area.	Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead.
Chthonicola sagittata	Speckled Warbler		V	2013	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. They prefer woodlands with a grassy understorey, often on ridges or gullies. The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds. Home ranges vary from 6-12 hectares.
Circus assimilis	Spotted Harrier		V	2012	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Spotted Harrier is found throughout Australia but rarely in densely forested and wooded habitat of the escarpment and coast. Preferred habitat consists of open and wooded country with grassland nearby for hunting. Habitat types include open grasslands, acacia and mallee remnants, spinifex, open shrublands, saltbush, very open woodlands, crops and similar low vegetation. The Spotted Harrier is more common in drier inland areas, nomadic part migratory and dispersive, with movements linked to the abundance of prey species. Nesting occurs in open or remnant woodland and unlike other harriers, the Spotted Harrier nests in trees.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)		V	2013	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Lives in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer, with short grass or bare ground and with fallen logs or dead trees present.
Daphoenositta chrysoptera	Varied Sittella		V	2014	High	Recorded within the study area during winter and spring surveys. Suitable habitat throughout the study area.	The Varied Sittella is a sedentary species which inhabits a wide variety of dry eucalypt forests and woodlands, usually with either shrubby understorey or grassy ground cover or both, in all climatic zones of Australia. Usually inhabit areas with rough-barked trees, such as stringybarks or ironbarks, but also in mallee and acacia woodlands, paperbarks or mature Eucalypts. The Varied Sittella feeds on arthropods gleaned from bark, small branches and twigs. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.
Dasyornis brachypterus	Eastern Bristlebird	EN	E1	#	Low	Not previously recorded within 10 kilometres of the study area and no potential habitat was observed.	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.
Ephippiorhynchus asiaticus	Black-necked Stork		E1	2014	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat	Found in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated lands and occasionally forages in open grassy woodland. Nests in live or dead trees usually near water.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						was recorded within the study area.	
Epthianura albifrons	White-fronted Chat		V	2009	Low	Not recorded during targeted winter and spring surveys. No suitable habitat present.	Sydney Metropolitan CMA: The White-fronted Chat occupies foothills and lowlands below 1000 m above sea level. In NSW it occurs mostly in the southern half of the state, occurring in damp open habitats along the coast, and near waterways in the western part of the state. The White-fronted Chat is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands or lightly timbered lands. Along the coastline, they are found in estuarine and marshy grounds with vegetation less than 1 m tall. The species is also observed in open grasslands and sometimes in low shrubs bordering wetland areas. Inland, the species is often observed in open grassy plains, saltlakes and saltpans that are along the margins of rivers and waterways. In Victoria White-fronted Chats have been observed breeding from late July through to early March. Nests are built in low vegetation and in the Sydney region nests have also been observed in low isolated mangroves. An Endangered Population occurs in the Sydney Metropolitan CMA area, at Newington Nature Reserve near Homebush and at Towra Point Nature Reserve.
Falco hypoleucos	Grey Falcon		E1	1993	Low	Not recorded within the	Found over open country and wooded lands of tropical

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						study area during targeted surveys in winter and spring. No suitable habitat present.	and temperate Australia. Mainly found on sandy and stony plains of inland drainage systems with lightly timbered acacia scrub.
Falco subniger	Black Falcon		V	2013	High	Recorded within the study area during winter and spring surveys. Suitable habitat throughout the study area.	Mainly occur in woodlands and open country where can hunt. Often associated with swamps, rivers and wetlands. Nest in tall trees along watercourses.
Glossopsitta pusilla	Little Lorikeet		V	2014	High	Recorded within the study area during winter and spring surveys. Suitable habitat throughout the study area.	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.
Hieraaetus morphnoides	Little Eagle		V	2012	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
Irediparra	Comb-crested		V	2012	Low	Not recorded during	Occurs in freshwater wetlands, lagoons, Billabongs,

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
gallinacea	Jacana					targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	swamps, lakes, rivers and reservoirs, generally with abundant floating aquatic vegetation.
Ixobrychus flavicollis	Black Bittern		V	2004	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	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.
Lathamus discolor	Swift Parrot	EN	E1	2012/#	Medium	Not recorded during targeted surveys in winter and spring. Suitable forage habitat present. Recorded from the locality of the study area.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box E. *microcarpa*, Grey Box *E. moluccana* and Blackbutt *E. pilularis*. This species is migratory, breeding in Tasmania and also nomadic,

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							moving about in response to changing food availability.
Limosa limosa	Black-tailed Godwit		V	2012	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Mainly coastal, usually in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats.
Lophoictinia isura	Square-tailed Kite		V	2013	High	Recorded within the study area during winter and spring surveys. Suitable habitat throughout the study area.	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii.* Individuals appear to occupy large hunting ranges of more than 100 kilometres2. 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.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)		V	1998	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	This species lives in a wide range of temperate woodland habitats, and a range of woodlands and shrublands in semi-arid areas.
Melithreptus gularis	Black-chinned Honeyeater (eastern		V	2011	Medium	Not recorded during targeted surveys in winter and spring.	Found mostly in open forests and woodlands dominated by box and ironbark eucalypts. It is rarely recorded east of the Great Dividing Range.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
	subspecies)					Suitable habitat present. Recorded from the locality of the study area.	
Neophema pulchella	Turquoise Parrot		V	2002	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs. Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies. Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies that are moist.
Ninox connivens	Barking Owl		V	2008	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Territories are typically 2000 ha in NSW habitats.
Ninox strenua	Powerful Owl		V	2013	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							least 100 cm. It has a large home range of between 450 and 1450 ha.
Oxyura australis	Blue-billed Duck		V	2007	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Almost wholly aquatic, preferring deep water in large, permanent wetlands with an abundant aquatic flora.
Pachycephala olivacea	Olive Whistler		V	2012	Low	Not recorded during targeted winter and spring surveys. No suitable habitat was recorded within the study area.	Found in a range of habitats including alpine thickets, wetter rainforest/woodlands, riparian vegetation and heaths.
Pandion cristatus	Osprey		V	1992	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 kilometres inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.
Petroica boodang	Scarlet Robin		V	2013	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present.	During the breeding season the Scarlet Robin is found in eucalypt forests and temperate woodlands, often on ridges and slopes. During autumn and winter it moves to more open and cleared areas. It has dispersive or locally

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						Recorded from the locality of the study area.	migratory seasonal movements. The Scarlet Robin forages amongst logs and woody debris for insects which make up the majority of its diet. The nest is an open cup of plant fibres and cobwebs, sited in the fork of a tree (often a dead branch in a live tree, or in a dead tree or shrub) which is usually more than 2 m above the ground. It is conspicuous in open and suburban habitats.
Petroica phoenicea	Flame Robin		V	2005	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes moist eucalyptus forests and open woodlands, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)		V	2014	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Grey-crowned Babbler is found in dry, open forests, scrubby woodlands, trees bordering roads and farmland with isolated trees.
Ptilinopus magnificus	Wompoo Fruit-Dove		V	2009	Low	Not recorded during targeted winter and spring surveys. No suitable habitat present.	Mainly occurs in large undisturbed patches of tall tropical or subtropical rainforest. Occasionally occurs in patches of monsoon forest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodland or vine thickets near rainforest.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
Ptilinopus regina	Rose-crowned Fruit-Dove		V	2007	Low	Not recorded during targeted winter and spring surveys. No suitable habitat present.	Occurs in tall tropical and subtropical, evergreen or semi-deciduous rainforest, especially with dense growth of vines. Prefers large patches of rainforest, but sometimes occurs in remnant patches surrounded by suboptimal habitat including farmlands.
Rostratula australis	Australian Painted Snipe	EN	E1	#	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat was recorded within the study area.	Usually found in shallow inland wetlands including farm dams, lakes, rice crops, swamps and waterlogged grassland. They prefer freshwater wetlands, ephemeral or permanent, although they have been recorded in brackish waters.
Stagonopleura guttata	Diamond Firetail		V	2000	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Found in a range of habitat types including open eucalypt forest, mallee and acacia scrubs. Often occur in vegetation along watercourses.
Sternula nereis nereis	Fairy Tern	VU		#	Negligible	Not previously recorded within 10 kilometres of the study area and no potential coastal habitat occurs.	The Fairy Tern nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. This species will also frequent embayments, estuarine habitats, wetlands and mainland coastlines.
Stictonetta naevosa	Freckled Duck		V	2014	Low	Not recorded during targeted winter and spring surveys. No suitable wetland habitat	The Freckled Duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits.

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						was recorded within the study area.	
Turnix maculosus	Red-backed Button-quail		V	2010	Low	Not recorded during targeted surveys in winter and spring. No suitable habitat present.	Red-backed Button-quail inhabit grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Red-backed Button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter.
Tyto longimembris	Eastern Grass Owl		V	1983	Low	Not recorded during targeted surveys in winter and spring. No suitable habitat present.	Occurs mainly in open tussock grassland, usually in treeless areas. Can also occur in marshy areas with tall dense tussocks of grass. Occasionally occurs in densely vegetated agricultural lands such as sugarcane fields.
Tyto novaehollandiae	Masked Owl		V	1952	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Masked Owl may be found across a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. It has mostly been recorded in open forests and woodlands adjacent to cleared lands. They nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. The nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet. It has a large home range of between 500 to

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							1000 ha.
Mammals							
Cercartetus nanus	Eastern Pygmy-possum		V	2005	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Patchily distributed from the coast to the Great Dividing Range, and as far as Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Soft fruits are eaten when flowers are unavailable and it also feeds on insects. Will often nest in tree hollows, but can also construct its own nest. Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5 ha area over a 5 month period. It is mainly solitary, and each individual uses several nests. Home ranges of males are generally less than 0.75 ha, and those of females are smaller.
Chalinolobus dwyeri	Large-eared Pied Bat	VU	V	2013/#	Low	Not recorded during targeted surveys in spring. No suitable habitat present.	Occurs from the Queensland border to Ulladulla, with largest numbers from the sandstone escarpment country in the Sydney Basin and Hunter Valley. Primarily found in dry sclerophyll forests and woodlands, but also found in rainforest fringes and subalpine woodlands. Forages on small, flying insects below the forest canopy. Roosts in colonies of between three and 80 in caves, Fairy Martin nests and mines, and beneath rock overhangs, but usually less than 10 individuals. Likely that it hibernates during the cooler months. The only known existing

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							maternity roost is in a sandstone cave near Coonabarabran.
Dasyurus maculatus	Spotted-tailed Quoll	EN	V	2006/#	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Occurs along the east coast of Australia and the Great Dividing Range. Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests. Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, an abundance of food and an area of intact vegetation in which to forage. Seventy per cent of the diet is medium-sized mammals, and also feeds on invertebrates, reptiles and birds. Individuals require large areas of relatively intact vegetation through which to forage. The home range of a female is between 180 and 1000 ha, while males have larger home ranges of between 2000 and 5000 ha. Breeding occurs from May to August.
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	2013	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Distribution extending east of the Great Dividing Range throughout the coastal regions of NSW, from the Queensland border to the Victorian border. Prefers wet high-altitude sclerophyll and coastal mallee habitat, preferring wet forests with a dense understorey but being found in open forests at lower altitudes. Apparently hibernates in winter. Roosts in tree hollows and sometimes in buildings in colonies of between 3 and 80 individuals. Often change roosts every night. Forages for beetles, bugs and moths below or near the canopy in forests with an open structure, or along trails. Has a large

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							foraging range, up to 136 ha. Records show movements of up to 12 kilometres between roosting and foraging sites.
Kerivoula papuensis	Golden-tipped Bat		V	1999	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Occurs in a narrow band down the coast from Cape York to Eden, in moist, closed forest that receives high rainfall. Important habitat features includes forest ecotones, streams and an abundance of vines. Primarily feeds on web-building spiders. Most nightly movements occur within 2 kilometres of the roost. Roosts in the nests of Yellow-throated Scrubwren and Brown Gerygone, as well as in tree hollows, foliage and roofs of houses.
Miniopterus australis	Little Bentwing-bat		V	2013	High	Recorded within the study area during spring surveys. Suitable forage habitat present. No roosting or breeding habitat present (e.g. caves, culverts).	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer. Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V	2010	High	Recorded within the study area during spring surveys. Suitable forage habitat present. No roosting or breeding habitat present (e.g. caves, culverts).	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.
Mormopterus norfolkensis	Eastern Freetail-bat		V	2013	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Distribution extends east of the Great Dividing Range from southern Queensland to south of Sydney. Most records are from dry eucalypt forests and woodland. Individuals tend to forage in natural and artificial openings in forests, although it has also been caught foraging low over a rocky river within rainforest and wet sclerophyll forest habitats. The species generally roosts in hollow spouts of large mature eucalypts (including paddock trees), although individuals have been recorded roosting in the roof of a hut, in wall cavities, and under metal caps of telegraph poles. Foraging generally occurs within a few kilometres of roosting sites.
Myotis macropus	Southern Myotis		V	2013	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.
Petaurus australis	Yellow-bellied Glider		V	2005	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the	Restricted to tall native forests in regions of high rainfall along the coast of NSW. Bago Plateau: Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						locality of the study area.	flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types. Live in family groups of 2-6 individuals which commonly share a number of tree hollows. Family groups are territorial with exclusive home ranges of 30-60 ha. Very large expanses of forest (>15,000 ha) are required to conserve viable populations.
Petaurus norfolcensis	Squirrel Glider		V	2008	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Wagga Wagga and Barrenjoey peninsula (north syd): Sparsely distributed along the east coast and immediate inland areas as far west as Coonabarabran in the northern part of the state and as far west as Tocumwal along the southern border of the state. Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow-bearing trees and a mix of eucalypts, banksias and acacias. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. They live in family groups of 2-10 individuals and maintain home ranges of 0.65 and 10.5 ha, varying according to habitat quality and food resource availability. Family groups occupy multiple hollows over time.
Petrogale penicillata	Brush-tailed Rock-wallaby	VU	E1	#	Low	Not previously recorded within 10 kilometres of the study area and no potential habitat was observed.	Occurs along the Great Dividing Range south to the Shoalhaven, and also occurs in the Warrumbungles and Mt Kaputar. Habitats range from rainforest to open woodland. It is found in areas with numerous ledges, caves and crevices, particularly where these have a

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							northerly aspect. Individuals defend a specific rock shelter, emerging in the evening to forage on grasses and forbs, as well as browse in drier months. Home sizes range from 2-30 ha.
Phascogale tapoatafa	Brush-tailed Phascogale		V	2010	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	The Brush-tailed Phascogale had a scattered distribution centred around the Great Dividing Range. It prefers open forests with a sparse ground cover, but also inhabits mallee and rainforests. It feeds on insects and nectar, particularly in rough-barked trees. The Brush-tailed Phascogale will Nests and shelter in tree hollows, tree stumps and occasionally birds nests, and can use more than 40 nests in a year. Suitable tree hollows have entrances 25-40 mm wide. Females have exclusive territories of approximately 20 - 60 ha, while males have overlapping territories of up to 100 ha. Breeding occurs from May to July, after which all the males die.
Phascolarctos cinereus	Koala	VU	V, E2	2013	High	Species recorded within the study area during the current Biosis (2014) surveys.	Pittwater LGA and Hawks nest: In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include Eucalyptus robusta, E. tereticornis, E. punctata, E. haemostoma and E. signata. They are solitary with varying home ranges. In high quality habitat home ranges may be 1-2 ha and overlap, while in semi-arid country they are usually discrete and around 100 ha.
Potorous tridactylus tridactylus	Long-nosed Potoroo	VU	V	#	Low	Not recorded during targeted surveys in	Cobaki Lakes and Tweed Heads West population: Occurs from Queensland to Victoria, normally within 50

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						winter and spring. No habitat present.	kilometres of the coast. Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy. Known to eat fungi, arthropods, fleshy fruit, seeds and plant tissue. It is solitary and sedentary, buts tends to aggregate in small groups. It has two breeding seasons, one in late winter-early spring and the other in late summer. This species appears to benefit from a lack of recent disturbance.
Pseudomys novaehollandiae	New Holland Mouse	VU		2005/#	Low	Not recorded during targeted surveys in winter and spring. No habitat present.	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The home range of the New Holland Mouse can range from 0.44 ha to 1.4 ha. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging above-ground for food, predisposing it to predation by native predators and introduced species. Breeding typically occurs between August and January, but can extend into autumn.
Pseudomys oralis	Hastings River	EN	E1	#	Low	Not recorded during	Occurs in upland forests (at altitudes between 300-1250

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
	Mouse					targeted surveys in winter and spring. No habitat present.	m) from Barrington Tops to Queensland. Inhabits open forests and woodlands with a grass, sedge, rush or heath understorey. The Hastings River Mouse nests within cavities in root systems of trees, holes in the ground, rock piles, hollow logs and epiphytes near the ground. Native grasses and sedges for a large part of the diet. Legumes, seeds, fruits, moss, fungi and insects are also eaten. Females have a home range of 1 ha, and males up to 2 ha. The species occurs at low densities (often <per 1 ha).
Pteropus poliocephalus	Grey-headed Flying-fox	VU	V	2011/#	High	Species recorded within the study area during the current Biosis (2014) surveys.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies (camps), commonly in dense riparian vegetation. Bats commute daily to foraging areas, usually within 15 kilometres of the day roost although some individuals may travel up to 70 kilometres.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V	2009	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Found throughout NSW. They have been reported from southern Australia between January and June. Reported from a wide range of habitats throughout eastern and northern Australia, including wet and dry sclerophyll forest, open woodland, acacia shrubland, mallee, grasslands and desert. They roost in tree hollows in colonies of up to 30 (but more usually two to six) and have also been observed roosting in animal burrows, abandoned Sugar Glider nests, cracks in dry clay, hanging from buildings and under slabs of rock. It is high-flying, making it difficult to detect. It forages above the canopy of

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
							eucalypt forests, but comes lower to the ground in mallee or open country.
Scoteanax rueppellii	Greater Broad-nosed Bat		V	2010	Medium	Not recorded during targeted surveys in spring. Suitable habitat present. Recorded from the locality of the study area.	Occurs along the Great Dividing Range, generally at 500 m but up to 1200 m, and in coastal areas. Occurs in woodland and rainforest, but prefers open habitats or natural or human-made openings in wetter forests. Often hunts along creeks or river corridors. Flies slowly and directly at a height of 30 m or so to catch beetles and other large, flying insects. Also known to eat other bats and spiders. Roosts in hollow tree trunks and branches.
Vespadelus troughtoni	Eastern Cave Bat		V	2013	Medium	Not recorded during targeted surveys in spring. Suitable forage habitat present. Recorded from the locality of the study area.	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. It roosts in small groups, often in well-lit overhangs and caves, mine tunnels, road culverts, and occasionally in buildings.
Reptiles							
Hoplocephalus bitorquatus	Pale-headed Snake		V	1994	Medium	Not recorded during targeted surveys in winter and spring. Suitable habitat present. Recorded from the locality of the study area.	Found in a variety of habitats from wet sclerophyll forest to dry eucalypt forest on the western slopes of NSW. Feeds largely on frogs and lizards.
Hoplocephalus bungaroides	Broad-headed Snake	VU	E1	#	Low	Not previously recorded within 10 kilometres of	Mainly occurs in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically

Scientific name	Common name	EPBC Act	TSC Act	Most recent record	Likelihood of occurrence	Rationale for likelihood	Habitat description
						the study area and no suitable sandstone habitat occurs within the study area.	found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they generally use rock crevices and exfoliating rock during the cooler months and tree hollows during summer.
Amphibians							
Litoria aurea	Green and Golden Bell Frog	VU	E1	1992/#	Low	Not recorded during targeted surveys in winter and spring. No habitat present.	Most existing locations for the species occur as small, coastal, or near coastal populations, with records occurring between south of Grafton and northern VIC. The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks , although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop , feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.
Mixophyes balbus	Stuttering Frog	VU	E1	#	Low	Not previously recorded within 10 kilometres of the study area and no suitable preferred habitat occurs within the study area.	This species is usually associated with mountain streams, wet mountain forests and rainforests. It rarely moves very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains.

* - habitat descriptions have been adapted by qualified ecologists (zoologists) from the DoEE Species Profile and Threats (SPRAT) Database, OEH Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

A5.3 Migratory species (EPBC Act listed)

Includes records from the following sources:

OEH NSW BioNet Wildlife Atlas (OEH 2014f; accessed on 06/08/2014)

DoE Protected Matters Search Tool database (DoE 2014; accessed on 06/08/2014)

BirdLife Australia data search (Birdlife Australia 2014)

Current survey

Bold denotes species recorded in the study area during the current assessment.

Table 48 Migratory fauna species recorded/predicted within 10 kilometres of the study area

Scientific name	Common name	EPBC Act	TSC Act	Most recent record
Anthochaera phrygia	Regent Honeyeater	EN	E4A	2012/#
Apus pacificus	Fork-tailed Swift			2004
Ardea ibis	Cattle Egret			2014
Ardea modesta	Eastern Great Egret			2014
Calidris acuminata	Sharp-tailed Sandpiper			2014
Calidris ferruginea	Curlew Sandpiper		E1	2013
Calidris melanotos	Pectoral Sandpiper			2009
Calidris ruficollis	Red-necked Stint			2013
Chalcophaps indica	Emerald Dove			2012
Charadrius bicinctus	Double-banded Plover			2006
Chlidonias leucopterus	White-winged Black Tern			2011
Gallinago hardwickii	Latham's Snipe			2013
Haliaeetus leucogaster	White-bellied Sea-Eagle			2013
Hirundapus caudacutus	White-throated Needletail			2013
Hydroprogne caspia	Caspian Tern			2013
Limosa lapponica	Bar-tailed Godwit			2012
Limosa limosa	Black-tailed Godwit		V	2012
Merops ornatus	Rainbow Bee-eater			2013
Monarcha melanopsis	Black-faced Monarch			2013
Myiagra cyanoleuca	Satin Flycatcher			2008
Numenius madagascariensis	Eastern Curlew			1993
Pandion cristatus	Osprey		V	1992

Scientific name	Common name	EPBC Act	TSC Act	Most recent record
Plegadis falcinellus	Glossy Ibis			2013
Pluvialis fulva	Pacific Golden Plover			2013
Rhipidura rufifrons	Rufous Fantail			2013
Rostratula australis	Australian Painted Snipe	EN	E1	#
Sterna hirundo	Common Tern			2011
Symposiachrus trivirgatus	Spectacled Monarch			2009
Tringa glareola	Wood Sandpiper			1986
Tringa nebularia	Common Greenshank			2012
Tringa stagnatilis	Marsh Sandpiper			2014

Appendix 6 Significant Impact Criteria assessments

The following Significant Impact Criteria (SIC) assessment has been prepared in accordance with the Matters of National Environmental Significance, Significant Impact Criteria guidelines 1.1 Environment Protection and Biodiversity Conservation Act (DoE 2013) for species determined to have a medium or greater likelihood of occurrence within the study area. This applied to a total of two flora species and five fauna species including:

- Small-flower Grevillea *Grevillea parviflora subsp. parviflora* (Vulnerable)
- Tall Knotweed *Persicaria elatior* (Vulnerable)
- Koala *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) (Vulnerable)
- Grey-headed Flying-Fox *Pteropus poliocephalus* (Vulnerable)
- Spotted-tailed Quoll *Dasyurus maculatus maculatus* (SE mainland population) (Endangered)
- Blossom-dependent birds including:
  - Regent Honeyeater *Anthochaera Phrygia* (Critically Endangered)
  - Swift Parrot *Lathamus discolour* (Endangered)
- White-bellied Sea-eagle *Haliaeetus leucogaster* (Marine)Black-faced Monarch Monarcha melanopsis (Marine, migratory)
- Rainbow Bee-eater *Merops ornatus* (Marine)

Small-flower Grevillea *Grevillea parviflora* subsp. *parviflora*

Small-flower Grevillea *Grevillea parviflora subsp. parviflora* is listed as Vulnerable under the EPBC Act and Vulnerable under the TSC Act. It is a low spreading to erect shrub which sporadically occurs throughout the Sydney Basin (OEH 2013). Main occurrences of Small-flower Grevillea are located south of Sydney in the Appin – Wedderburn – Picton – Bargo districts associated with the Nepean and Georges Rivers and separately and in the Hunter within the Cessnock - Kurri Kurri area (particularly Werakata NP). Separate populations are also known from Putty to Wyong and Lake Macquarie on the Central Coast (OEH 2013). Generally, Small-flower Grevillea occurs on sandy clay loam soils often with lateritic ironstone gravels. Soils are derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine grained sandstones (DoE 2015a). Small-flower Grevillea grows in range of vegetation types varying from heath and shrubby woodland to open forest however, it sometimes also occurs in open, slightly disturbed sites such as the edge of tracks (OEH 2013). In the Sydney area the species has been recorded in Shale Sandstone Transition Forest and Coastal Foothills Spotted Gum Ironbark Forest (NPWS 2002).

This vulnerable species has been assessed in accordance with the aforementioned significant impact guidelines (DoE 2013) using the following significant impact criteria:

- *Lead to a long-term decrease in the size of an important population of a species.*
- *Reduce the area of occupancy of an important population.*
- *Fragment an existing important population into two or more populations.*
- *Adversely affect habitat critical to the survival of a species.*
- *Disrupt the breeding cycle of an important population.*

- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*
- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.*
- *Introduce disease that may cause the species to decline, or*
- *Interfere substantially with the recovery of the species.*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will lead to a long-term decrease in the size of an important population of a species

An 'important population' is defined by DoE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are:

- Key source populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity.
- Populations that are near the limit of the species range.

No individuals or important populations of small-flower Grevillea were recorded within the locality. The closest records of Small-flower Grevillea are approximately 10 kilometres east of the study area, near Wallaroo State Forest (OEH 2014f). However none of the populations within the Hunter-Central Rivers CMA are considered 'important populations'. Based on the lack of an important population in the locality, the Project will not lead to a long-term decrease in the size of an important population of Small-flower Grevillea.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will reduce the area of occupancy of an important population

No small-flower Grevillea was recorded within or immediately surrounding the study area and no important populations of Small-flower Grevillea were identified. The nearest location of Small-flower Grevillea is located approximately 10 kilometres east of the study area (OEH 2014f). Further, there are no recorded important populations in the locality. It is therefore considered an unlikely that the Project will reduce the area of occupancy of an important population of this species.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will fragment an existing important population into two or more populations

No important populations of Small-flower Grevillea were identified within the locality. The nearest location of an individual record was recorded approximately 10 kilometres from the study area and will not be fragmented by the proposed works.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will adversely affect habitat critical to the survival of a species

Despite none being identified during the winter and spring targeted survey, in total approximately 53.79 hectares of potentially suitable habitat will be cleared for the Project. However, within the Hunter-Central Rivers region, Small-flower Grevillea has been found associated with a number of vegetation formations, classes and types (OEH 2013). In particular, Small-flower Grevillea has been found within vegetation communities of Hunter-Macleay Dry Sclerophyll Forests, Coastal Floodplain Woodlands and Coastal Swamp Forest (identified within the study area)

Habitat clearing associated with the proposed works is unlikely to adversely affect habitat critical to the survival of the species given that the species is often associated with a wide range of vegetation formations classes and types occurring in the locality and given no individuals were found within the study area.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will disrupt the breeding cycle of an important population

There is no real chance or possibility of significant impact to Small-flower Grevillea as no individuals or important populations of Small-flower Grevillea were identified within the study area, hence disruptions to regeneration and dispersal are unlikely.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

In total approximately 53.79 hectares of potentially suitable habitat for Small-flower Grevillea will be cleared for the Project. However as some of this habitat contained Blady Grass *Imperata cylindrical* and Tick Bush *Kunzea ambigua* which are known to reduce the quality and availability of suitable habitat for Small-flower Grevillea (DoE 2015a) the habitat whilst being potential habitat is considered marginal. In addition, as this species was not located during targeted survey effort, habitat removal is unlikely to cause further decline of the species given that the habitat is marginal and no individuals were recorded.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Exotic species, such as Lantana, as well as natives, such as Blady Grass and Tick Bush, considered harmful to Small-flower Grevillea were identified throughout the areas of impact (habitat to be cleared). It is therefore unlikely that the works will exacerbate the current proportion of these harmful species or result in a recruitment of other harmful species as this vegetation is planned for clearance. However, adjoining vegetation to be monitored for establishment of weeds as the Project begins and continues, and controlled as per Section 5 of the BAR.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline,

There are no known diseases at this current time, likely to impact Small-flower Grevillea.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result interfere substantially with the recovery of the species.

There is currently no recovery plan for this species. However, there is a targeted strategy for managing and assisting the recovery of Small-flower Grevillea. This has been developed within the site-managed species stream of the Saving Our Species program (OEH 2013). The site-managed species stream means that 5 management sites where conservation activities are needed most have been identified. The study area is not listed as a management site for Small-flower Grevillea as there is no population known to occur there. Therefore, the proposed clearing does not conflict with or interfere substantially with the recovery of the species.

Conclusion
Based on the above assessment the Project will not significantly impact Small-flower Grevillea as:

- The species was not recorded within the study area.
- There are no associated impacts to important populations of Small-flower Grevillea.
- Vegetation to be cleared is considered marginal and the nearest located individuals are located 10 kilometres east of the study area.

Tall Knotweed *Persicaria elatior*

Tall Knotweed *Persicaria elatior* is listed as Vulnerable under the EPBC Act and as Vulnerable under the TSC Act. It is an erect short-lived, herbaceous species with known individuals and/or populations occurring from the North Coast, Central Coast and South Coast Botanical Subdivisions in New South Wales (DoE 2015b). It prefers damp habitat including; coastal swamps, along watercourses, streams and lakes, swamp forest and disturbed areas (DoE 2015b). It is generally found associated with *Melaleuca linearifolia, Melaleuca quinquenervia, Lophostemon suaveolens, Casuarina glauca, Corymbia maculata, Pseudognaphalium luteoalbum* and *Polygonum hydropiper* (Quinn et al. 1995). Tall Knotweed grows rapidly, flowers and sets seeds within six months of germinating, flowering mostly in summer (Quinn et al. 1995).

This vulnerable species has been assessed in accordance with the aforementioned significant impact guidelines using the following significant impact criteria:

- *Lead to a long-term decrease in the size of an important population of a species.*
- *Reduce the area of occupancy of an important population.*
- *Fragment an existing important population into two or more populations.*
- *Adversely affect habitat critical to the survival of a species.*
- *Disrupt the breeding cycle of an important population.*
- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.*
- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.*
- *Introduce disease that may cause the species to decline, or*
- *Interfere substantially with the recovery of the species.*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will lead to a long-term decrease in the size of an important population of a species

An 'important population' is defined by DoE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are:

- Key source populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity.
- Populations that are near the limit of the species range.

No Tall Knotweed was recorded within the study area, however the dams and ephemeral wet soaks were considered to provide potential habitat for the species. The study area is not located at the limit of the range of Tall Knotweed, which is distributed from Mt Dromedary in south east NSW to Grafton in the north. The

closest records of Tall Knotweed is approximately 4 kilometres from the study area (OEH 2014i). The Project will therefore not lead to a long-term decrease in the size of an important population of Tall Knotweed.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will reduce the area of occupancy of an important population

No Tall Knotweed were recorded within the study area and no important populations of Tall Knotweed were identified within 10 kilometres from the study area (OEH 2014i). If the species is currently dormant within the seed bank or there are inconspicuous individuals present within the study area, the survey effort to date suggests that their occurrence limited in number and extent and not part of an important population. It is therefore considered unlikely that the Project will reduce the area of occupancy for an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will fragment an existing important population into two or more populations

No individuals or important populations of Tall Knotweed were identified within the study area. Habitat for Tall Knotweed is typically ephemeral wet soaks, creek lines and dams. These features are usually scattered across the landscape and therefore fragmented in their distribution. The nearest population has recorded approximately 4 kilometres from the study area and will not become fragmented by the proposal.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species is defined as areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long term evolutionary development.
- For the reintroduction of populations or recovery of the species or ecological community.

In total approximately 1.69 hectares of potentially suitable habitat will be cleared for the Project, including:

- 0.67 of Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion, reported as HU923 Swamp Mahogany- Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT1718).
- 1.02 ha of offline dams.

Habitat clearing associated with the proposed works is unlikely to adversely affect habitat critical to the survival of the species given that no habitat fitting this description was recorded within the study area.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will disrupt the breeding cycle of an important population

Tall Knotweed appears to be short-lived however germinates readily and grows rapidly, setting seeds within six months of germination (DoE 2015b). There is no real chance or possibility of significant impact as no individuals or populations were identified within the study area, hence disruptions to regeneration and dispersal are unlikely.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 1.69 hectares of potentially suitable habitat will be cleared for the proposal. There are larger areas of higher quality habitat within the broader region, already known to support individuals or populations of Tall Knotweed. Therefore, the proposal is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The NSW threatened species profile for Tall Knotweed lists a number of species that are harmful to the species including:

- Longleaf Primrose Willow *Ludwigia longifolia.*
- Black-berry Nightshade *Solanum nigrum.*
- Buffalo grass *Stenotaphrum secundatum.*
- Grazers generally.

No individuals of Tall Knotweed were identified within the study area. Potential habitat for the species within the study area will be removed therefore the impacts of these harmful species will be negligible. On a broader scale, the Project is unlikely to cause the introduction or exacerbation of these harmful species into any existing populations of Tall Knotweed.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will introduce disease that may cause the species to decline,

There are no known diseases at this time, likely to impact Tall Knotweed.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result interfere substantially with the recovery of the species.

There is currently no recovery plan for this species. Furthermore the Project will not interfere substantially with the long-term recovery of this species given that a targeted strategy for managing and assisting the recovery of Tall Knotweed has been developed within the site-managed species stream of the Saving Our Species program (OEH 2013i). The site-managed species stream means that 5 management sites where conservation activities are needed most have been identified. The study area is not listed as a management site for Tall Knotweed which includes:

- Mallanganee - Kyogle LGA
- Gibberagee - Clarence Valley LGA
- Wanda wetlands - Port Stephens LGA
- Bevian swamp - Eurobodalla LGA
- An additional un-named translocation site.

Conclusion

Based on the above assessment the Project will not significantly impact Tall Knotweed as:

- No individuals were recorded within the study area.
- There are no associated impacts to important populations of Tall Knotweed.
- Vegetation to be cleared is considered marginal and the nearest located individuals are located 4 kilometres from the study area.

Koala *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory)

The Koala is listed as Vulnerable under the EPBC Act and Vulnerable under the TSC Act. It is an arboreal folivore inhabiting eucalypt forests and woodlands throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia (DoE 2015c; OEH 2014j).

Habitat suitability and the home range of Koalas depends on the size and species of trees present, soil nutrients, climate and rainfall. Generally, home ranges are between 1 hectare and 500 hectares and dispersal distances vary from between 3.5 kilometres and 16 kilometres per day (DoE 2015c).

Koalas feed almost exclusively on the leaves of *Eucalyptus*, *Corymbia* and *Angophora* species, although it has been recorded feeding from other tree species including, on occasions, exotic species (DoE 2015c). Primary feed trees include; *Eucalyptus robusta, E. tereticornis, E. punctata, E. haemastoma* and *E. signata* (Department of Planning, 1995). Additional feed trees include some species of *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp. (DoE 2015c).

Approximately 51.63 hectares of suitable Koala habitat was identified within the study area. Koalas and/or signs of Koala activity were recorded throughout the study area. However, the results of targeted surveys indicate that the study area supports a relatively low density of Koalas (≤ 0.1 Koala per hectare). Further, there was no evidence of breeding Koalas (e.g. females with young).

Is there is a real chance or possibility that the action will lead to a long-term decrease in the size of an important population of a species?

An 'important population' is defined by DoE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are:

- Key source populations either for breeding or dispersal.
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Koalas were recorded twice within the study area during surveys. One individual was recorded during winter surveys, and one individual was recorded during spring surveys. It is uncertain whether this represents two records of the same individual or two separate animals. No Koalas were recorded during targeted surveys for this species in summer.

There was no evidence of breeding (in the form of females with young) recorded during the survey period. Targeted SAT surveys indicated that the study area supports only a low density of Koalas (≤0.1 Koala per hectare) (Appendix 4). Given the low population density and the absence of breeding females it is unlikely that the study area supports an important population of Koalas. The action will not therefore lead to a long-term decrease in the size of an important population of Koalas.

Is there a real chance or possibility that the action will reduce the area of occupancy of an important population?

As outlined above, Koalas within the study area do not represent an important population. The Project will not therefore reduce the area of occupancy of an important population.

Is there a real chance or possibility that the action will fragment an existing important population into two or more populations?

As outlined above, Koalas within the study area do not represent an important population. The Project will not therefore reduce the area of occupancy of an important population.

Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of a species?

Habitat critical to the survival of a species or ecological community' is defined by DoE (2013) as areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal.
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- to maintain genetic diversity and long term evolutionary development.
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to habitat identified within the recovery plan for the species and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DoE 2013).

To date, no areas of critical habitat have been listed for the Koala. However, in accordance with EPBC Act Referral Guidelines (DoE 2014) for the vulnerable Koala the removal of Koala habitat resulting from the Project will adversely affect habitat critical to the survival of the species.

Is there a real chance or possibility that the action will disrupt the breeding cycle of an important population?

As outlined above, Koalas within the study area do not represent an important population. The Project will not therefore reduce the area of occupancy of an important population.

Is there a real chance or possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Approximately 51.63 hectares of Koala habitat will be removed for the Project. It is therefore likely that the Project will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent the species is likely to decline locally.

Is there a real chance or possibility that the action will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

Feral dogs *Canis lupus familiaris* were recorded within the study area during field surveys. Dog attack is known to be a significant cause of koala mortality (DoE 2015c). However, the Project is unlikely to result in an increase of invasive species, including feral dogs.

An action is likely to have a significant impact on a vulnerable species is there a real chance or possibility that the action will introduce disease that may cause the species to decline,

The most well-known disease affecting koala populations is associated with particular strains of *Chlamydia* (DoE 2015c). Many koalas carry *Chlamydia* but do not always show clinical symptoms, however for those that do, the symptoms include; eye, urinary tract, respiratory track and reproductive tract infections. It is unknown whether the two koalas identified within the study area, or individuals recorded in the broader area have this disease (DoE 2015c). Another well-known disease is Koala Retrovirus (KoRV). This disease is transmitted genetically and from koala to koala via close contact. Up to 100% of koalas in Queensland and NSW are thought to have KoRV (DoE 2015c). Neither of these diseases will increase or lead to species decline as a result of the Project.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result interfere substantially with the recovery of the species.

An approved recovery plan was prepared for the Koala in November 2008 (DECC 2008). The objectives of both the National Koala Conservation Strategy (ANZECC 1998) and the Approved Koala Plan (DECC 2008) are provided below:

- Objective 1: To conserve Koalas in their existing habitat.
- Objective 2: To rehabilitate and restore Koala habitat and populations.
- Objective 3: To develop a better understanding of the conservation biology of Koalas.
- Objective 4: To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local scale.
- Objective 5: To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care.
- Objective 6: To manage over browsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat.
- Objective 7: To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The Project is likely to conflict with Objective 1.

Conclusion

Based on the above assessment it is likely that Koalas will be significantly impacted by the Project and as such, a Referral under the provisions of the EPBC Act is recommended for this species.

Grey-headed Flying-Fox *Pteropus poliocephalus*

The Grey-headed Flying-Fox *Pteropus poliocephalus* is listed as Vulnerable under the EPBC Act and as Vulnerable under the TSC Act. Grey-headed Flying-Fox is a canopy-feeding frugivore, blossom-eater and a nectarivore of rainforests, tall sclerophyll forests and woodlands, heaths and swamps, gardens and cultivated fruit crops (DoE 2015d).

They forage opportunistically, often at distances up to 30 kilometres from camps, and occasionally up to 60–70 kilometres per night, in response to patchy food resources (NSW Scientific Committee 2001). The species congregates in large numbers at roosting sites (camps). Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (OEH 2014k).

One Grey-headed Flying-fox was recorded foraging within the study area during current surveys. The study area provides approximately 53.79 hectares of suitable forage habitat for this species. However, suitable forage habitat is abundant throughout the wider locality.

No roosting or breeding camps of the Grey-headed Flying-fox were recorded within the study area during the current surveys.

Is there is a real chance or possibility that the action will lead to a long-term decrease in the size of an important population of a species?

An 'important population' is defined by DoE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

During the field survey Grey-headed Flying Foxes were recorded within the study area. Additionally, background searches revealed that approximately 23 individuals had been previously recorded approximately 3.5 kilometres of the study area (OEH 2014f). The Project will remove 53.79 hectares of forage habitat for the Grey-headed Flying-fox. However, given the extent of suitable forage habitat in the locality, the mobility of the species and the absence of roost or breeding camps within or in proximity to the study area it is unlikely that the Project will adversely decrease the size of these populations.

Is there a real chance or possibility that the action will reduce the area of occupancy of an important population?

The study area is not considered to support an important population of the Grey-headed Flying-fox. Approximately 53.79 hectares of forage habitat will be cleared for the Project. This clearing is unlikely to significantly reduce the area of occupancy given that no known breeding or roosting camps were within the study area.

Is there a real chance or possibility that the action will fragment an existing important population into two or more populations?

Grey-headed Flying-foxes are highly mobile animals. Clearing of approximately 53.79 hectares of forage habitat will not fragment the local population.

Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of a species?

'Habitat critical to the survival of a species or ecological community' is defined by DoE (2013) as areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long term evolutionary development.
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to habitat identified within the recovery plan for the species and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DECCW 2009b; DoE 2013).

To date, no areas of critical habitat have been listed for the Grey-headed flying-fox. The study area provides forage habitat only for Grey-headed Flying-fox. There are many known examples of better quality and better-suited habitat within the broader area. Given that the Grey-headed Flying-foxes is a highly mobile species, habitat clearing associated with the Project is unlikely to adversely affect habitat critical to the survival of the species.

Is there a real chance or possibility that the action will disrupt the breeding cycle of an important population?

No known breeding or roosting camps of the Grey-headed flying-fox were found within the study area. Given that individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (OEH 2014k), clearing of the vegetation in the study area would not disrupt the breeding cycle of the local population.

Is there a real chance or possibility that the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Approximately 53.79 hectares of forage habitat for Grey-headed flying-fox will be cleared for the Project. There are other suitable habitats within the broader region already known to support Grey-headed Flying-fox populations. Therefore, the Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

There are no specific invasive species known to be harmful to Grey-headed Flying Foxes therefore the Project is unlikely to have a significant impact.

Is there is a real chance or possibility that the action will introduce disease that may cause the species to decline?

The effects of the diseases such as Australian bat Lyssavirus (ABL), Bat Paramyxovirus and Menangle Pig virus on the Grey-headed Flying-fox are unknown (DoE 2015d). However, the Project is unlikely to introduce disease that may cause species decline.

Is there a real chance or possibility that it will result interfere substantially with the recovery of the species?

There is a draft national recovery plan for the Grey-headed flying fox (DECCW 2009). Objectives of the recovery plan include:

- To reduce the impact of threatening processes.
- To arrest decline throughout their range.
- To conserve their functional roles in seed dispersal and pollination of native plants.
- To improve the comprehensiveness and reliability of information available to guide recovery.

- The Project is unlikely to conflict with any of these objectives and will therefore unlikely interfere substantially with the recovery of the species.

Conclusion

Based on the above assessment the Grey-headed Flying-fox is unlikely to be significantly impacted by the Project and as such, a Referral under the provisions of the EPBC Act is not recommended for this species.

Spotted-tailed Quoll *Dasyurus maculatus maculatus* (SE mainland population)

The Spotted-tailed Quoll *Dasyurus maculatus maculatus* (SE mainland population) is listed as Endangered under the EPBC Act and as Vulnerable under the TSC Act. It is a nocturnal, carnivorous marsupial with reddish-brown fur and distinctive white spots (DoE 2015e).

It is recorded across a range of habitat such as; rainforest, open forest, woodland, coastal heath, inland riparian forest, the sub-alpine zone to the coastline in eastern NSW, eastern Victoria, south-east and north-eastern Queensland and Tasmania (DoE 2015e; OEH 2014l).

Spotted-tailed Quolls use hollow-bearing trees, fallen logs, caves, rock outcrops and rocky-cliff faces as den sites and have an average litter size of five (OEH 2014l). They are a generalist predator, preying on; gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, domestic foul, reptiles and insects (OEH 2014l).

Spotted-tailed Quolls were not recorded within the study area during the current surveys, despite the use of survey methods targeting this species. Given the proximity of records of the Spotted-tailed Quoll from the wider locality, combined with habitat assessment it is assumed that the Project will remove approximately 53.79 hectares of potential habitat for this species.

Is there a real chance or possibility that it will lead to a long-term decrease in the size of a population?

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

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

- Despite targeted surveys, no Spotted-tailed Quolls were found within the study area. However, 30 recent Spotted-tailed Quoll records occur within 10 kilometres of the study area (OEH 2014f). Within the study area, approximately 53.79 hectares of suitable habitat for the Spotted-tailed Quoll will be cleared for the Project. However, clearing this habitat is unlikely to lead to a long-term decrease in the size of a population given that no population was identified within the study area, and there are known populations and alternative habitat within the broader area.

Is there a real chance or possibility that the action will reduce the area of occupancy of the species?

Vegetation clearance is likely to remove approximately 53.79 hectares of potentially suitable habitat for Spotted-tailed Quoll, however given that no individuals were observed during the field survey it is unlikely to reduce the area of occupancy of the species. There are known areas of occupancy within the wider locality that will not be impacted by the Project.

Is there a real chance or possibility that the action will fragment an existing population into two or more populations?

Despite targeted surveys, no Spotted-tailed Quolls were found within the study area. The removal of habitat is therefore not anticipated to have a significant impact causing population fragmentation.

Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of a species?

'Habitat critical to the survival of a species' is defined by DoE (2013) as areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to habitat identified within the recovery plan for the species and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DoE 2013).

To date, no areas of critical habitat have been listed for the Spotted-tailed Quoll. The Project will not therefore adversely affect habitat critical to the survival of the Spotted-tailed Quoll.

Is there a real chance or possibility that the action will disrupt the breeding cycle of a population?

The Spotted-tailed Quoll requires suitable den sites (such as hollow logs, tree hollows, rock outcrops or caves) for breeding (DoE 2015e; OEH 2014m). Within the study area, hollow-bearing trees and hollow logs provide potential breeding habitat for this species. The Spotted-tailed Quoll was not recorded within the study area during the current surveys. Although the study area provides suitable potential breeding habitat for this species, more extensive similar or better quality habitat occurs in the wider locality. Suitable habitat in surrounding lands will not be impacted by the Project.

Given the absence of records of this species and the occurrence of suitable habitat in the wider locality, the Project will not disrupt the breeding cycle of a population of the Spotted-tailed Quoll.

Is there a real chance or possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

In total approximately 53.79 hectares of potentially suitable habitat will be cleared for the Project. Habitat clearing associated with the Project is unlikely to adversely affect habitat critical to the survival of the species for the following reasons:

- The species is often associated with a wide range of vegetation formations, classes and types (OEH 2014l).
- The species is highly mobile and there are is other suitable habitat within the broader area.
- No individuals were recorded found within the study area.

Is there a real chance or possibility that the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?

Despite targeted surveys, no Spotted-tailed Quolls were found within the study area. However, Red Foxes *Vulpes vulpes* and Dogs *Canis lupus familiaris,* which are major threats to the Spotted-tailed Quoll (DoE 2015e) were observed in the study area and may affect populations of Spotted-tailed Quolls within the broader area. The Project is unlikely to result in an increase of invasive species, including dogs and foxes.

Is there a real chance or possibility that the action will introduce disease that may cause the species to decline?

There are no known diseases likely to impact Spotted-tailed Quoll.

Is there a real chance or possibility that the action will interfere with the recovery of the species?

To date, there is currently no recovery plan for the Spotted-tailed Quoll however OEH lists 4 activities to assist with the recovery of this species:

- Consult with OEH/NPWS if Spotted-tailed Quolls are raiding poultry, rather than taking direct action.
- Consult with OEH/NPWS if poison baiting is planned in or near areas where Spotted-tailed Quolls are known or likely to occur.
- Undertake cat and fox control using poison-baiting techniques least likely to affect quolls.
- Retain and protect large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understorey or dense vegetation along drainage lines.

- The Project is not considered to significantly impact or interfere with the recovery of Spotted-tailed Quolls.

Conclusion

Based on the above assessment the Spotted-tailed Quoll is unlikely to be significantly impacted by the Project and as such, a Referral under the provisions of the EPBC Act is not recommended for this species.

Blossom-dependent birds: Regent Honeyeater *Anthochaera phrygia* and Swift Parrot *Lathamus discolor*

The Regent Honeyeater *Anthochaera phrygia* is listed as Endangered under the EPBC Act and Critically Endangered under the TSC Act. The Regent Honeyeater inhabits temperate woodlands, open forests and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak (DoE 2015f; OEH 2014n).

It occurs mainly within vegetation communities that have a significantly high abundance and species richness of bird species as well as a large number of mature trees, high canopy cover and an abundance of mistletoes (OEH 2014n). They are distributed mainly in vegetation communities on inland slopes of south-east Australia but can sometimes be found in drier coastal woodlands and forests some years (OEH 2014n).

The Regent Honeyeater is a generalist forager, feeding on nectar from a wide range of *Eucalyptus* species and mistletoes (DoE 2015f; OEH 2014n).

The Swift Parrot *Lathamus discolor* is listed as Endangered under the EPBC Act and as Endangered under the TSC Act. The Swift Parrot is a highly nomadic species that inhabits dry sclerophyll eucalypt forests and woodlands in New South Wales (DoE 2015g; OEH 2014o). It migrates in response to food availability and seasonal changes. It is often recorded in New South Wales between May and August and breeds in Tasmania during the warmer seasons (DoE 2015g; OEH 2014o).

The Swift Parrot is mainly an arboreal forager, feeding on nectar (mainly from eucalypts) as well as psyllid insects and lerps, seeds and fruits. Favoured feed trees include winter-flowering species such as *Eucalyptus robusta, E. albens, E. sideroxylon*, *Corymbia maculata* and *C. gummifera*. Commonly used lerp-infested trees include *Eucalyptus microcarpa*, *E. moluccana* and *E. pilularis* (DoE 2015g).

Targeted surveys in winter and spring did not record the Regent Honeyeater or the Swift Parrot within the study area. Given the proximity of recent records combined with the results of habitat assessment it is considered that the Project will remove 53.79 hectares of potential foraging habitat for both of these species. However, more extensive areas of similar or better quality habitat for the Regent Honeyeater and the Swift Parrot occurs throughout the wider locality.

Is there a real chance or possibility that the action will lead to a long-term decrease in the size of a population?

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

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

Despite targeted surveys, neither the Regent Honeyeater nor Swift Parrot were recorded within the study area. However, both species may occasionally utilise seasonal forage habitat within the study area, albeit infrequently. Wildlife Atlas data indicates that the closest record for the Regent Honeyeater is approximately 4.5 kilometres while the closest record for the Swift Parrot is 5 kilometres from the study area (OEH 2014o). Within the Hunter-Central region, both the Regent Honeyeater and Swift Parrot are associated with a range of vegetation formations, classes and types with extensively recorded 'known' distributions outside the study area. It is therefore considered unlikely that the Project will lead to a long-term decrease in the size of a population (OEH 2014n; OEH 2014o).

Is there a real chance or possibility that the action will reduce the area of occupancy of the species?

The study area does not lie at or near the limit of the area of occupancy of the Swift Parrot, which extends from south east Queensland through New South Wales, Victoria to South Australia and Tasmania (Pizzey and Knight 2012). In addition, the study area does not lie near the limit of the area of occupancy of the Regent Honeyeater, which extends from South-east Queensland to Victoria (Pizzey and Knight 2012). Given the absence of records of these species within the study area, the extent of suitable habitat in the wider locality and the high mobility of these species, it is considered unlikely that the proposal would reduce the area of occupancy of the Regent Honeyeater and/or Swift Parrot.

Is there a real chance or possibility that the action will fragment an existing population into two or more populations?

Clearing of approximately 48.62 hectares of potential forage habitat for the Project will not fragment an existing population of either species into two or more populations give:

- Regent Honeyeaters and Swift Parrots have not been recorded within the study area.
- Larger areas of similar or better quality forage habitat for these species occurs throughout the wider locality.
- The Regent Honeyeater and the Swift Parrot are highly mobile blossom nomads.

Is there a real chance or possibility that the action will adversely affect habitat critical to the survival of a species?

Approximately 53.79 hectares of potential forage habitat for the Regent Honeyeater and the Swift Parrot will be removed for the Project. Given the absence of records of these species within the study area and the extent of suitable forage habitat in the wider locality it is considered unlikely that the Project will adversely affect habitat critical to the survival of the Regent Honeyeater and/or the Swift Parrot.

Is there a real chance or possibility that the action will disrupt the breeding cycle of a population?

The Project will remove approximately 48.62 hectares of potential foraging habitat for the Regent Honeyeater and Swift Parrot. However, given the extensive habitat occurring outside the study area provided that both species are highly mobile (frequently migrating in response to food availability and seasonal changes) (DoE 2015f; DoE 2015g). It therefore considered unlikely that the Project would disrupt the breeding cycle of a population of either of these species.

Is there is a real chance or possibility that the action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Project will remove approximately 53.79 hectares of potential foraging habitat for the Regent Honeyeater and Swift Parrot. More extensive areas of similar or better habitat for these species occur in the wider locality. These species have not been recorded within the study area, and are both highly mobile species. It is therefore unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat for either the Regent Honeyeater or the Swift Parrot to the extent that either of these species is likely to decline.

Is there is a real chance or possibility that the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?

The Regent Honeyeater and Swift Parrot would be susceptible to predation by foxes and feral dogs (which were recorded within the study area) however the impact of predation from these species is noted as being low and is not a focus of recovery actions (DoE 2015f; DoE 2015g). The Project is unlikely to increase the number of invasive predatory species that will significantly impact on the Regent Honeyeater and/or Swift Parrot.

Is there a real chance or possibility that the action will introduce disease that may cause the species to decline?

There are no known diseases impacting Regent Honeyeater.

Infection by *Psittacine circoviral* (beak and feather) disease (PCD) affecting endangered psittacine species is listed as a key threatening process (DoE 2015g). Swift parrots are considered to have a high potential for being adversely impacted by PCD due to their low population numbers and the fact that PCD has been recorded in wild birds in New South Wales (DoE 2015g). The Project is unlikely to result in the introduction of PCD into the study area, or increase the incidence of PCD in birds in New South Wales.

Is there a real chance or possibility that the action will interfere with the recovery of the species?

A recovery plan exists for the Regent Honeyeater and was developed in 1999 (Menkhorst et al. 1999).

A national recovery plan for the Swift Parrot was developed in 2011 (Saunders and Tzaros 2011). The overall objective of the plan is to; prevent further population decline of the Swift Parrot, to achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat and to increase carrying capacity. Main recovery actions implemented to achieve these objectives are (Saunders and Tzaros 2011):

- Objective 1: To identify and prioritise habitats and sites used by the species across its range, on all land tenures.
- Objective 2: To implement management strategies to protect and improve habitats and sites on all land tenures
- Objective 3: To monitor and manage the incidence of collisions, competition and Beak and Feather Disease (BFD).
- Objective 4: To monitor population trends and distribution throughout the range.

The Project is unlikely to conflict or interfere with the recovery of the Regent Honeyeater and/or the Swift Parrot.

Conclusion

Based on the above assessment the Regent Honeyeater and the Swift Parrot are unlikely to be significantly impacted by the Project and as such, a Referral under the provisions of the EPBC Act is not recommended for either of these species.

White-bellied Sea-eagle *Haliaeetus leucogaster*

White-bellied Sea-eagle was delisted as a migratory species under the EPBC Act on 1 July 2015. Within Australia it is distributed around the Australian coastline including Tasmania (Threatened Species Section 2006), as well as inland along rivers and wetlands of the Murray Darling Basin (Pizzey and Knight 2006; NSW Scientific Committee 2016). The population of White-bellied Sea-eagle in NSW is moderately low with studies estimating the population size to consist of approximately 800 breeding pairs, or 1,600 mature adults (Debus 2008; NSW Scientific Committee 2016). It is likely this estimate is conservative and, allowing for a floating population and uncertainty associated with study estimations, the total NSW population probably exceeds 2,500 individuals but is likely to be fewer than 10,000 mature individuals (NSW Scientific Committee 2016).

'Important habitat' for the species

Important habitat for White-bellied Sea-eagle includes nesting and foraging habitat, as these habitat types are of critical importance to the species at particular life-cycle stages. Generally nesting habitat consists of areas of mature open forests within 5 km of a large water body, or more rarely on sea cliffs and rock stacks (Threatened Species Section 2006, O'Donnell and Debus 2012). Nest trees are typically emergent eucalypts, with dead emergent branches used as 'guard roosts' (O'Donnell and Debus 2012; NSW Scientific Committee 2016). Remnant trees located in pasture are also occasionally utilised, however forest locations are preferred and likely enhance breeding success (O'Donnell and Debus 2012).

Foraging habitat typically consists of areas incorporating large waterbodies to support the Sea-eagle diet of waterbirds, freshwater turtles, and fish (Debus 2008; NSW Scientific Committee 2016). Nesting grounds are usually selected in close proximity to foraging grounds, potentially to capitalise on the energetic efficiency of transporting large prey to nestlings (O'Donnell and Debus 2012).

Table 49 White-bellied Sea-eagle, listed migratory species - assessment against Significant Impact Criteria (CoA 2013)

Significant Impact Criteria (migratory species)	Likelihood of significant impact	Justification
1. 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.	Low	The proposed development involves the removal of 53.79 hectares of native vegetation covering six PCTs. 53.06 ha, covering four PCTs, can be broadly characterised as open dry/wet sclerophyll forest (OEH 2017), which is one of the preferred vegetation types for White-bellied Sea-eagle. The development is also approximately 3.5 km from Williams River which represents foraging habitat for the species. Given the presence of open sclerophyll forest within the study area, and the proximity of the foraging habitat along Williams River, the vegetation within the study area could be considered important nesting habitat for the species. However, studies have shown an adverse relationship exists between human activities and Sea-eagle breeding outcomes, with Sea-eagles becoming agitated and flushing from nest sites when humans approach (Dennis et al. 2011; Clunie 2003). Flushing distances of up to 800 m have been recorded in some studies (Debus 2008) and disturbance during courtship and early in the breeding season can result in eggs or small young being abandoned (Dennis et al. 2011). The existing operations occurring within the quarry are likely to represent a significant deterrent to the breeding pairs nesting in the immediate vicinity. It is probable that breeding individuals would preferentially

Significant Impact Criteria (migratory species)	Likelihood of significant impact	Justification
		select nesting sites in the large vegetation patch to the north of the quarry away from human disturbance. Given the species adversity to human activity it is likely the areas immediately surrounding the quarry (including the study area) are not utilised by the species for breeding, and therefore do not constitute important habitat. Due to the existing human disturbance represented by the quarry activities, and the large quantity of intact habitat located to the north, there is a low likelihood of significant impact to White-bellied Sea-eagle from the proposed development.
2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory.	Low	Direct threats to White-bellied Sea-eagle as a result of invasive species have not been documented (DoE 2019a; NSW Scientific Committee 2016). Invasive species harmful to White-bellied Sea-eagle are therefore likely to include species that impact on their food sources. However, it should be noted that introduced fish (including trout) can act as an additional food source for Sea-eagles resulting in higher food abundances (Debus 2008). Sea-eagles may also be at risk of non-target poisoning in areas where pest vertebrate invasive species are subject to poison control programs (Clunie 2003; NSW Scientific Committee 2016). Given the diet of White-bellied Sea-eagles is dominated by aquatic fauna, the proposed works are unlikely to result in the establishment of harmful invasive species that would impact on the eagles food sources. Therefore, there is a low likelihood of impact from invasive species to important habitat of White-bellied Sea-eagle.
3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Low	As detailed above, it is unlikely that White-bellied Sea-eagles utilise the areas surrounding the quarry for nest sites given their adversity to human activity (Debus 2008; Dennis et al. 2011). White-bellied Sea-eagles are also territorial when breeding with the core territory defended around nesting sites typically consisting of a 1,000 m radius (Dennis et al. 2011). In the unlikely event that Sea-eagles are nesting in proximity to the existing quarry, the core territory defended by a breeding pair would make it unlikely that any more than two breeding pairs would be present in the area. This represents approximately 0.16% of the NSW population (assuming a population of 2,500 individuals, NSW Scientific Committee 2016), which is not considered to be an ecologically significant proportion of the population. Given the factors outlined above there is a low likelihood of serious disruption to the lifecycle of an ecologically significant proportion of the population of White-bellied Sea-eagle as a result of the proposed development.

Black-faced Monarch *Monarcha melanopsis*

Black-faced Monarch is a listed migratory species under the EPBC Act. It is widespread across eastern Australia with a known distribution encompassing the entire eastern seaboard (DoE 2019b; Pizzey and Knight

2006). The population in NSW occurs around the eastern slopes and tablelands of the Great Divide, and is rarely recorded farther inland (DoE 2019b).

The Black-face Monarch typically occurs in rainforest ecosystems but can also be found in gullies in mountain areas or coastal foothills, softwood scrub dominated by Brigalow *Acacia harpophylla*, and coastal scrub dominated by Coast Banksia *Banksia integrifolia* and Southern Mahogany *Eucalyptus botryoides*. It is also occasionally found among mangroves, and sometimes in suburban parks and gardens (DoE 2019b).

'Important habitat' for the species

Black-faced Monarch is a wet forest specialist and important habitat for the species has been defined in the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015) as rainforest and wet sclerophyll forest, especially in sheltered gullies and slopes, with a dense understorey of ferns and/or shrubs (DoE 2015). The important habitat impact area threshold, above which a significant impact to the species is likely, is 2,660 ha for international significance, and 260 ha for national significance (DoE 2015).

Table 50 Black-faced Monarch, listed migratory species - assessment against Significant Impact Criteria (CoA 2013)

Significant Impact Criteria for listed migratory species (CoA 2013).	Likelihood of the Project triggering criteria for migratory bird species	Notes
1. 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.	Low	The proposed works involve the removal of 53.79 hectares of native vegetation covering six PCTs. PCT 1584 can be broadly characterised as wet sclerophyll forest (OEH 2017) which matches one of the important habitat types for this species, and is present across 2.16 hectares of the study area. This patch exists as a small fragment directly adjacent to the existing quarry. Given the small size of the patch, which is less than the 260 ha important habitat area threshold defined for the species (DoE 2015), it does not satisfy the criteria for important habitat for this species. Furthermore, in its already fragmented state, there is a low likelihood its removal would lead to further fragmentation that would result in a significant impact to Black-faced Monarch.
2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory.	Low	The invasive species Black Rat *Rattus rattus*, and invasive vines of riparian habitat such as Rubber Vine *Cryptostegia grandiflora* have been defined as harmful invasive species to Black-faced Monarch in the referral guidelines for the species (DoE 2015). The proposed works are highly unlikely to result in the establishment of Black Rat or Rubber Vine within the study area. It is recommended that a suitable weed management protocol is implemented to ensure that no transfer of weeds or pests occur as a result of the proposed works. Therefore, there is a low likelihood of impact to Black-faced Monarch as a result of an invasive species becoming established in an area of important habitat for the species.
3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically	Low	The proportion of the Black-faced Monarch population that has been determined as 'ecologically significant' is 4,600 individuals (1% of the total population) for international importance, and 460 individuals (0.1% of the total population) for national important (DoE 2015). The proportion of the

Significant Impact Criteria for listed migratory species (CoA 2013).	Likelihood of the Project triggering criteria for migratory bird species	Notes
significant proportion of the population of a migratory species.		population likely to result in a significant impact if affected is 465 for international importance, and 47 for national importance (DoE 2015). Breeding habitat for Black-faced Monarch has been identified as rainforest habitat, where it typically nests near the top of trees with large leaves, as well as gallery forest, waterside thickets, wet sclerophyll forest with a tall shrub layer, and occasionally in mangroves (DoE 2019b; Pizzey and Knight 2006). Of these habitat types only 2.16 ha of wet sclerophyll forest (PCT 1584) has been identified for removal within the study area. This area is unlikely to support an ecologically significant proportion of the population (460 individuals for national importance). Furthermore, the size of this patch is less than the 250 ha important habitat area threshold defined for the species (DoE 2015). Given the factors outlined above there is a low likelihood of serious disruption to the lifecycle of an ecologically significant proportion of the population of Black-faced Monarch as a result of the proposed development.

Rainbow Bee-eater *Merops ornatus*

Rainbow Bee-eater was delisted as a migratory species under the EPBC Act on 7 June 2016. It is the only species of bee-eater in Australia and is distributed across much of mainland Australia (Boland 2004; DoE 2019c; Pizzey and Knight 2006). The total population size of the Rainbow Bee-eater in Australia has not been estimated and the population within NSW has not been defined (DoE 2019c). It occurs mainly in open forests and woodland, shrublands, and in various cleared or semi-cleared habitats including sandpits, road cuttings, and golf courses (DoE 2019c; Pizzey and Knight 2006).

'Important habitat' for the species

Important habitat for Rainbow Bee-eaters includes nesting and foraging habitat, as these areas are of critical importance to the species at particular life-cycle stages. Nest sites are typically located in open sclerophyll forest and heath where the birds build unlined ovoid chambers at the end of straight tunnels, excavated directly into flat or sloping ground, or into cliff faces (Boland 2004). The species is known to utilise various cleared or semi-cleared habitat, including farmland and areas of human habitation, and breeding burrows have been recorded in gravel heaps and vehicle ruts as well as the more typical ridge, creek bank and low cliff areas (DoE 2019; Lill 1993).

Table 51 Rainbow Bee-eater, listed migratory species - assessment against Significant Impact Criteria (CoA 2013)

Significant Impact Criteria for listed migratory species (CoA 2013).	Likelihood of the Project triggering criteria for migratory bird species	Notes
1. 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.	Low	The proposed development involves the removal of 53.79 hectares of native vegetation covering six PCTs. 53.06 ha, covering four of the PCTs, can be broadly characterised as open dry/wet sclerophyll forest (OEH 2017), and represents potential breeding habitat for the species. However, given the wide range of habitats where this species breeds, including cleared and semi-cleared areas, and the large quantity of intact vegetation located to the north of the quarry, this habitat is unlikely to constitute 'important habitat' for this species. Therefore, there is a low likelihood of impact to important habitat for Rainbow Bee-eater as a result of the proposed development.
2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory.	Low	Invasive species harmful to the Rainbow Bee-eater include predatory species that prey on eggs and nestlings. These include foxes *Vulpes vulpes*, dingoes *Canis familiaris dingo*, feral dogs *Canis lupus familiaris*, and Cane Toads *Bufo marinus*. One study found nest predation by native predators affected 10% nests, whilst predation by dingoes and cane toads alone accounted for 49% of all nest terminations (Boland 2004). The proposed works are highly unlikely to result in the establishment of above-mentioned harmful invasive species within the study area. Therefore, there is a low likelihood of impact to Rainbow Bee-eater as a result of an invasive species becoming established in an area of important habitat for the species.
3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	Low	The open sclerophyll forest located within the study area represents potential breeding habitat for Rainbow Bee-eater. However, given the wide range of habitats where this species breeds, including cleared and semi-cleared areas, and the large quantity of intact vegetation located to the north of the quarry, this habitat is unlikely to constitute 'important habitat' for this species. Therefore, there is a low likelihood of impact to important habitat for Rainbow Bee-eater as a result of the proposed development. Furthermore, the only actual identified threat to Rainbow Bee-eater is the invasive species Cane Toad. This species reduces the breeding success and productivity of the bee-eater by feeding on eggs and nestlings, and usurping and occupying nesting burrows (Boland 2004; DoE 2019c). The proposed works are unlikely to result in the establishment or increased prevalence of Cane Toad within the study area (Boland 2004; DoE 2019c). Given the factors outlined above there is a low likelihood of serious disruption to the lifecycle of an ecologically significant proportion of the population of Rainbow Bee-eater as a result of the proposed development.

Conclusion

The significant impact assessments undertaken above for White-bellied Sea-eagle, Black-faced Monarch, and Rainbow Bee-eater have been undertaken in reference the recommendations to avoid, minimise and mitigate impacts detailed in the BAR. These assessments found a low likelihood of impact for these species against the significant impact criteria for listed migratory species under the EPBC Act.

Appendix 7 Credit profile report

Biodiversity credit report

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

Date of report: 23/05/2019 Time: 1:15:50PM Calculator version: v4.0

Major Project details

Proposal ID:	0095/2019/4980MP
Proposal name:	Brandy Hill Quarry Expansion BBA Stage 1
Proposal address:	979 Clarence Town Road Seaham NSW 2324
Proponent name:	Hanson Construction Materials Pty Ltd
Proponent address:	Level 5 75 George Street Parramatta NSW 2150
Proponent phone:	02 9354 2638
Assessor name:	Rebecca Dwyer
Assessor address:	8 Tate Street Wollongong NSW 2500
Assessor phone:	02 4201 1054 0095
Assessor accreditation:	

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	11.24	647.00
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	7.54	434.00
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	2.01	96.00
Total	20.79	1,177

Credit profiles

1. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798)

Number of ecosystem credits created	96
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798) Tallowwood - Small-fruited Grey Gum - Kangaroo Grass grassy tall open forest on foothills of the lower North Coast, (HU762) Tallowwood - Smooth-barked Apple - Blackbutt grass tall open forest of the Central and lower North Coast, (HU770) Pink Bloodwood - Thin-leaved Stringybark - Grey Ironbark shrub - grass open forest on ranges of the lower North Coast, (HU772)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814)

Number of ecosystem credits created	434
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816)

Number of ecosystem credits created	647
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter 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
Koala	Phascolarctos cinereus	18.78	488

Biodiversity credit report

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

Date of report: 23/05/2019 Time: 1:23:53PM Calculator version: v4.0

Major Project details

Proposal ID:	0095/2019/4980MP
Proposal name:	Brandy Hill Quarry Expansion BBA Stage 2
Proposal address:	979 Clarence Town Road Seaham NSW 2324
Proponent name:	Hanson Construction Materials Pty Ltd
Proponent address:	Level 5 75 George Street Parramatta NSW 2150
Proponent phone:	02 9354 2638
Assessor name:	Rebecca Dwyer
Assessor address:	8 Tate Street Wollongong NSW 2500
Assessor phone:	02 4201 1054
Assessor accreditation:	0095

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Forest Red Gum grassy open forest on floodplains of the lower Hunter	1.67	111.22
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.64	440.00
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	0.27	15.00
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	14.59	840.00
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	0.15	7.00
Total	24.32	1,413

Credit profiles

1. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798)

Number of ecosystem credits created	7
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798) Tallowwood - Small-fruited Grey Gum - Kangaroo Grass grassy tall open forest on foothills of the lower North Coast, (HU762) Tallowwood - Smooth-barked Apple - Blackbutt grass tall open forest of the Central and lower North Coast, (HU770) Pink Bloodwood - Thin-leaved Stringybark - Grey Ironbark shrub - grass open forest on ranges of the lower North Coast, (HU772)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806)

Number of ecosystem credits created	15
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814)

Number of ecosystem credits created	840
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816)

Number of ecosystem credits created	440
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5. Forest Red Gum grassy open forest on floodplains of the lower Hunter, (HU812)

Number of ecosystem credits created	111
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum grassy open forest on floodplains of the lower Hunter, (HU812) Coastal floodplain sedgelands, rushlands, and forblands of the North Coast, (HU532) Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion, (HU635) Parramatta red gum - Fern-leaved banksia - Melaleuca sieberi swamp woodland of the Tomaree Peninsula, (HU865) Prickly-leaved Paperbark - Flax-leaved Paperbark swamp forest on poorly drained soils of the Central Coast, (HU929) Cabbage Gum - Forest Red Gum - Flax-leaved Paperbark Floodplain Forest of the Central Coast, (HU934) Swamp Oak - Sea Rush - Baumea juncea swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU941) Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast, (HU942) Grey Gum - Red Gum - Paperbark shrubby open forest on coastal lowlands of the Northern Sydney Basin and Lower North Coast, (HU963)	Upper Hunter 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
Koala	Phascolarctos cinereus	24.17	628

Biodiversity credit report

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

Date of report: 6/08/2019 Time: 1:58:06PM Calculator version: v4.0

Major Project details

Proposal ID:	0095/2019/4980MP
Proposal name:	Brandy Hill Quarry Expansion BBA Stage 3
Proposal address:	979 Clarence Town Road Seaham NSW 2324
Proponent name:	Hanson Construction Materials Pty Ltd
Proponent address:	Level 5 75 George Street Parramatta NSW 2150
Proponent phone:	02 9354 2638
Assessor name:	Rebecca Dwyer
Assessor address:	8 Tate Street Wollongong NSW 2500
Assessor phone:	02 4201 1054
Assessor accreditation:	0095

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.03	405.00
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	0.85	48.00
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	0.13	7.00
Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast	0.67	46.00
Total	8.68	506

Credit profiles

1. Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806)

Number of ecosystem credits created	48
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814)

Number of ecosystem credits created	7
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816)

Number of ecosystem credits created	405
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Upper Hunter and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast, (HU932)

Number of ecosystem credits created	46
IBRA sub-region	Upper Hunter

Offset options - Plant Community types	Offset options - IBRA sub-regions
Swamp Mahogany - Flax-leaved Paperbark swamp forest on coastal lowlands of the Central Coast, (HU932) Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937)	Upper Hunter 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
Koala	Phascolarctos cinereus	8.68	226

Appendix 8 Targeted Koala Survey Report

Brandy Hill Quarry Expansion

Targeted Threatened Species Survey –

Koala *Phascolarctos cinereus*

Prepared for Hanson Construction Materials Pty Ltd

05 November 2017

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Document information

Report to:	Pip Cox of Hanson
Prepared by:	Carl Corden
Biosis project no.:	19323

File name: 19323.AttachmentB.Targeted.Koala.Survey.FIN01.20150317

Citation: Biosis 2015. Targeted threatened species survey for Koala. Report for Hanson. Author: Corden, C. Biosis Pty Ltd, Sydney Office. Project no. 19323.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Brian Wilson	09.01.2014
Draft version 02	Carl Corden	20.01.2015
Final version 01	Jane Murray	24.02.2015
Updated Final	Samuel Luccitti	05.11.2017

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- Pip Cox and Simon Jones of Hanson

The following Biosis staff were involved in this project:

- Carl Corden for field surveys and reporting
- James Shepherd for mapping
- Jane Murray and Brian Wilson for quality assurance

Contents

1 Introduction

1.1 Background

Hanson Construction Materials Pty Ltd (Hanson) is seeking approval to expand the existing Brandy Hill Quarry located at 979 Clarence Town Rd, Seaham (the Project). The Project will be assessed against Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as a State Significant Development (SSD). To support the design and approval of the Project, Hanson is preparing an Environmental Impact Statement (EIS).

While undertaking the flora and fauna assessments to support the EIS, Biosis identified the presence of the Koala *Phascolarctos cinereus* within the Project area. The Koala is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). The presence of Koalas within the Project area was deemed likely to trigger the requirement to submit a referral for impacts on Commonwealth Matters of National Environmental Significance (NES). A Significant Impact Criteria assessment was therefore undertaken for the Koala, and the results of the assessment confirmed that the Project was likely to result in a significant impact on Koalas.

Targeted Koala and Koala habitat utilisation surveys were recommended to provide additional information for inclusion with the Commonwealth EPBC Act referral for the Project. The need for additional targeted surveys is stipulated by the *EPBC Act referral guidelines for the vulnerable Koala* (Commonwealth of Australia 2014). Biosis Pty Ltd was commissioned by Hanson to undertake targeted Koala surveys to provide additional information to support the Commonwealth EPBC Act referral for the Project.

The following definitions apply to the Project and are used throughout this document:

The **Project area** includes the area that forms the SSD application as per Attachment 1 (Figure 1 and Figure 2) of the EPBC Referral.

The **study area** encompasses the area within the Project area comprising vegetation to be removed, as well as adjacent areas supporting potential Koala habitat (Figure 1 below).

The **Koala** refers to the combined populations of the Koala in Queensland, New South Wales and the Australian Capital Territory, which were determined to be a single population for the purposes of the Vulnerable listing for this species under the Commonwealth EPBC Act.

1.2 Scope of works

The scope of works for this study involved targeted surveys for the Koala using the Spot Assessment Technique (SAT) in conjunction with point searches for Koalas, in line with relevant species survey guidelines (DoE 2013). Surveys were undertaken in December to meet the optimal survey period for this species, and were conducted by an ecologist experienced in Koala survey methods. Following the field survey, the following tasks were completed:

- Identified and mapped koala habitat, activity and recorded the number and location of any Koalas observed.
- Prepared and analysed data in accordance with the SAT to determine habitat utilisation by Koalas within the study area.
- Prepared an EPBC Act referral for the Minister of the Environment.

This report was prepared to provide an addendum to the Biodiversity Assessment Report (Biosis 2015) prepared to support the EIS.

1.3 Objectives of the report

The occurrence of Koalas at the proposed quarry expansion at Brandy Hill was confirmed from sightings of Koalas in addition to detection of scats during both the winter and spring fauna assessments of the Project area. To provide DoE with adequate information to support the determination of whether Project, a state significant development (SSD) under the *Environmental Planning and Assessment Act 1979* (EP&A Act), may potentially become a 'controlled action', Biosis completed targeted Koala surveys using the SAT developed by the Australian Koala Foundation (Phillips and Callaghan 2011) in conjunction with point searches for Koalas.

The objectives of the survey were to establish population density and habitat utilisation within the Project area and the adjacent study area (vegetation to be cleared as part of the proposed SSD and surrounding suitable habitat).

The tasks of the project are identified as follows:

- Undertake a targeted Koala surveys and Koala activity surveys within the Project area and suitable adjoining habitat (study area).
- Determine the potential for the Project area to provide habitat for the Koala.

Given the scope of works outlined above, and relevant species survey guidelines and requirements for the Koala, this report documents the following:

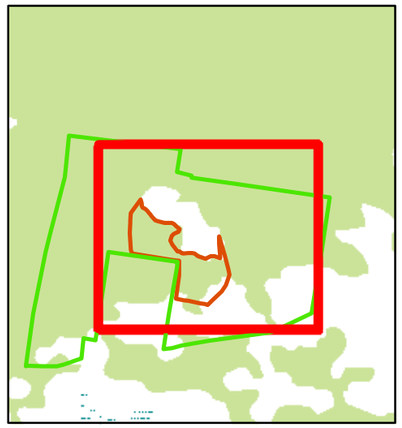
- Background information.
- Survey methodology.
- Survey limitations.
- Results of the field survey.
- Survey conclusion.

Following the survey an EPBC Act referral to the Minister has been prepared, of which this report forms Attachment B, including the details of the proposed SDD works and findings of the targeted Koala surveys and relevant components of the flora and fauna assessment.

1.4 Literature and database review

The following policies, documents and databases were reviewed to provide background information for this report:

- *EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capitol Territory)* (Commonwealth of Australia 2014).
- NSW BioNet - the database for the Atlas of NSW Wildlife (OEH 2015).
- State Environmental Planning Policy (SEPP) No. 44 – Koala Habitat Protection.
- *Port Stephens Comprehensive Koala Plan of Management* (CKPoM) (Port Stephens Council 2002).



Legend

- Koala Survey Grid 200m
- Koala Survey Grid Extent
- Vegetation clearing area

Figure 1: Study area and SAT survey points

0 75 150 225 300 375

Metres
Scale: 1:7,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 19323
Date: 05 January 2015,
Checked by: CAC, Drawn by: LDM, Last edited by: jshepherd
Location:P:\19300s\19323\Mapping
19323_F3_KoalaSatSurvey

2 Background

2.1 Habitat and ecology

Koalas are generally solitary animals inhabiting eucalypt woodlands and forests. They have been known to feed on the foliage of more that 100 eucalypt and non-eucalypt species, though they prefer only a few browse species in any one location. Koalas are inactive for most of the day, spending most of their time in trees and feeding and moving between trees at night. They display complex social hierarchies and territories, with their home range varying between less than two hectares to several hundred hectares, depending on habitat quality (DoE SPRAT 2014).

SEPP 44 defines potential Koala habitat as *"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component"*. Core Koala habitat is defined as *"land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population"*.

SEPP 44 does not apply to Major Projects that are being assessed as SSD. However, SEPP 44 Koala habitat definitions have been used to determine potential and core Koala habitat areas for the study area. The Port Stephens CKPoM mapping was also used to identify Koala habitat within the study area.

2.2 Species distribution

The Koala has a sparse and fragmented distribution throughout the central and north coasts of NSW, and throughout eastern Australia from Queensland to the Eyre Peninsula in South Australia, with some populations occurring west of the Great Dividing Range (DoE SPRAT 2014).

NSW OEH Bionet data indicates a total of 6,749 Koala records from within the Port Stephens LGA, as at 20 January 2015 (OEH 2015). Figure 2 shows the locality of historical records of the species in the immediate locality of the study area (NSW OEH Bionet 2015).

Legend

- Koala records (OEH Bionet)
- Search area
- Study area

Figure 2: Koala records within 10km of the study area

0 860 1,720 2,580 3,440 4,300

Metres

Scale: 1:86,000 @ A3

Coordinate System: GDA 1994 MGA Zone 55

N

biosis

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Matter: 15743
Date: 20 January 2015,
Checked by: , Drawn by: SMV, Last edited by: jshepherd
Location:P:\19300s\19323\Mapping
19323_F2_KoalaRecords

3 Methodology

All Biosis field surveys were conducted by a qualified and competent zoologist under the authority of a current NSW *National Parks and Wildlife Act, 1974* Scientific Licence (SL100758) to harm/trap/pick/hold/study protected fauna and native flora, and a current Animal Research Authority (ARA) (TRIM 14/271#4) issued under the NSW *Animal Research Act, 1985* Certificate of Approval by the Animal Ethics Committee (AEC) of the Director-General of NSW Agriculture to conduct fauna survey work carried out as part of Environmental Impact Statements, Species Impact Statements and general wildlife research.

3.1 Previous Surveys

Comprehensive flora and fauna surveys were conducted within the study area in winter and spring. These surveys included vegetation mapping (identifying the occurrence of Koala feed trees) and targeted threatened fauna searches, including diurnal and nocturnal searches for Koalas. Methods used to search for Koalas included:

- Diurnal searches of trees for Koalas within bird census and BioBanking plots.
- Diurnal incidental searches beneath Koala feed trees within bird census and vegetation survey plots for signs of Koalas (scats and scratches).
- Diurnal incidental searches of trees for Koalas and signs of Koala activity while traversing the Project area and the study area.
- Nocturnal spotlighting and call playback for Koalas throughout the Project area and study area.

3.2 Current SAT and point surveys

Targeted Koala and Koala activity surveys were conducted 9 to 11 December 2014. Surveys were conducted by 3 or 4 staff for a maximum of 8 hours on each day. The timing of the surveys was considered appropriate for detecting both Koalas and signs of Koala activity as stipulated in the Draft Koala Referral Guidelines (DoE 2013). The targeted survey was guided by key documents:

- *Draft EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)* (DoE 2013).
- The *Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas Phascolarctos cinereus* (Phillips and Callaghan 2011).
- DRAFT NSW *Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004).
- Department of the Environment's (DoE) Species Profile and Threats Database (SPRAT).

Koala SAT and point survey locations were selected using a systematic grid-based approach. A 200m interval grid was placed over a map of the Project and study areas and the intercept points of the grid were used as potential survey sites. Figure 1 shows the location of potential Koala SAT survey points.

From the potential points, final survey sites were selected based on:

- The proximity of each potential survey site to Koala habitat (i.e. sites in cleared land or the operating quarry area were not selected).

- The location of the points within or immediately adjacent to the Project area.
- The total number of sites that could be adequately sampled during field surveys.

At each site surveyed a combination of two survey methods were employed. These were the SAT methodology and Koala point searches. Methods for each are described below.

3.2.2 SAT surveys

The SAT methodology employed was as described by Phillips and Callaghan (2011). At each point surveyed, a central tree was chosen (usually a preferred Koala feed tree if present). The base of this and the nearest 29 trees (> or = 100mm diameter at breast height) were searched for Koala scats by one observer for up to 2 minutes per tree. Searches were conducted within 1 metre from the base of the tree, and were conducted on the surface as well as beneath leaf litter (using a small hand-held rake). If Koala scats were detected the tree was scored as a "1". If no scats were detected within 2 minutes the tree was scored as a "0". The total score was then added for 30 trees to determine the activity value of the site.

In accordance with the methodology described by Phillips and Callaghan (2011) the Project area was mapped as "East Coast – low abundance". This was primarily based on Koala density estimates obtained during previous and current surveys, indicating that the Project area is likely to support less than 0.1 Koalas per hectare. The activity scores for East Coast – low abundance are as follows:

- 0 – 2 scats recorded – "Low" activity.
- 3 scats recorded – "Medium" activity.
- 4 – 30 scats recorded – "High" activity.

For the purposes of the assessment, "Low" activity areas (including areas where no scats were recorded) are considered to be used only infrequently by Koalas. Areas of "Medium" and "High" activity are considered to represent preferred Koala habitat within the Project area and the study area.

3.2.3 Koala point surveys and population density estimate

At each of the survey points selected, a total of 5 minutes was spent searching all vegetation (from ground to canopy) within a 25 metre radius of the central tree for any Koalas present. Any Koalas recorded within the 25 metre radial search were used in calculations of population density for the Project area. Any Koalas recorded outside of the 25 metre radial search area were counted as incidental records only, and were not used in population density estimates.

Each 25 metre radial search equated to a total of 0.125 hectares. The total search area for Koala population density estimates was therefore 0.125 hectares multiplied by the total number of sites surveyed. Thus the Koala population density for the study area was calculated using the total number of Koalas recorded within the 25 metre radial searches divided by the total area searched, and an estimate of the number of Koalas per hectare derived.

3.3 Survey limitations

General fauna surveys and targeted Koala surveys were conducted over three seasons in varying weather conditions. It is considered that this range of conditions was appropriate for detecting Koalas or signs of Koala activity throughout the study area.

The systematic grid based assessment provides a randomised approach to surveys. This method has the potential to over or under-estimate Koala activity if sites selected are co-incidentally over or under-utilised

compared to remaining parts of the study area. A relatively large number of sites were sampled to ensure the study area was adequately sampled.

4 Results

4.1 Desktop assessment and previous surveys

Figure 2 shows Koala records are known from the wider locality. Anecdotal reports from Brandy Hill Quarry staff indicate low abundance of Koalas over many years of operations.

Results of previous surveys indicate presence of one individual in winter and one individual in spring surveys (see Figure 3).

No breeding female Koalas were recorded during previous surveys. Under SEPP 44 the Project would therefore be defined as "potential" Koala habitat. The Port Stephens CKPoM maps the Project as supporting areas of "Preferred" and "Marginal" Koala habitat.

4.2 SAT surveys

Figure 1 and Figure 3 shows the locations of SAT survey points surveyed and the activity levels recorded at each SAT survey point. A total of 29 SAT points were surveyed. The data collected during the SAT surveys is included in Appendix 1.

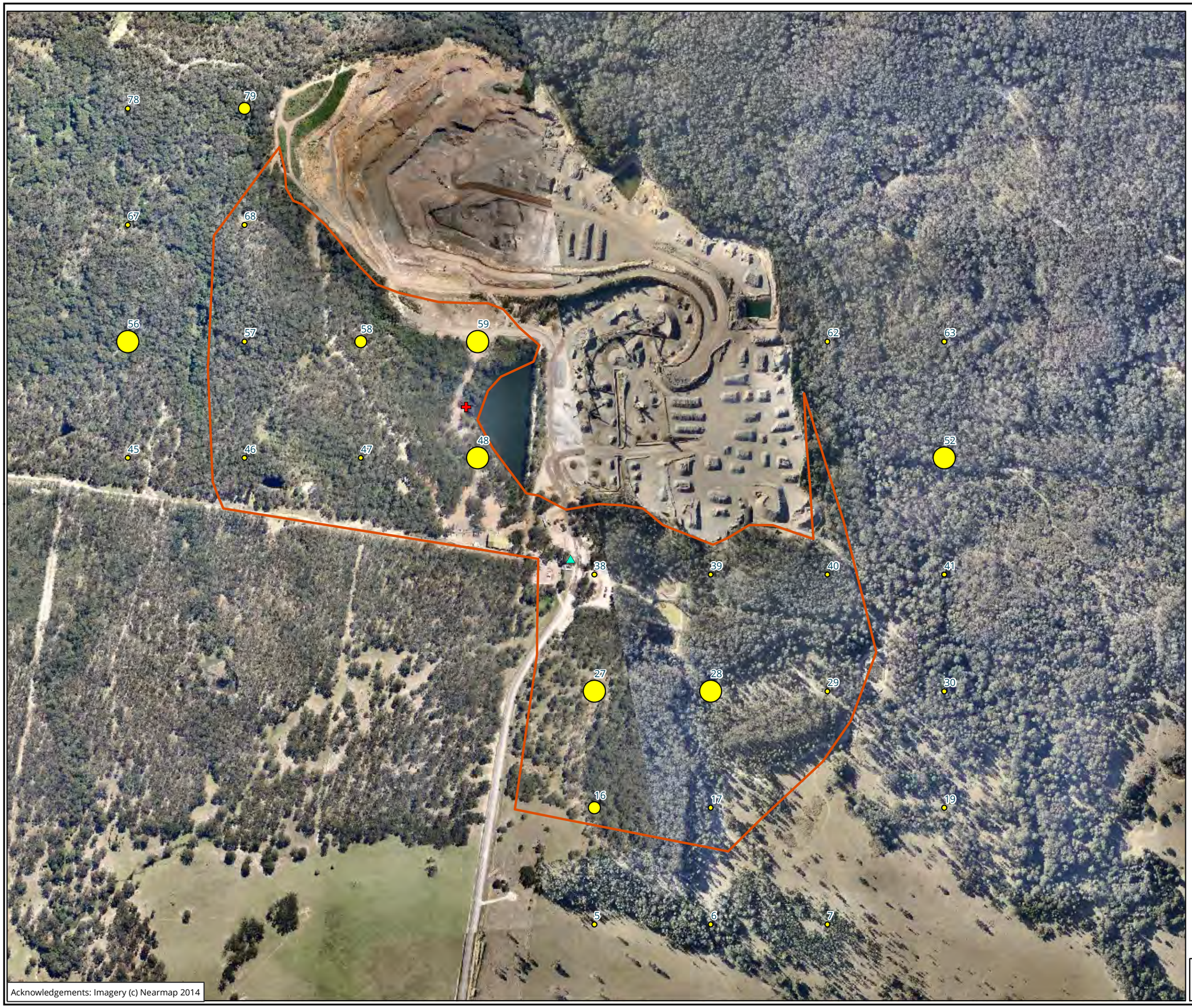
The East Coast low abundance category chosen based on the population density estimate calculated in Section 4.3 below as well as previous survey records.

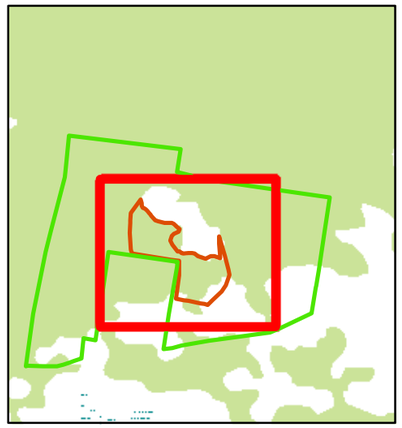
Mapping shows 6 High (between 4 and 30 trees with scats) and 3 Medium (3 trees with scats) activity sites within the study area, with the remaining 20 sites surveyed within the study area showing low (0 to 2 trees with scats) activity levels. With the exception of two outlying "High" sites to the east and west of the Project area, the SAT data indicates that the major areas of Koala activity occur within the Project vegetation clearing area. A band of High and Medium activity occurs from northwest to southeast, indicating a potential Koala activity corridor through the Project area (see Figure 3).

4.3 Koala point surveys and population density estimate

At each SAT point surveyed (see Figure 3) searches were conducted for individual Koalas within a 25m radius of the central tree chosen for the SAT surveys. No Koalas were recorded at any of the 29 survey points searched during the SAT surveys.

During the surveys a total of 3.6 hectares (29 x 0.125 hectares) of Koala habitat were searched for Koalas. This includes a search of 1.9 hectares (15 x 0.125 hectares) within the Project area. Although it is not possible to estimate actual Koala population density based on the Koala point surveys it can be assumed that the population within the Project area would be <0.1 Koalas per hectare of habitat present.





Legend

- Vegetation clearing area

Koala records

- August 2014
- November 2014

Koala Activity

- Low
- Medium
- High

Figure 3: Koala activity and records

0 60 120 180 240 300

Metres
Scale: 1:6,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

biosis

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 19323
Date: 05 January 2015,
Checked by: CAC, Drawn by: LDM, Last edited by: jshepherd
Location:P:\19300s\19323\Mapping
19323_F4_KoalaActivity_20141219

5 Discussion and recommendations

Koalas were recorded by Biosis within the project boundary on two separate occasions however neither record was during the Koala point surveys. Combined with the low numbers of Koala records from previous surveys and anecdotal observations of long-term staff at the Brandy Hill Quarry this indicates that, despite activity levels shown in the SAT data, the Project area currently supports only a low density of Koalas. The relatively high activity levels in parts of the Project may therefore indicate frequent use by a small number of individuals.

The Project area supports up to 48.65 hectares of Koala habitat, all of which would be removed for the Project. The total area of the site owned by Hanson is 561 hectares and large tracts of this land to the north east, north west and west of the proposed development area will be retained. Based on available vegetation mapping these areas contain similar habitat opportunities for Koala as those available within the project boundary. Land to the immediate north and north west of the Hanson property boundary is the subject of two separate Biobanking Agreements and will be conserved in perpetuity under provisions of the NSW Threatened Species Conservation Act 1995 (TSC Act). Under the terms of these Biobanking Agreements, management measures will be undertaken which improve the condition of native vegetation and hence Koala habitat. It is therefore unlikely that removal Koala habitat for the Project will result in a significant reduction in the area of occupancy of Koalas in the locality, given the area of suitable habitat that will remain in adjacent land.

Koala habitat mapping provided in the Port Stephens Councils CKPoM indicates that a narrow strip of preferred Koala habitat occurs to the east of the project, providing an opportunity for north-south movement of Koalas between the population of Koalas at Brandy Hill to the south and the biobank sites located to the north of the project. This north-south corridor will not be impacted by the project. Based on Koala records from the OEH database it is likely that Koala movement occurs north-west to south-east along a corridor of habitat located to the west of the project. It is therefore considered unlikely that extension of the project to the south of the current quarry would result in a significant barrier to Koala movement in the wider locality.

To date, no areas of Commonwealth identified "critical habitat" have been listed for the Koala. However, in accordance with the *EPBC Act Referral Guidelines for the vulnerable listed Koala* (Commonwealth of Australia 2014) removal of Koala habitat resulting from the Project has potential to adversely affect "habitat critical to the survival of the species".

As recommended in the Referral Guidelines, a Koala habitat appraisal has been completed to assess impacts of the Project on Koalas (see Appendix 2). The Koala habitat appraisal determined that the Project achieved a total habitat assessment score of 9. In accordance with Referral Guidelines, the Project is therefore likely to result in adverse effects on habitat critical to the survival of the Koala given the Project will:

- *Impact on an area supporting habitat critical to the survival of the Koala (a habitat score of > or = 5).*
- *Require clearing of > or = 20 hectares of habitat containing known Koala food trees in an area with a habitat score > or =8.*

Based on the results of previous surveys (Biosis 2015) as well as the current SAT and Koala point surveys, combined with the results of the Koala habitat appraisal and the Significant Impact Criteria assessment of which a significant impact to Koala was determined to be likely (Biosis 2015), it is therefore recommended that a Referral under the Commonwealth EPBC Act for impacts on Matters of NES (Koalas) be submitted for the Project. This document has therefore been prepared to supplement the EPBC Act referral for Koalas.

Should the Project proceed, the following recommendations are made to minimise potential impacts on Koalas, resulting from the Project:

- A Biodiversity Management Plan (incorporating management measures for Koalas) should be prepared to outline the clearance procedure (including protection measures for adjacent vegetation), protocols for Koala finds and incidents and include an educational brochure for all workers to review prior to working on the Project.
- An ecologist should undertake pre-clearance surveys within the Project area immediately prior to the removal of any vegetation to give the clearance go ahead.
- An ecologist or fauna rescuer to be present during vegetation clearing to minimise impacts on Koalas displaced or injured during clearing.
- An ecologist or regional Koala care group should be contacted if any Koalas are injured and/or distressed during the construction and operation phases of the Project.
- Low site speed limits should be established on site to reduce the potential for vehicle impacts on Koalas. All drivers working on the Project should be made aware of Koalas and instructed to take precautions when driving on site.

6 References

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Port Stephens Council 2002. *Port Stephens Comprehensive Koala Plan of Management* (CKPoM). Port Stephens Council with the Australian Koala Foundation.

7 Appendices

7.1 Appendix 1 – SAT data sheets

Spot: Spotted Gum Creb: E. crebra Fib: E. fibrosa RG: E. tereticornis

Koala SAT Survey Data Sheet

Mel: Melaleuca sp.

biosis

Project: Brandy Hill Quarry **Matter No.:** 19323

SAT ID: 38	Date: 9-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0945		WP: 1077	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	E-creb	Creb	Creb	Fibrosa	Fib	Creb	Creb	Fib	Creb	Creb	Fib	Creb	Creb	Creb	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Spot	Creb	Creb	Creb	Fib	Spot	Creb	Creb	Creb	Creb	Creb	Spot	Fib	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

SAT ID: 39	Date: 9-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 1015		WP: 1078	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	RG	Spot	Creb	Creb	Creb	Creb	Creb	Creb	RG	Creb	Spot	RG	Creb	Creb	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Creb	Creb	Creb	Spot	Spot	Spot	RG	Creb	RG	Creb	RG	Creb	Spot	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

SAT ID: 40	Date: 9-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 1045		WP: 1079	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Creb	Creb	Creb	Creb	Creb	Creb	Spot	Creb	Creb	Creb	Creb	Creb	Creb	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Creb	Creb	Mel	Creb	Creb	Creb	Creb	Creb	Creb	Creb	Creb	Creb	Creb	Creb
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

GB: E. moluccana Fib: E. fibrosa Mel: Melaleuca sp. Stri – Stringbark sp.

Koala SAT Survey Data Sheet

biosis

Project: Brandy Hill Quarry **Matter No.:** 19323

SAT ID: 29			Date: 9-12-14			Staff: CAC + 3 Hanson			GPS:		East:				
			Time: 1115						WP: 1090		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	GB	GB	GB	GB	Fib	Fib	Fib	GB	GB	GB	Mel	Spot	Fib	Spot	Fib
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GB	GB	GB	Fib	GB	RG	Spot	Fib	Creb	Fib	Creb	Fib	Fib	Stri	Stri
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
No. Koalas recorded within 25m radial search (5 minutes): Ø															

Ø

SAT ID: 27			Date: 9-12-14			Staff: CAC + 2 Hanson			GPS:		East:				
			Time: 1230						WP: 1081		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	RG	RG	RG	RG	RG	RG	RG	RG	RG	RG	Creb	GB	GB	Spot	RG
No. scats:	Ø	Ø	Ø	1	Ø	Ø	1	1	Ø	Ø	Ø	1	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GB	GB	RG	GB	GB	Creb	RG	RG	RG	RG	RG	RG	RG	RG	RG
No. scats:	1	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	1
No. Koalas recorded within 25m radial search (5 minutes): Ø															

7

SAT ID: 28			Date: 9-12-14			Staff: CAC + 2 Henson			GPS:		East:				
			Time: 1300						WP: 1082		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Spot	Creb	Spot	Spot	GB	Creb	GB	Spot	GB	Creb	Spot	GB	Spot	GB
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	1	1	Ø	1	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Mel	Spot	GB	Spot	Spot	GB	GB	Mel	GB	Creb	Spot	GB	GB	GB	Creb
No. scats:	1	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1
No. Koalas recorded within 25m radial search (5 minutes): Ø															

6

Cas- Casuarina glauca Ang- Angophora floribunda

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 17	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1320		WP: 1083	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Fib	RG	Spot	Fib	Spot	Cleb	Spot	Spot	Cleb	Spot	Spot	Spot	Fib	Spot	Spot
No. scats:	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Cleb	Spot	Spot	Fib	Cleb	Spot	Fib	Spot	Spot	RG	Cleb	Spot	Spot	Spot	Cleb
No. scats:	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

2

SAT ID: 6	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1345		WP: 1084	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Cas	Ang	RG	RG	RG	Ang	RG	RG	Cas	Ang	RG	Ang	Ang	Cas	Cas
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Ang	Ang	Cas	Cas	Cas	Ang	Ang	Ang	RG	Ang	RG	RG	Ang	RG	RG
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

0

SAT ID: 5	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1405		WP: 1085	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas	Cas
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

0

GG: Grey Gum

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 16	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1425		WP: —	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Mel	Mel	Mel	Creb	Spot	Mel	Mel	Mel	Spot	RG	RG	Mel	Mel	RG	Mel
No. scats:	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Mel	Mel	Mel	Mel	GB	Creb	Spot	Spot	Creb	Mel	Mel	Mel	Mel	Creb	Spot
No. scats:	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

3

SAT ID: 48	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1520		WP: 1086	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Spot	Spot	Creb	Creb	RG	RG	Creb	Creb	GG	GB	Spot	Creb	Mel	Stri	Stri
No. scats:	Ø	Ø	Ø	Ø	1	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GB	RG	Spot	Creb	Creb	GG	Creb	Creb	GB	Spot	RG	Stri	GB	GB	Spot
No. scats:	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø

No. Koalas recorded within 25m radial search (5 minutes):

4

SAT ID: 59	Date: 9-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1540		WP: 1087	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	RG	Stri	RG	Mel	RG	Creb	Stri	RG	Creb	GG	GG	Stri	RG	Creb	GG
No. scats:	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Creb	Creb	Stri	Creb	GG	GG	Creb	Creb	Ang	Ang	GG	GG	Stri	Stri
No. scats:	1	1	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

5

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 47	Date: 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: ~~0800~~		WP: 1088	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Stri	Stri	Stri	Spot	Stri	Spot	Stri	Spot	Creb	Spot	Spot	Acac.	Stri	Acac.
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Stri	Stri	Spot	Spot	GG	Spot	Creb	Spot	Spot	Stri	Stri	Stri	Spot	Spot
No. scats:	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

1

SAT ID: 58	Date: ~~0815~~ 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0815		WP: 1089	North:

Tree no.:	1	2	3	4	RG	6	7	8	9	10	11	12	RG	14	15
Sp:	Creb	Creb	Stri	Stri	~~RG~~	Creb	Spot	Creb	Creb	Creb	Stri	Creb	~~RG~~	Creb	Stri
No. scats:	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Stri	Creb	Stri	Stri	Creb	~~RG~~	Kurrajong	~~RG~~	Kurra.	Kurra.	Stri	Creb	Creb	Spot	Stri
No. scats:	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

3

SAT ID: 57	Date: 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0840		WP: 1090	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Stri	GG	Stri	Spot	Spot	Stri	Stri	Stri	Kurra.	Stri	GG	Spot	Spot	Stri	GG
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Spot	Spot	Spot	Stri	Creb	Stri	GG	Stri	Stri	Stri	GG	Stri	Stri	Stri	Stri
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

0

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 68	Date: 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0855		WP: 1091	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Spot	Creb	RG	Stri	RG	Creb	Spot	Spot	RG	Stri	Spot	Stri	Stri	Creb
No. scats:	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Spot	Stri	Kurra	RG	Creb	Kurra	Spot	Stri	Stri	Spot	Creb	Stri	Creb	Creb	Spot
No. scats:	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

2

SAT ID: 79	Date: 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0920		WP: 1092	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	RG	RG	Creb	Stri	Kurra	RG	RG	Spot	RG	Stri	RG	Creb	Creb	RG	RG
No. scats:	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Stri	Fib	RG	Creb	Stri	RG	RG	Stri	Creb	Creb	Stri	RG	RG	Stri	Stri
No. scats:	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

3

SAT ID: 78	Date: 10-12-14	Staff: CAC + 3 Hanson	GPS:	East:
	Time: 0940		WP: 1093	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Stri	Stri	Stri	Kurra	RG	RG	Creb	Stri	Stri	Stri	RG	Spot	Stri	RG	Stri
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Stri	Stri	Spot	Stri	Spot	RG	Stri	Creb	Stri	Stri	Creb	Stri	Stri	Stri
No. scats:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. Koalas recorded within 25m radial search (5 minutes): 0

0

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 46	Date: 10-12-14	Staff: CAC +2 Hanson	GPS:	East:
	Time: 1110		WP: 1094	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Spot	Stri	Spot	Spot	Stri	GG	GG	Spot	Spot	Spot	Stri	Spot	Stri	Spot
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GG	GG	Stri	Stri	GG	GG	Spot	GG	GG	Spot	GG	Spot	GG	Stri	GG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 45	Date: 10-12-14	Staff: CAC +2 Hanson	GPS:	East:
	Time: 1130		WP: 1095	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Fib	Mel	Stri	Stri	RG	RG	Fib	Fibr	RG	Fib	Fib	Fib	RG	RG	RG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Spot	Fib	Fib	Fib	RG	Mel	Stri	RG	Fib	Fib	Fib	Mel	Fib	Stri	Spot
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 56	Date: 10-12-14	Staff: CAC +2 Hanson	GPS:	East:
	Time: 1145		WP: 1096	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Stri	Stri	Stri	Stri	Stri	Stri	Stri	Stri	Stri	RG	Stri	Creb	Stri	Stri	Spot
No. scats:	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Spot	Creb	Creb	Stri	Spot	Kurra	Stri	Creb	Stri	Stri	Stri	Creb	Stri	Stri	Stri
No. scats:	Ø	Ø	Ø	1	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 67	Date: 10-12-14	Staff: CAC +2 Hanson	GPS:	East:
	Time: 1200		WP: 1097	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Creb	Creb	Creb	RG	Spot	Stri	RG	RG	Spot	Creb	RG	Mel	Stri	Kuri
No. scats:	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Spot	RG	RG	Stri	Creb	Stri	Stri	RG	Stri	RG	Stri	RG	Stri	RG	Stri
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 62	Date: 10-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1345		WP: 1098	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	Mel	Stri	Mel	Stri	Creb	Creb	Mel	Mel	Stri	Mel	Creb	Creb	Mel	Stri
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Mel	Creb	Stri	Stri	Mel	RG	Stri	Mel	Creb	Stri	RG	RG	Stri	Creb
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 63	Date: 10-12-14	Staff: CAC +2 Hanson	GPS:	East:
	Time: 1405		WP: 1099	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Spot	RG	GG	GG	GG	Creb	Stri	Creb	Spot	GG	Stri	GG	RG	GG	GG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GG	GG	GG	Creb	GG	Spot	Spot	GG	Spot	GG	GG	Spot	Spot	GG	GG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

Coach- Coachwood

Koala SAT Survey Data Sheet

Project: Brandy Hill Quarry **Matter No.:** 19323

biosis

SAT ID: 52			Date: 10-12-14			Staff: CAC + 2 Hanson			GPS:		East:				
			Time: 1420						WP: 1100		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Fib	Fib	Creb	Fib	Fib	Creb	Fib	Creb	Fib	Mel	Stri	RG	Creb	Fib	Creb
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	1	Ø	Ø	Ø	Ø	1	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Creb	Mel	RG	Mel	GG	Creb	Creb	RG	Creb	Spot	Creb	Creb	RG	Creb	Creb
No. scats:	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
No. Koalas recorded within 25m radial search (5 minutes): Ø															

4

SAT ID:			Date:			Staff:			GPS:		East:				
			Time:						WP:		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:															
No. scats:															
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:															
No. scats:															
No. Koalas recorded within 25m radial search (5 minutes):															

SAT ID: 41			Date: 10-12-14			Staff: CAC + 2 Hanson			GPS:		East:				
			Time: 1500						WP: 1101		North:				
Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Coach	Kulla	Spot	GG	Stri	Stri	Stri	Coach	Spot	Stri	Spot	Stri	Stri	Creb	Mel
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	GG	Spot	GG	Stri	Mel	Mel	Mel	Mel	Spot	Creb	Creb	Mel	Mel	Spot	Creb
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
No. Koalas recorded within 25m radial search (5 minutes): Ø															

Ø

Alph: Alphitonia excelsa (Red Ash)

Ang: Angophora floribunda

Koala SAT Survey Data Sheet

biosis

Project: Brandy Hill Quarry **Matter No.:** 19323

SAT ID: 30	Date: 11-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 0940		WP: 1102	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Spot	Creb	Stri	Creb	Creb	Creb	Stri	RG	Spot	Spot	Creb	Creb	Alph.	Stri	Creb
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Alph.	RG	Alph.	Creb	RG	Creb	GG	Creb	Creb	Stri	RG	Cas.	Spot	Creb	Creb
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 19	Date: 11-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1005		WP: 1103	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Creb	RG	Creb	Creb	RG	Creb	Stri	RG	Stri	Stri	Stri	Stri	RG	Creb	RG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	RG	RG	Fib	RG	Fib	RG	Creb	Creb	RG	RG	RG	RG	RG	RG	RG
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

SAT ID: 7	Date: 11-12-14	Staff: CAC + 2 Hanson	GPS:	East:
	Time: 1035		WP: 1104	North:

Tree no.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sp:	Ang	Cas	Cas	Cas	Ang	Cas	Ang	Cas	Cas	Cas	Creb	Mel	Mel	RG	Ang
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
Tree no.:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sp:	Cas	Cas	Mel	Cas	Cas	Creb	Cas	Ang	Mel	Cas	Ang	Cas	Mel	Cas	Mel
No. scats:	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

No. Koalas recorded within 25m radial search (5 minutes): Ø

+ Black-faced Monarch
+ Leaden F-catcher seen

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7.2 Appendix 2 – Koala habitat appraisal

Koala habitat appraisal - Brandy Hill Quarry expansion		
Action: Quarry expansion in the Lower Hunter, NSW Context: Coastal (East Coast - low abundance)		
Associated infrastructure: Additional quarry areas		
Primary impacts: Vegetation clearing, vehicle strike		
Impact area size: 97 hectares		
Attribute	**Score**	**Habitat appraisal**
Koala occurrence	2	Koala records known from the locality for the study area
		Biosis conducted targeted Koala surveys in winter and spring 2014 using diurnal and nocturnal searches and call playback. A total of 2 Koalas was recorded within the Project area.
		Biosis conducted targeted SAT and Koala point surveys in summer 2014 to determine Koala population density estimate. No Koalas were recorded during this period.
Vegetation structure and composition	2	Comprehensive vegetation mapping undertaken by Biosis in winter and spring 2014 mapping all vegetation within the study area. All forest and woodland communities present support 2 or more Koala food tree species.
Habitat connectivity	2	Koala habitat present is a component of an area of suitable habitat > 1,000 hectares
Key existing threats	2	No evidence of recent or regular Koala fatalities from vehicle strikes or dog attacks
Recovery value	1	Uncertain whether the habitat present is important for achieving the interim recovery objectives for Koalas.
Total	9	Based on the area of habitat to be cleared and total habitat score a Commonwealth referral under the EPBC Act is recommended.