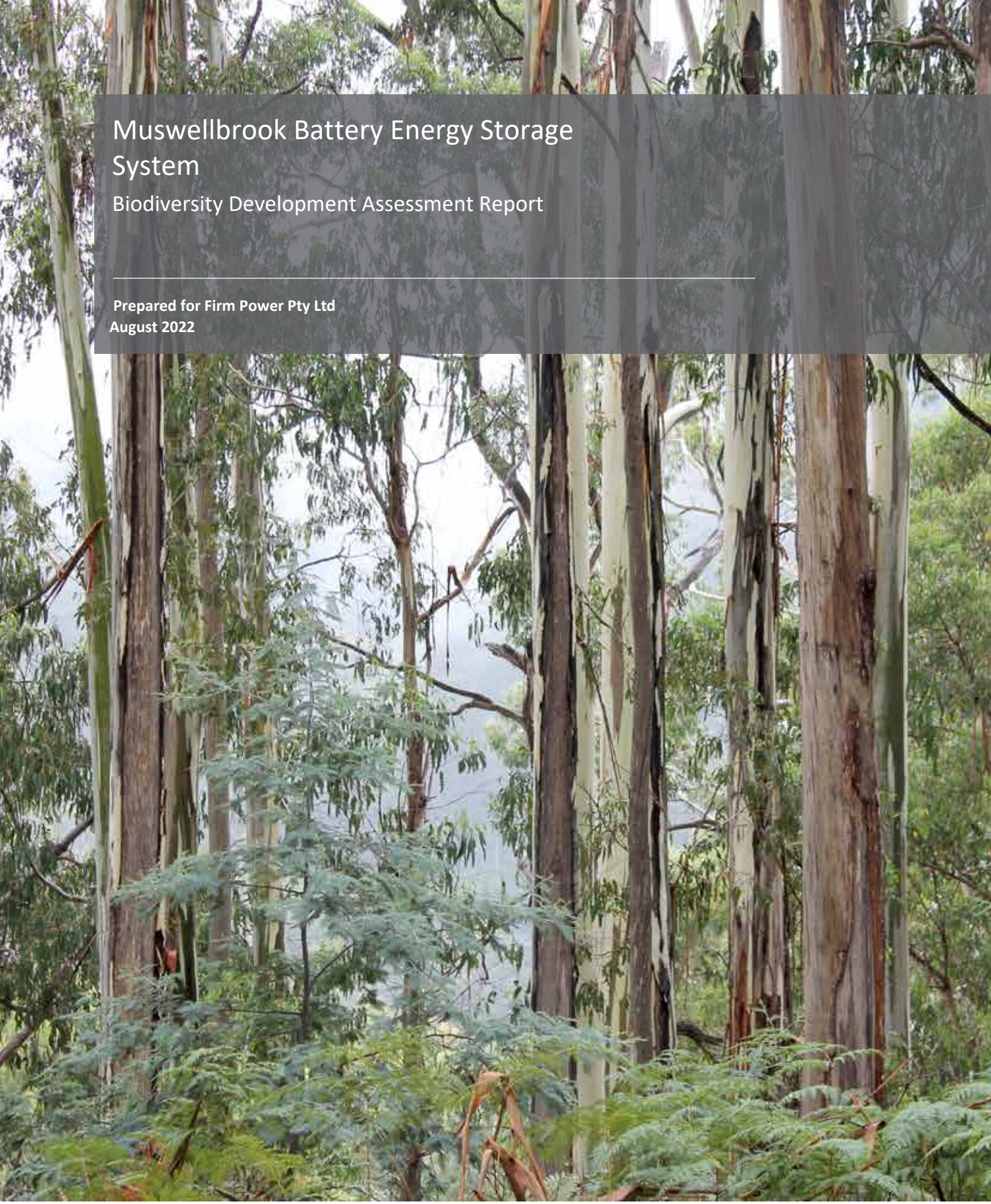
Muswellbrook Battery Energy Storage System

Biodiversity Development Assessment Report

Prepared for Firm Power Pty Ltd
August 2022



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Muswellbrook Battery Energy Storage System

Biodiversity Development Assessment Report

Report Number

E220140 RP1

Client

Firm Power Pty Ltd

Date

24 August 2022

Version

v1 Final

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24 August 2022

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24 August 2022

Executive Summary

ES1 Project description

Firm Power Pty Ltd (Firm Power) (the proponent) is seeking State Significant Development consent (SSD-29704663) under Section 4.36(2) of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop an approximately 150 megawatt AC (MW_{AC}) Battery Energy Storage System (BESS) on land directly adjacent to the Ausgrid Muswellbrook substation, on Wanaruah Country, within the Muswellbrook local government area (LGA) (Figure 1.1).

The BESS and associated infrastructure (herein referred to as 'the project') will occupy an area of up to 4.94 ha and will be contained within the BESS Site Layout shown in Figure 1.2.

The BESS will store energy from the grid and will have a delivery capacity of up to 150 MW_{AC} and a useable storage capacity of 300 megawatt-hour (MWh). It will connect to the adjacent Ausgrid Muswellbrook Substation via an underground or overhead 132 kV sub-transmission line. No external transmission lines or off-site connection works are proposed by the project.

The project will utilise the existing site access from Sandy Creek Rd Road (Figure 1.2).

EMM Consulting Pty Ltd (EMM) was commissioned by Firm Power to prepare this Biodiversity Assessment Development Report (BDAR) to accompany the Environmental Impact Statement (EIS) for the project.

This BDAR has been prepared in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Method (DPIE 2020a) (herein referred to as the 'BAM'). This BDAR has been prepared to document the biodiversity assessment methods and results, initiatives built into the project design to avoid and minimise biodiversity impacts, and additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

This BDAR also provides assessment of the project against the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), for potential impacts on Matters of National Environmental Significance (MNES).

ES2 Landscape features

The subject land is located within the following:

- Sydney Basin Interim Biogeographic Regionalisation of Australia (IBRA) bioregion;
- Hunter IBRA subregion;
- Central Hunter Foothills (Mitchell) Landscape, and
- Upper Hunter Channels and Floodplain NSW (Mitchell) Landscape.

The percentage of native vegetation cover is estimated at approximately 27.7 % based on the regional mapping dataset, with a patch size calculated to be greater than 100 ha due to contiguity (within 100 m) of vegetation on site with nearby vegetation within the region.

Sandy Creek, a sixth order stream, occurs within the assessment area and is mapped as Key Fish Habitat (KFH), and the subject land contains one unnamed third order stream.

No areas of outstanding biodiversity value, important geological features or other significant landscape features occur in the subject land (Figure 3.2).

ES3 Native vegetation

The subject land contains the following native Plant Community Types (PCTs):

- 0.21 ha of PCT 1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin, and
- 0.09 ha of PCT 1603 – Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter.

PCT 1655 in the subject land conforms to the threatened ecological community (TEC), *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*, listed as Vulnerable under the BC Act.

The PCTs in the subject land do not conform to any TECs listed under the EPBC Act.

ES4 Threatened species

Due to the project timeline and seasonal constraints, no targeted surveys were conducted as part of this assessment. A habitat assessment for candidate species was conducted during the field surveys on 28 March 2022. Where habitat in the subject land is suitable, species have been assumed as present, and subsequently retained in the BAM calculator (BAMC). Based on the habitat assessment, the following species were assumed to be present:

- *Cryptostylis hunteriana* - Leafless Tongue Orchid;
- *Delma impar* – Striped Legless Lizard
    - (the Hunter Valley Delma (*Delma vescolineata*), has not yet been listed under the BC Act);
- *Diuris tricolor* - Pine Donkey Orchid;
- *Diuris tricolor* - endangered population - Pine Donkey Orchid population in the Muswellbrook LGA;
- *Eucalyptus glaucina* – Slaty Red Gum;
- *Prasophyllum sp.* Wybong;
- *Pterostylis chaetophora;*
- *Pterostylis gibbosa* - Illawarra Greenhood, and
- *Thesium australe* – Austral Toadflax.

ES5 Impact avoidance, minimisation, and mitigation

The disturbance footprint is constrained to the following direct impacts to biodiversity values in the subject land:

- loss of 0.3 ha of native vegetation and associated habitat for fauna species.

Avoidance and minimisation strategies include avoiding native vegetation where possible.

ES6 Assessment of impacts under other relevant biodiversity legislation

The assessment concluded that the project is unlikely to result in a significant impact on the MNES and referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

ES7 Biodiversity impacts and offsets

To compensate for impacts on native vegetation the following credits are required:

- two ecosystem credits of PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin.

To compensate for impacts on threatened species (assumed presence) the following credits are required:

- two species credits of Leafless Tongue Orchid;
- three species credits of Striped Legless Lizard (in lieu of Hunter Valley Delma);
- two species credits of Pine Donkey Orchid;
- two species credits of Pine Donkey Orchid population in the Muswellbrook LGA;
- two species credits of Slaty Red Gum;
- three species credits of *Prasophyllum sp*. Wybong;
- two species credits of *Pterostylis chaetophora;*
- two species credits of Illawarra Greenhood; and
- two species credits of Austral Toadflax.

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1 Introduction

1.1 Background

Firm Power Pty Ltd (Firm Power) (the proponent) is seeking State Significant Development consent (SSD-29704663) under Section 4.36(2) of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop an approximately 150 megawatt AC (MW_{AC}) Battery Energy Storage System (BESS) on land directly adjacent to the Ausgrid Muswellbrook substation, on Wanaruah Country, within the Muswellbrook local government area (LGA) at 20-24 Sandy Creek Road, Muswellbrook, NSW (Figure 1.1).

EMM Consulting Pty Ltd (EMM) was commissioned by Firm Power to prepare this Biodiversity Assessment Development Report (BDAR) to accompany the Environmental Impact Statement (EIS) for the project.

This BDAR has been prepared in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Method (DPIE 2020a) (herein referred to as the 'BAM') to document the biodiversity assessment methods and results, initiatives built into the project design to avoid and minimise biodiversity impacts, and additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

This BDAR also provides assessment of the project against the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), for potential impacts on Matters of National Environmental Significance (MNES).

1.1.1 Project description

The BESS and associated infrastructure (herein referred to as 'the project') will occupy an area of up to 4.94 ha and will be contained within the BESS Site Layout shown in Figure 1.2.

The BESS will store energy from the grid and will have a delivery capacity of up to 150 MW_{AC} and a useable storage capacity of 300 megawatt-hour (MWh). It will connect to the adjacent Ausgrid Muswellbrook Substation via an underground or overhead 132 kV sub-transmission line. No external transmission lines or off-site connection works are proposed by the project.

The Muswellbrook BESS includes the following key infrastructure:

- enclosed lithium-ion batteries;
- power conversion systems including associated switchgear, protection and control equipment, transformers and enclosures for housing equipment;
- underground power and fibre optic cabling interconnecting the equipment;
- grid connection equipment including main power transformer, switchgear, protection and control equipment, metering, reactive power equipment, filtering equipment, auxiliary/earthing transformers and enclosures/buildings for housing equipment;

- underground or overhead 132kV sub-transmission lines to connect the BESS to the Muswellbrook substation;
- earthing and lightning protection systems;
- site office, storage area/enclosure, internal access tracks, on-site parking, security fencing, CCTV, lighting and temporary construction laydown area; and
- vegetation screening and noise walls.

The primary components associated with the installation of the BESS are as follows:

- site investigations, vegetation clearing, levelling, bench and access way construction, drainage system installation and installation of foundations/supports to install equipment on;
- transport to site and installation of equipment;
- testing and commissioning of the equipment; and
- operation and maintenance.

The project will utilise the existing site access from Sandy Creek Rd Road (Figure 1.2).

Works will be required within the existing Ausgrid substation to enable connection of the BESS to the grid (refer to 'Ausgrid substation works' in Figure 1.2). There are no biodiversity values within this area, due to it being an existing substation, comprising crushed rock surfacing, concrete foundations, and other substation equipment (such as switchgear, busbars, conductors, supports), therefore it was not included within the study area.

Construction of the project is expected to take up to 12 months.

The batteries will be manufactured offsite and delivered ready for installation following completion of site preparation, including levelling, and constructing a bench on which to install the BESS.

Once constructed, the BESS will operate 24 hours a day, seven days a week. It is anticipated the BESS will be operational for a period of approximately 20 years after which time the BESS would be removed and the site decommissioned, including the removal of all above ground infrastructure and remediation of the site. It is conceivable that the infrastructure may be upgraded rather than decommissioned and the lifespan of the BESS extended.

1.2 Subject land description

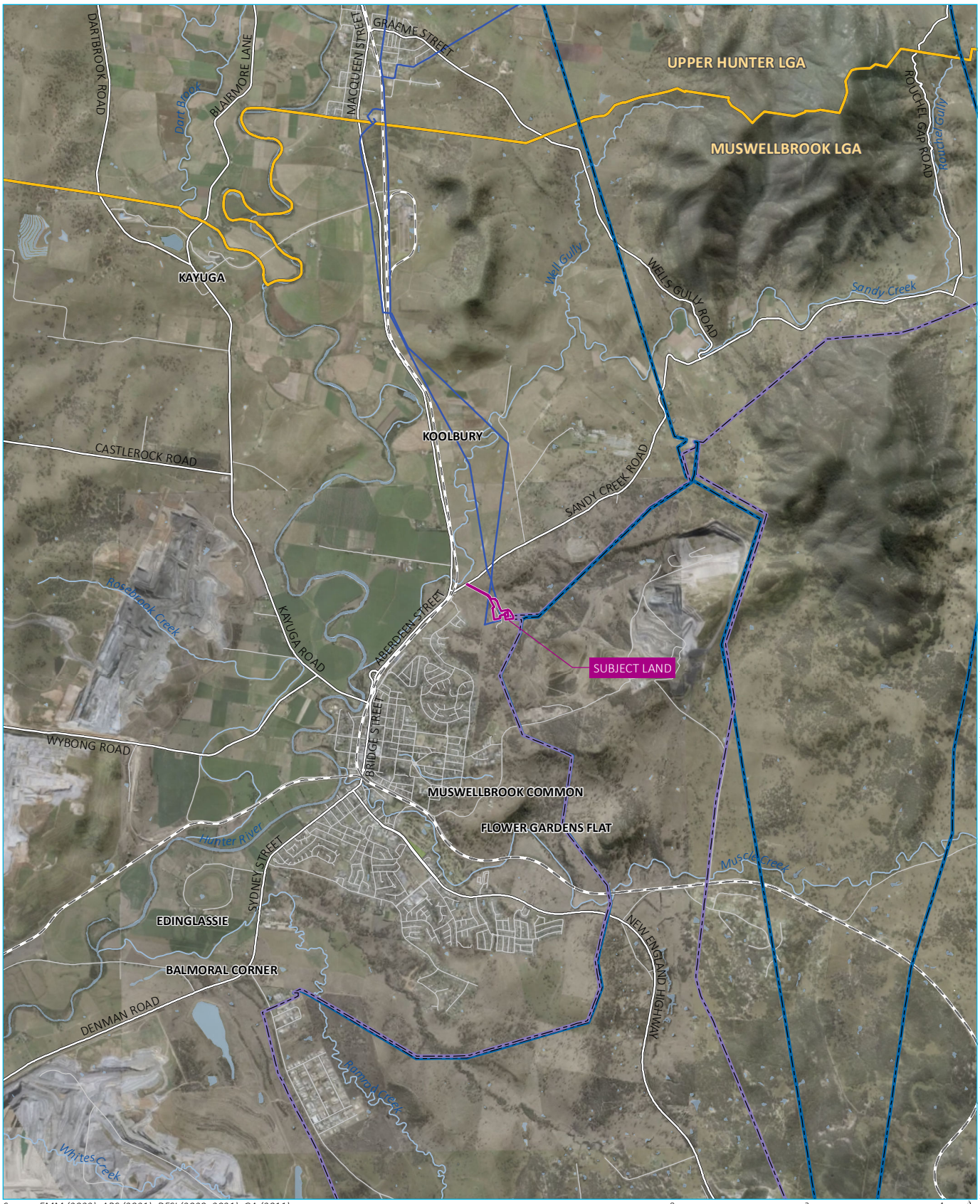
The subject land is located on Wanaruah Country, in the Muswellbrook LGA approximately 3 km northeast of the Muswellbrook town centre

The subject land is accessed via Sandy Creek Rd and a single lane private access road leading to the substation. The subject land is zoned as SP2 - Infrastructure, except for the proposed transmission line from the BESS substation to the Muswellbrook substation, which is located on C3 – Environmental Management zoned land. The existing access road borders land zoned R5 – Large Lot Residential under the Muswellbrook Local Environment Plan (LEP) 2009.

The subject land occurs over three Lots; Lot 11 DP 839233 (current substation and laydown area) (SP2 zoned land), Lot 12 DP 839233 (C3 zoned land) and Lot 15 DP 905479 (existing access road) (SP2 zoned land). The subject land is directly adjacent (north and northeast) of the existing Muswellbrook Ausgrid substation.

A variety of land uses exist in the assessment area including, coal mining, grazing, cropping, residential and industrial. To the north of the subject land lies mostly cleared grazing and cropping land, to the east lies a coal mine operated by Muswellbrook Coal Pty. Ltd. To the south of the subject land lies Muswellbrook Waste and Recycling Facility and to the west, residential areas, and the Muswellbrook town centre.

The land uses in the area surrounding the subject land have resulted in a highly fragmented landscape with limited connectivity. within the subject land, areas of exotic vegetation and grassland are prevalent, due to historical land clearing for agriculture and mining. The native vegetation which does occur, is highly fragmented and occurs as small patches of paddock trees with very limited canopy cover in some areas. Vegetation within the assessment area increases in density as larger patches to the east, however connectivity is still limited due to historical clearing practices.



Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

0 2 4 km

GDA 1994 MGA Zone 56

N

KEY

- Subject land
- Rail line
- Major road
- Minor road
- Named watercourse
- Waterbody
- Local government area
- State forest

Transmission line

- 132 kV
- 330 kV
- 33kV

INSET KEY

- Major road
- NPWS reserve
- State forest

Regional context

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 1.1

EMM creating opportunities

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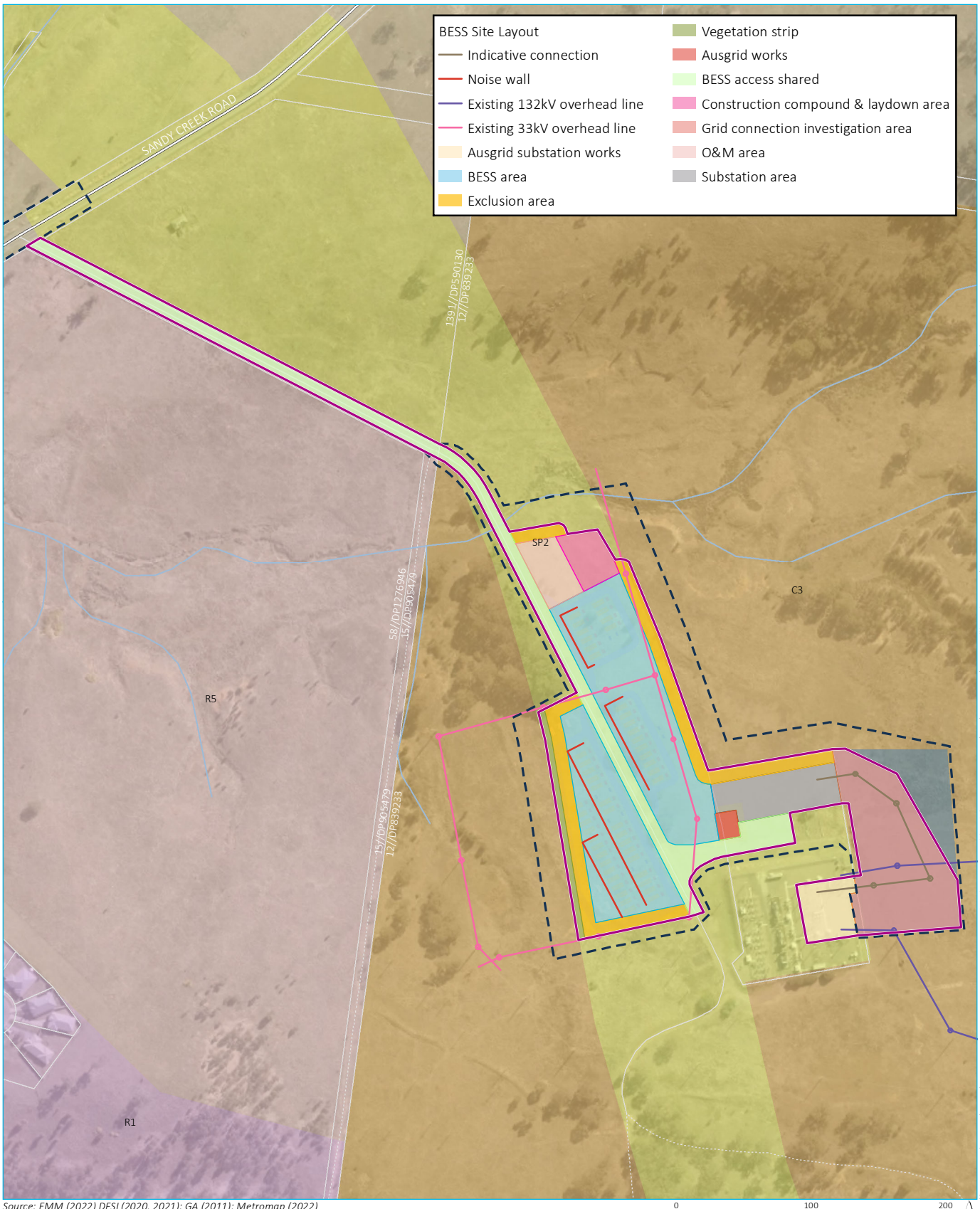

Source: EMM (2022) DFSI (2020, 2021); GA (2011); Metromap (2022)

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GDA 1994 MGA Zone 56

N

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KEY

Subject land
Study area

Existing environment
Major road
Minor road
Vehicular track
Watercourse/drainage line
Cadastral boundary

Land zoning
C3 Environmental Management
R1 General Residential
R5 Large Lot Residential
RU1 Primary Production
SP2 Infrastructure

Layout

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 1.2

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1.3 Assessment requirements

On 10 December 2021, Firm Power received Secretary's Environmental Assessment Requirements (SEARs) for the project. The relevant requirements of the SEARs, and where they are addressed in this BDAR, are listed in Table 1.1.

Table 1.1 Assessment requirements

Requirement	Section addressed
Biodiversity – including:	
• an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016* (NSW), the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR), unless BCS and DPIE determine the proposed development is not likely to have any significant impacts on biodiversity values;	This report
• the BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM; and	Section 6
• if an offset is required, details of the measures proposed to address the offset obligations.	Section 8

1.4 Terminology

Project elements referred to in this BDAR are defined in Table 1.2.

Table 1.2 Project elements referred to in this BDAR

Project elements	Definition
Assessment area	1,500m buffer of subject land Figure 3.1
Study area	Area assessed for direct and indirect impacts Figure 3.2
Subject land	Area subject to all proposed direct impacts in accordance with the 'subject land' definition in the BAM (DPIE 2020a). This includes the final footprint and construction footprint, which includes temporary laydown areas and ancillary structures.
Indirect impact area	Area subject to anticipated indirect impacts

1.5 Biodiversity assessment pathway

The NSW Biodiversity Offsets Scheme (BOS) is the framework for assessing and offsetting unavoidable impacts on biodiversity from development. Where the BOS applies to a development, the Development Application must be accompanied by a Biodiversity Development Assessment Report (BDAR), prepared in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020a).

For State Significant Development (SSD) projects, the requirement for assessment under the BOS is automatically triggered. The EIS must be accompanied by a Biodiversity Development Assessment Report (BDAR), unless it can be demonstrated that there will be no impacts on biodiversity.

1.6 Purpose of this report

This BDAR, prepared in accordance with the BAM, accompanies the EIS for SSD- 29704663 under Section 4.36(2) of the EP&A Act. The purpose of this report is to:

- describe biodiversity values of the subject land;
- assess the likelihood that threatened species and communities (threatened biodiversity) listed under relevant the NSW *Biodiversity Conservation Act 2016* (BC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) could occur in the subject land;
- document the strategies implemented to avoid and/or minimise impacts of the project on threatened biodiversity;
- assess residual threatened biodiversity impacts, after avoidance and minimisation strategies have been implemented; and
- provide environmental safeguards to mitigate threatened biodiversity impacts during construction and operation.

1.7 Information sources

1.7.1 Publications and databases

To provide context for the project, information about flora and fauna species, populations, communities, and habitats from the locality (generally within 10 km) was obtained from the following databases:

- BioNet Atlas of NSW Wildlife (BioNet Atlas) for previous threatened species records within the locality;
- BioNet Vegetation Classification database to determine NSW Plant Community Types (PCTs) in the subject land;
- BioNet Threatened Biodiversity Data Collection (TBDC) for threatened species profiles; and
- Commonwealth Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) (DAWE 2022a) for MNES likely to occur within the subject land.

1.7.2 Spatial data

Spatial data encompassing the subject land and assessment area was provided by Firm Power. Base map data was obtained from NSW Department of Finance, Services and Innovation (DFSI) databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from NSW Department of Primary Industry (DPI).

The following spatial datasets were utilised during the development of this report:

- *Hunter Upper State Vegetation Map,* VIS ID 4894 (DPIE 2019)
- *Mitchell Landscapes Version V3.1* (DPIE 2017);
- *Interim Biogeographic Regionalisation of Australia* (IBRA) *Version 7* (DoEE 2017);
- *Strahler Stream Order* (DPI 2015); and

- *Directory of Important Wetlands* (DAWE 2022b).

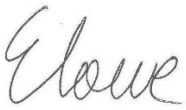
Mapping undertaken during the assessment was conducted using a hand-held GPS unit, mobile tablet computers running Collector for ArcGIS™ and Survey123 for ArcGIS™ and aerial photo interpretation. Accuracy is subject to accuracy of GPS devices, generally ±5 m. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

Spatial data relevant to this BDAR was provided to the Biodiversity Conservation Division (BCD) of the NSW Department of Planning and Environment (DPE) following lodgement of the BDAR.

1.8 Declarations

1.8.1 Certification under clause 6.15 *Biodiversity Conservation Act 2016*

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Signature: 

Date: 24/08/2022

BAM Assessor Accreditation no: BAAS18135

This BDAR has been prepared to meet the requirements of the BAM (DPIE 2020a).

1.9 Staff qualifications and contributions

This BDAR was prepared by Bianca Seal and Luke O'Brien in accordance with the BAM and reviewed by Erin Lowe (BAAS18135). Contributors and staff qualifications are listed Table 1.3.

Table 1.3 Staff qualifications and contributions

Name	Position and project role	Qualifications	Relevant years of experience
Erin Lowe	Associate Ecologist Technical review	BScience BNatHistIllus BAAS18135	12+
Paul Rossington	Associate Ecologist Technical review	BScience MScience BAM assessor accreditation	18+
Bianca Seal	Ecologist Author, BAM credit calculations, field surveys	BSc, PgDipGIS	3+
Luke O'Brien	Ecologist Author, BAM credit calculations, field surveys	BEnvSc&Mgt BSc (Hons)	7+

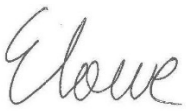
Table 1.3 Staff qualifications and contributions

Name	Position and project role	Qualifications	Relevant years of experience
Andres Echeverri	GIS analyst Spatial calculations, report figures.	BEnvSc, MGIS	5+

1.9.1 Conflict of Interest

As per the Accredited BAM Assessor Code of Conduct, BAM Accredited Assessors must not act in circumstances where there is actual, perceived, or potential conflict of interest.

I, Erin Lowe declare that I have considered the circumstances and there is no actual, perceived, or potential conflict of interest. This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Signature: 

Date: 24/08/2022

BAM Assessor Accreditation no: BAAS18135

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as Matters of National Environmental Significance (MNES) under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DAWE for determination as to whether it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act, and a decision made as to whether to grant approval.

The project is unlikely to have a significant impact on a biodiversity MNES, and therefore will not be referred to DAWE and is unlikely to be deemed a controlled action based on impacts to biodiversity. Further information is provided in Section 7.1.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DPE).

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments (EPIs) including State Environmental Planning Policies (SEPPs). EPIs relevant to the natural environment are outlined further below.

i State Environmental Planning Policy (Planning Systems) 2021

On 10 December 2021, the project was declared to be State Significant Development (SSD) by the NSW Minister for Planning under the provisions of the EP&A Act.

Section 4.36(2) of the EP&A Act provides that a SEPP may declare any development, or any class or description of development, to be SSD.

Clause 2.6(1) of State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) provides that development is SSD for the purposes of the EP&A Act if:

- the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the EP&A Act; and
- the development is specified in Schedule 1 or 2.

The proposed development is characterised as SSD as the proposal is for the purpose of electricity generating works with a capital investment value ('CIV') in excess of $30 million, pursuant to Section 20 of Schedule 1 of the Planning Systems SEPP.

ii State Environmental Planning Policy (Biodiversity and Conservation) 2021

The State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP) was ratified on the 1 March 2022 and consolidates, transfers and repeals provisions of numerous SEPPs, which includes the former *State Environmental Planning Policy (Koala Habitat Protection) 2020* (Koala SEPP 2020) and *State Environmental Planning Policy (Koala Habitat Protection) 2021* (Koala SEPP 2021). No policy changes have been made to the provisions of the Koala SEPPs; they have simply been transferred to the Biodiversity and Conservation SEPP.

The former Koala SEPP 2020 and 2021 together aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

In nine LGAs – Metropolitan Sydney (Blue Mountains, Campbelltown, Hawkesbury, Ku-Ring-Gai, Liverpool, Northern Beaches, Hornsby, Wollondilly) and the Central Coast LGA, former Koala SEPP 2021 provisions apply to all land use zones. Outside of these areas, the provisions of the former Koala SEPP 2020 continue to apply to all land zoned RU1, RU2, and RU3.

As SSD, the project does not require approval from Council, and thus consideration of the provisions of the former Koala SEPP 2020 and Koala SEPP 2021 are not triggered. Nonetheless, consideration has been given to the potential occurrence and impacts upon the Koala within this report, as required by the BC Act and EPBC Act.

2.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is the legislation responsible for the conservation of biodiversity in NSW through the protection of threatened flora and fauna species, populations and ecological communities. The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), establishes the Biodiversity Offsets Scheme (BOS).

The BOS includes establishment of the Biodiversity Assessment Method (the BAM, DPIE 2020a) for use by accredited persons in biodiversity assessment under the scheme. The purpose of the BAM is to assess the impact of actions on threatened species and threatened ecological communities, and their habitats and determine offset requirements. For SSD projects, use of the BAM is mandatory, unless a BDAR waiver is granted.

The BAM sets out the requirements for a repeatable and transparent assessment of terrestrial biodiversity values on land to:

- identify the biodiversity values on land subject to proposed development;
- determine the impacts of a proposed development, following all measures to avoid, minimise and mitigate impacts; and
- quantify and describe the biodiversity credits required to offset the residual impacts of proposed development on biodiversity values.

This biodiversity assessment has been undertaken in accordance with the requirements of the BAM.

2.4 Fisheries Management Act 1994

The NSW *Fisheries Management Act 1994* (FM Act) contains provisions for the conservation of fish stocks, Key Fish Habitat (KFH), biodiversity, threatened species, populations, and ecological communities. It regulates the conservation of fish, vegetation and some aquatic macroinvertebrates and the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities, key threatening processes (KTPs) and declared critical habitat. Assessment guidelines to determine whether a significant impact is expected are detailed in section 220ZZ and 220ZZA of the FM Act.

Another objective of the FM Act is to conserve KFH. These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. KFH is defined in Section 3.2.1 and 3.2.2 of the *Policy and Guidelines for Fish Conservation and Management* (DPI 2013).

The impact of the project on threatened aquatic species, populations, communities, habitats and KFH are considered in Section 5.1.

2.5 Biosecurity Act 2015

The primary objective of the NSW *Biosecurity Act 2015* (Biosecurity Act) is to provide a framework for the prevention, elimination and minimisation of biosecurity risks.

The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The provisions of the Biosecurity Act are discussed further in Section 7.2.

2.6 Water Management Act 2000

Division 6 of the *Water Management Act 2000* (WM Act) requires consideration of controlled activities (ie activities within 40 m of riparian land) and aquifer interference activities. The NSW Aquifer Interference Policy (NOW 2012) requires an assessment of potential impacts on groundwater users, including groundwater dependent ecosystems. Impacts on riparian land are considered in Section 5.1.1 of this report.

Stage 1 – Biodiversity assessment

3 Site context

3.1.1 Landscape features

Landscape features have been assessed in accordance with Section 3.1 of the BAM.

3.1.2 Bioregions and landscapes

The subject land is located within the Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) region and the Hunter IBRA subregion (Figure 3.1).

The assessment area is located across two NSW (Mitchell) Landscapes:

- Central Hunter Foothills; and
- Upper Hunter Channels and Floodplain (Figure 3.2).

As most of the assessment area is in the Central Hunter Foothills NSW (Mitchell) Landscape, this was the landscape used in this assessment.

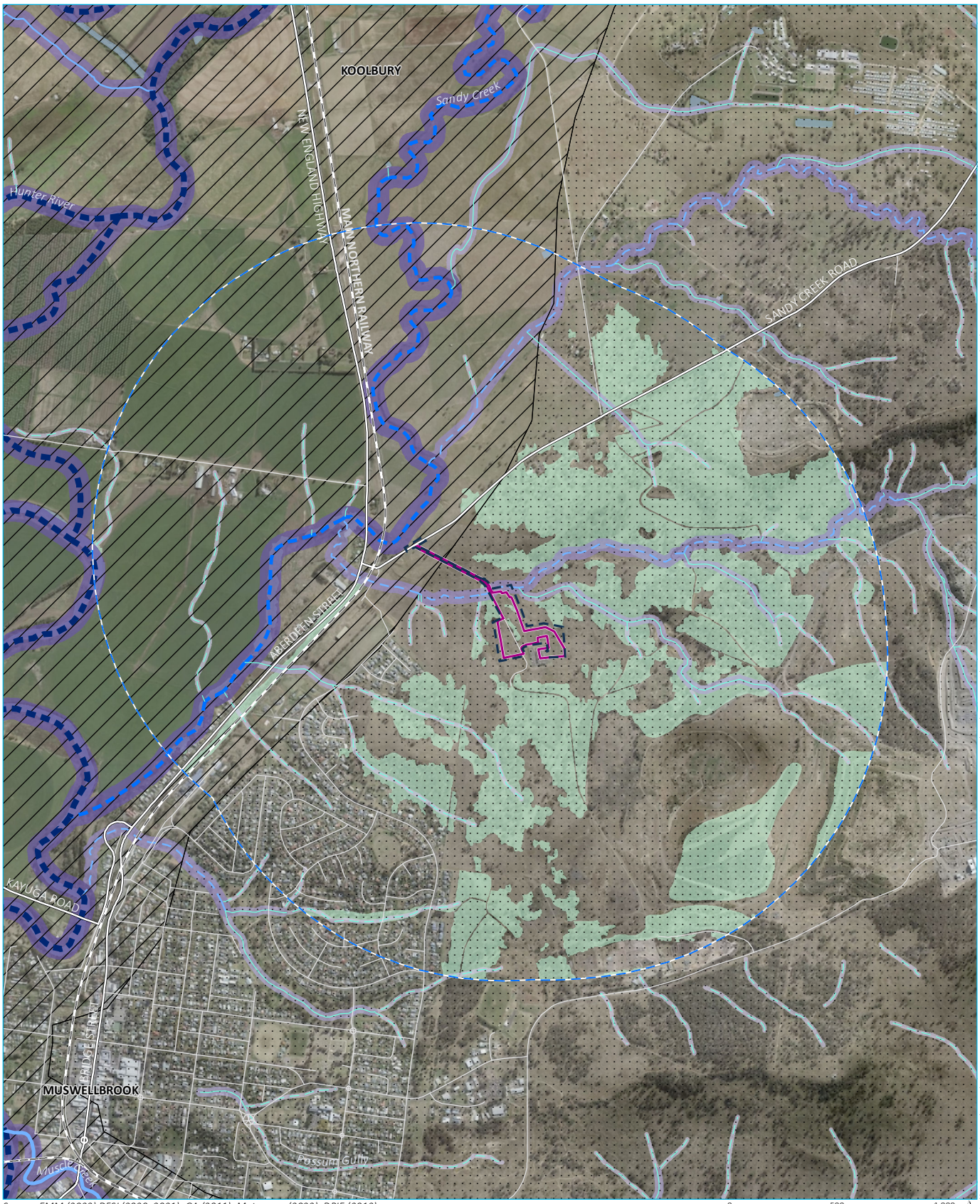
3.1.3 Connectivity

The locality of the subject land is considered highly fragmented with native vegetation often occurring in isolated patches surrounded by a matrix of exotic vegetation. This is also consistent with the vegetation within and adjoining the subject land.

The subject land is adjacent to an unnamed third-order stream. The stream has a highly disturbed riparian zone, lacking treed vegetation and is primarily dominated by the introduced species, Sharp Rush (*Juncus acutus*).

3.1.4 Areas of geological significance

No areas of geological significance occur in the assessment area. An existing and operational open cut mine occurs approximately 1.2 kilometres from the subject land. Due to its current operation and the nature of the mine (open cut as opposed to tunnelling), the mine is not anticipated to support areas of geological significance.



Source: EMM (2022) DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

Note:Sydney Basin IBRA region and Hunter IBRA subregion occurs across the entire assessment area

0 500 1,000 m

GDA 1994 MGA Zone 56

N

KEY

- Subject land
- Study area
- Assessment area (1500 m buffer)
- Native vegetation (277 ha, 27.7%)
- NPWS reserve (refer to inset)
- State forest (refer to inset)

NSW (Mitchell) landscape

- Central Hunter Foothills
- Upper Hunter Channels and Floodplain

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 9th order

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m
- 50 m

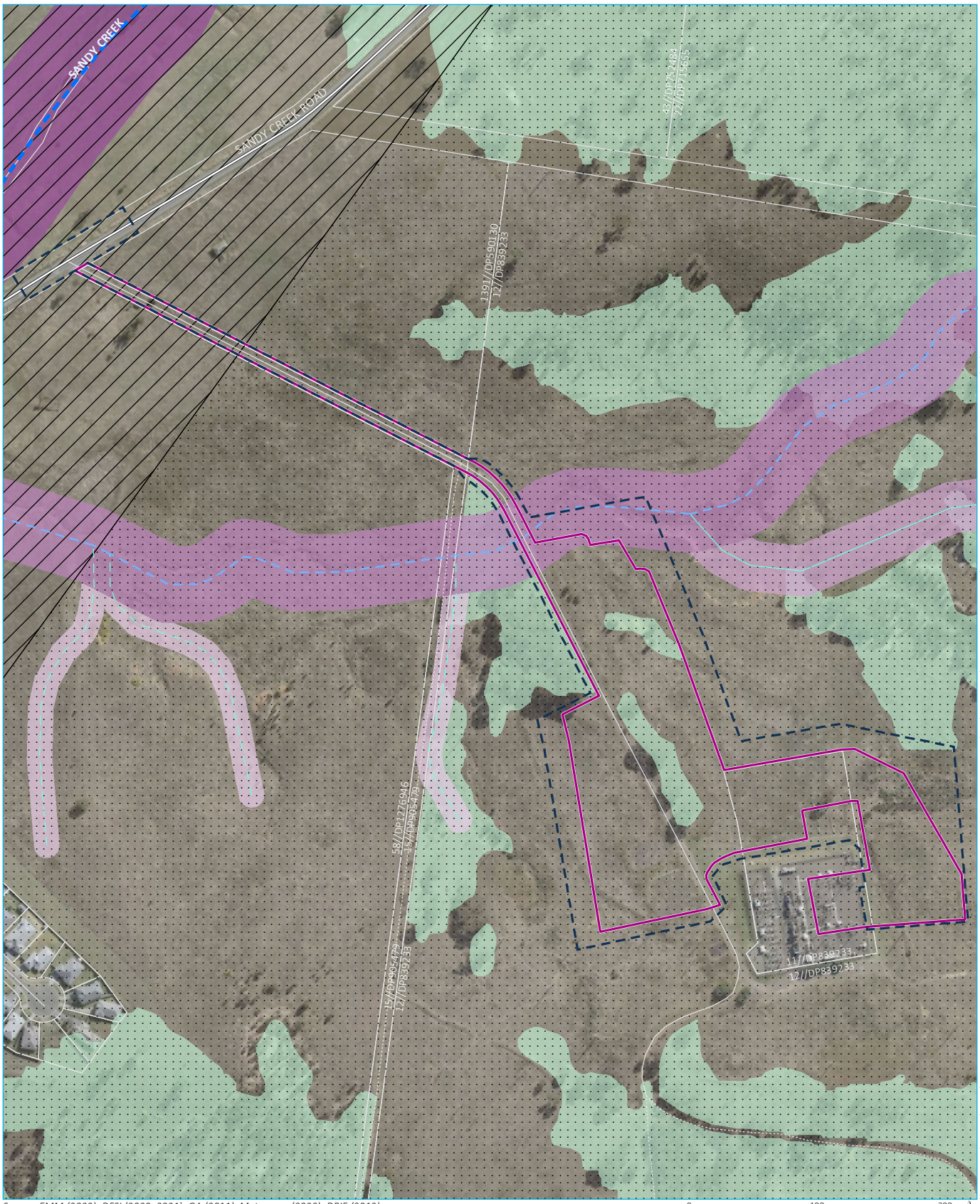
Existing environment

- Rail line
- Major road
- Minor road
- Waterbody

Location map

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 3.1

EMM creating opportunities



Source: EMM (2022); DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

Note:Sydney Basin IBRA region and Hunter IBRA subregion occurs across the entire assessment area

0 100 200 m

GDA 1994 MGA Zone 56

N

KEY

- Subject land
- Study area
- Assessment area (1500 m buffer)
- Native vegetation

Existing environment

- Major road
- Minor road
- Vehicular track
- Cadastral boundary

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 6th order

NSW (Mitchell) landscape

- Central Hunter Foothills
- Upper Hunter Channels and Floodplain

Riparian buffer

- 10 m
- 20 m
- 30 m
- 50 m

Site map

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 3.2

EMM creating opportunities

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3.1.5 Rivers, streams, estuaries, and wetlands

The subject land is located within the Hunter catchment. The Hunter catchment covers 21,500 square kilometres of coastal NSW (DPIE n.d). The Hunter River is the largest river in the catchment, beginning in Mount Royal Ranges on the western side of Barrington Tops.

The assessment area contains a number of water courses (Figure 3.2) including:

- 26 unnamed first-order water courses;
- five unnamed second order water courses;
- one unnamed third order water course;
- one sixth order water course (Sandy Creek); and
- one ninth order water course (Hunter River).

Most of these waterways flow into the Hunter River to the west of the assessment area.

Sandy Creek, a sixth order stream, occurs within the assessment area (Figure 3.1) and is mapped as Key Fish Habitat (KFH).

The subject land contains one unnamed third order stream (Figure 3.2).

No mapped KFH or freshwater threatened species distributions overlap with the subject land.

No nationally important or RAMSAR wetlands have been mapped within the assessment area. No Coastal Wetlands defined under the Coastal Management SEPP are mapped within the assessment area.

3.1.6 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value, as declared by the NSW Minister for Energy and Environment, within the subject land.

3.2 Native vegetation cover

Native vegetation cover been assessed in accordance with Section 3.2 of the BAM.

3.2.1 Native vegetation extent

Regional vegetation mapping across the subject land and locality (DPIE 2019) identifies a range of vegetation communities. To calculate native vegetation cover, these vegetation types were classified as native or non-native, as shown inTable 3.1.

Table 3.1 Native vegetation assessment

PCT (DPIE 2019)	Classification
42 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Native
796 - Derived grassland of the NSW South Western Slopes	Native
1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Native
1607 - Blakelys Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Native
1691 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Native
1766 - Weeping Myall - Plains Grass grassy woodlands of the Brigalow Belt South	Native
Non-native	Non-native

The native vegetation extent was then assessed against aerial imagery to adjust for inconsistencies between the regional vegetation mapping and aerial imagery. Areas such as cropped farmland were excluded, whilst rehabilitated areas associated with Muswellbrook Coal mine were included.

A 1,500 m buffer was placed around the subject land and the area of native vegetation within the assessment area and the percent native vegetation was then calculated, consistent with the requirements of the BAM. The extent of native vegetation cover based on this data source is shown in Figure 3.1.

Vegetation proximal to the subject land is generally highly disturbed and fragmented to the west, however larger patches of less fragmented remnant native vegetation are found in central and eastern parts of the assessment area. The less fragmented native vegetation occurs as open woodland, whilst the highly fragmented areas to the northwest are only likely to contain only very small areas of native vegetation dispersed amongst grazing paddocks, cropland and residential areas. Native vegetation cover for the subject land is provided in Table 3.2.

Table 3.2 Percentage of native vegetation cover by IBRA subregion

IBRA subregion	Native vegetation in assessment area (ha)	Assessment area (ha)	Approximate percentage of native vegetation in assessment area
Hunter	277	1,000	27.7%

4 Native vegetation

The assessment of native vegetation within the subject land was determined using Section 4 of the BAM, as summarised within this chapter.

4.1 Background review

A review of regional vegetation mapping was undertaken to inform the survey. The review included the following regional vegetation mapping dataset:

- State Vegetation Type Map: Hunter Upper - VIS_ID 4894 (DPIE 2019).

4.2 Methods

The following sections outline the methods employed to map vegetation, and to assess the vegetation integrity of native vegetation within the subject land.

4.2.1 Detailed vegetation mapping

An assessment of the subject land was undertaken on 28 March 2022 and included detailed vegetation mapping. The study area was traversed on foot, with vegetation mapped and aligned with NSW plant community types (PCTs). PCTs were stratified into vegetation zones based on broad condition state using the definitions in Table 4.1.

Table 4.1 Definitions used in delineation of vegetation zones

Condition class	Description
High	Largely intact with all strata present and minimal disturbance.
Medium	Some elements or stratum missing or immature, but minimal disturbance.
Poor	Tree stratum present, but understorey vegetation degraded due to weeds or other major disturbance such as regular maintenance.
Derived native grassland (DNG)	Tree stratum and mid stratum missing. Native vegetation restricted to shrub and groundcover.

Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded. Vegetation was mapped in the field using GPS-enabled tablet computers using Collector for ArcGIS™.

4.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the subject land, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 4.2.1, 4.3.3 and 4.3.4 of the BAM. Plot data was collected from the subject land on 28 March 2022. At each plot location the following was undertaken:

- one 20 x 20 m plot, for assessment of composition and structure; and

- one 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1-5%) or estimated to the nearest 5% (5- 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1,000, 1,500, 2,000, etc.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 3 of the BAM. Four plot surveys were undertaken within the subject land. Datasheets are provided in Appendix A.

4.3 Results

4.3.1 Vegetation of the subject land

The subject land contains primarily exotic vegetation with small remnant patches of native woodland. An individual *Eucalyptus* sp. was possibly identified as Slaty Red Gum (*Eucalyptus glaucina*) with a sample sent to the Australian National Herbarium for verification. For the purposes of this BDAR it has been assumed that the species is Slaty Red Gum, listed as vulnerable under the BC Act and EPBC Act.

The exotic vegetation occurs as a grassland across the subject land and is primarily dominated by Rhodes Grass (*Chloris gayana*), Fleabane (*Conyza bonariensis*) and Galenia (*Galenia pubescens*). The exotic species, Sharp Rush (*Juncus acutus*) is prevalent within a suspected man-made drainage channel. The Sharp Rush infestation occurs in the east of the subject land. There is no canopy or shrub stratum within the exotic vegetation.

The native woodland within the subject land is limited to a canopy stratum and sparse mid stratum. The ground layer, whilst containing native species, is also subject to weed invasion. The subject land has two distinct woodland patches: a Slaty Box (*Eucalyptus dawsonii*) patch with a Cooba (*Acacia salicina*) mid-stratum, and a small Bulloak (*Allocasuarina luehmannii)* patch, with a sparse ground layer. These woodland patches appear to have been previously disturbed, due to the existing weed encroachment and lack of an intact mid-stratum. Notwithstanding the modified state of the remnant vegetation, these have been classified as two plant community types (PCTs):

- PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin, and

- PCT 1603 – Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter.

The vegetation of the subject land is summarised in Table 4.2. PCTs mapped within the study area are displayed in Figure 4.1, including a narrow strip of PCT 1692 – Narrow-leaved Ironbark – Grey Box grassy woodland of the Central and Upper Hunter that lies between the boundary of the subject land and study area boundary. PCT 1692 will not be directly impacted.

Table 4.2 Vegetation and access tracks within the subject land

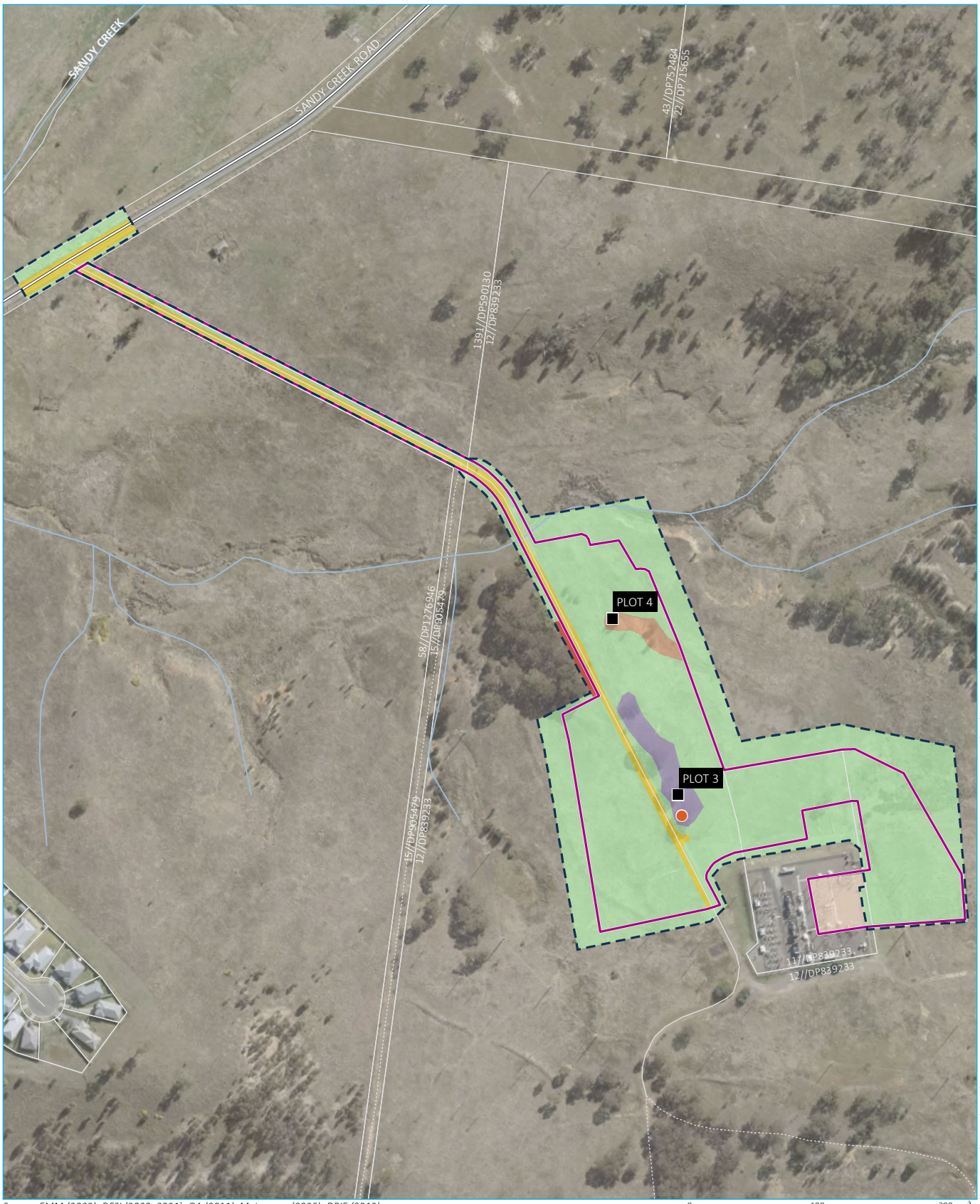
Vegetation type	Area (ha)
PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	0.209
PCT 1603 – Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	0.094
Exotic vegetation	4.231
Access track	0.402
Total area in hectares (to 2 decimal place)	**4.94**

4.4 Plant community types and vegetation zones

Each PCT recorded within the subject land is represented by one vegetation zone. Details for each vegetation zone are summarised in Table 4.3. Descriptions of the PCTs are presented in Table 4.4 and Table 4.5. The exotic vegetation is described in Table 4.6.

Table 4.3 Vegetation zones

Zone ID	PCT	Vegetation formation	Vegetation class	Area within subject land (ha)	Patch size (ha)	Vegetation integrity score
1	1655	Dry sclerophyll forests (shrubby formation)	Western Slopes dry sclerophyll forests	0.21	> 100	21.1
2	1603	Grassy Woodlands	Coastal Valley Grassy Woodlands	0.09	> 100	13.4



Source: EMM (2022); DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

Note: Sydney Basin IBRA region and Hunter IBRA subregion occurs across the entire assessment area

0 100 200 m

GDA 1994 MGA Zone 56

N

KEY

- Study area
- Subject land
- Assessment area (1500 m buffer)
- Plot
- Slaty Red Gum (*Eucalyptus glaucina*) (uncomfirmed)

Vegetation mapping

- Substation
- Access
- Exotic vegetation

Plant community type

- 1691 | Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- 1655 | Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin (Vulnerable-BC Act)
- 1603 | Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Existing environment

- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

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Plant community types in the subject land and plot locations

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 4.1

EMM
creating opportunities

Table 4.4 PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin

Attribute	Description
PCT ID	1655
Common name	Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
Vegetation class	Western Slopes Dry Sclerophyll Forests
Extent within subject land	0.209 hectares
Survey effort	Plot 3
Description and condition	This PCT was identified adjacent to the access track within the middle of the subject land. The patch comprises mature Slaty Box (*Eucalyptus dawsonii)* individuals, an individual Slaty Red Gum (*Eucalyptus glaucina*) and a number of Cooba (*Acacia salicina*). The groundcover shows signs of disturbance due to a moderate exotic species cover, with adjacent exotic grasslands allowing for high weed encroachment into the PCT. Despite the weed encroachment, several native forbs and grasses persist. These include Yellow Burr Daisy (*Calotis lappulacea*), Barb-wire Grass (*Cymbopogon refractus*), Red Grass (*Bothriochloa decipiens*) and Brown's Lovegrass (*Eragrostis brownii*). Exotic species occur within the midstratum and groundcover, including Pepper Tree (*Schinus molle* var. *areira*) and Fireweed (*Senecio madagascariensis*), which are high threat weeds. Exotic herbaceous and grass species are in relatively high diversity and include Galenia (*Galenia pubescens*), Paddy's Lucerne (*Sida rhombifolia*), Pale Pigeon Grass (*Setaria pumila)* and Rhodes Grass (*Chloris gayana*).
Justification of evidence used to identify the PCT	The occurrence of PCT1655 within the subject land is highly modified from the original community. PCT 1655 is the best fit based on (DPIE 2022a): • presence of Slaty Box as an indicator species. Grey Box (*Eucalyptus moluccana*) is also an indicator species and was identified adjacent to the subject land; • occurrence on flats and hillslopes associated with streams. The subject land occurs at approximately 180 m elevation, 150 m from an unnamed third order stream; and • occurrence within the Sydney Basin IBRA region and Hunter IBRA sub-region.
Status	**EPBC Act status: not listed** Does not conform to the threatened ecological community, Central Hunter Valley eucalypt forest and woodland ecological community (critically endangered ecological community (CEEC)), due to not meeting the condition thresholds as prescribed in Table 1 of the listing advice (DoE 2015): • Patch size is approximately 1.21 ha • The perennial native understorey vegetation cover is less than 50% **BC Act status: Vulnerable** Conforms to the threatened ecological community, *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion* on the following points (NSW Threatened Scientific Committee 2019): • occurs in the Muswellbrook LGA; • features characteristic species Slaty Box, Cooba, Barb-wire Grass and *Notelaea* sp.; and • occurs on derived colluvium soils as part of the Roxburgh soil landscape (DPIE 2022b).
Estimate of percent cleared value of PCT	36%

Table 4.5 PCT 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Attribute	Description
PCT ID	1603
Common name	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
Vegetation class	Coastal Valley Grassy Woodlands
Extent within subject land	0.094 hectares
Survey effort	Plot 4
Description and condition	This PCT was identified adjacent to the access track in the west of the subject land. The patch is also located within a large exotic vegetation patch, indicating that weed encroachment potential is high. The patch comprises mature and regenerating Bulloak (*Allocasuarina luehmannii*), no additional canopy or shrub species occur. The ground layer within the PCT is comprised of native and exotic grasses and forbs, in addition to a moderate cover of bare ground. Native species which occur within the ground layer include Brown's Lovegrass, Yellow Burr Daisy, Queensland Bluegrass (*Dichanthium sericeum*), Red Grass and *Panicum* spp. Exotic species include the high threat weeds Prickly Pear (*Opuntia stricta*) and Fireweed, in addition to Pale Pigeon Grass, Spear Thistle (*Cirsium vulgare*) and Purpletop (*Verbena bonariensis*).
Justification of evidence used to identify the PCT	The occurrence of PCT 1603 within the subject land is highly modified from the original community. PCT 1603 is the best fit based on (DPIE 2022a): • occurrence within the Sydney Basin IBRA region and Hunter IBRA sub-region; • association with flats and mid-slopes within the Central Hunter Valley; • presence of Grey Box adjacent to the subject land; • PCT 1603 is mapped within 800 m from the subject land (DPIE 2019); • presence of other characteristic species Barbed Wire Grass and Rock Fern (*Cheilanthes sieberi*).

Table 4.5 PCT 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Attribute	Description
PCT ID	1603
Status	**EPBC Act status: not listed** PCT 1603 has the potential to conform to the Central Hunter Valley eucalypt forest and woodland ecological community (CEEC), however; patches that are dominated solely by Bulloak are excluded. This excludes the PCT 1603 patch within the subject land from the listing (DoE 2015). **BC Act status: not listed** PCT 1603 has the potential to conform to Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (Central Hunter Grey Box – Ironbark Woodland) or Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions EEC (Hunter-Lowland Redgum Forest). The Central Hunter Grey Box – Ironbark Woodland EEC typically forms a woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), Kurrajong (*Brachychiton populneus* subsp. *populneus*) and Grey Box (*Eucalyptus moluccana*). Other tree species may be present and occasionally dominate or co-dominate and include Rough-barked Apple (*Angophora floribunda*) and Black Cypress Pine (*Callitris endlicheri*). The Hunter-Lowland Redgum Forest EEC is described as an open forest with most common canopy trees species being Forest Red Gum (*Eucalyptus tereticornis*) and Grey Gum (*Eucalyptus punctata*) although other frequently occurring canopy species are Smooth-barked Apple (*Angophora costata*), Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark and Grey Box. • These EECs are described as having *Eucalyptus* spp. dominated canopies, with Bulloak only described as being associated with the Central Hunter Grey Box – Ironbark Woodland. No regeneration of *Eucalyptus* spp. is present within the PCT. The lack of *Eucalyptus* spp. within the PCT 1603 patch excludes the PCT from these listings.
Estimate of percent cleared value of PCT	77%

Table 4.6 Exotic vegetation

Attribute	Description
PCT ID	-
Common name	Exotic vegetation
Vegetation class	-
Extent within subject land	4.23 hectares
Survey effort	Plots 1 and 2
Description and condition	The exotic vegetation occurs as a grassland across the subject land and is primarily dominated by Rhodes Grass (*Chloris gayana*), Fleabane (*Conyza bonariensis*) and Galenia (*Galenia pubescens*). The exotic species, Sharp Rush (*Juncus acutus*) is prevalent within a suspected man-made drainage channel. The Sharp Rush infestation occurs in the east of the subject land. There is no canopy or shrub stratum within the exotic vegetation.

Table 4.6 Exotic vegetation

Attribute	Description
Justification of evidence used to identify the PCT	Exotic vegetation was classified based on the high diversity and density of exotic vegetation and the low vegetation integrity score when plot data was entered into the BAMC. Two plots were carried out within the exotic vegetation, and when assessed, resulted in a VI score of 2.8 and 3 respectively. This justifies the classification of exotic vegetation and its exclusion as a PCT from this report. Vegetation integrity plot data is provided in Appendix A.
Status	EPBC Act status: not listed BC Act status: not listed
Estimate of percent cleared value of PCT	-

Photograph 4.1 Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin (plot 3)

Photograph 4.2 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter (plot 4)

Photograph 4.3 Exotic vegetation (plot 2)

5 Threatened species

5.1 Threatened species habitat description

The subject land has been historically cleared for agricultural purposes, particularly grazing. The result is that many habitat features have been removed or significantly degraded. The subject land provides limited refuge or habitat for fauna. The site does contain some woody debris within a patch of exotic species (Figure 5.1). This may be suitable for the threatened Striped Legless Lizard (*Delma impar*) which has been recorded approximately 800 m to the south of the subject land within similar habitat (OEH 2022b).

As of July 2022, the Hunter Valley Delma (*Delma vescolineata*), is confirmed to be a newly discovered species of legless lizard. The Hunter Valley Delma was previously considered a disjunct population of the BC Act listed Striped Legless Lizard. The records of *Delmar impar* to the south of the subject, therefore, are most likely to be the Hunter Valley Delma (*Delma vescolineata).* During the site inspection woody debris and a piece of corrugated iron was checked under for reptile species. One Eastern Ranges rock-skink (*Liopholis modesta*) was observed. No Legless Lizards were opportunistically recorded.

The site lacks hollow-bearing trees, and therefore does not provide suitable breeding habitat for hollow dependant bird and mammal species.

Drainage lines within the subject land are ephemeral and lack open water. The drains within the subject land are dominated by exotic vegetation species such as Sharp Rush. This does not provide suitable habitat for threatened frog species such as the Green and Golden Bell Frog (*Litoria aurea*), however would provide habitat for more common species such as Spotted Marsh Frog (*Limnodynastes tasmaniensis*) which was heard calling during surveys.

A total of five Koala feed tree species were recorded within the subject land. These trees are isolated from other areas of woodland beyond the subject land and therefore are unlikely to provide significant foraging resources for any populations of Koala that may reside within the locality.

5.1.1 Aquatic habitat

Sandy Creek, a sixth order stream occurring with the assessment area, is mapped as KFH (DPIE 2022c). The subject land intersects sections of the riparian corridor associated with an unnamed third order stream. The subject land is not likely to contain KFH and is unlikely to support threatened fish species or threatened aquatic ecological communities due to its ephemeral nature.

No threatened fish distributions have been identified for any of the waterways within the subject land. No threatened aquatic ecological communities have been identified within the study area.

5.2 Ecosystem credit species

Ecosystem credits species are threatened species that can be reliably predicted to use an area of land based on habitat surrogates. For the purposes of the BAM, ecosystem credit species are deemed to be offset through the habitat surrogates (PCTs) in which they occur.

A list of ecosystem credit species predicted to occur within the subject land, based on the PCTs present and generated by the BAMC associated within the BAM is provided in Table 5.1. The potential for these species to occur within the subject land was assessed in accordance with Section 5.2.2 of the BAM, with no species excluded from the assessment.

Table 5.1 Assessment of ecosystem credit species within the subject land

Scientific name	Common name	Sensitivity to gain class
Anthochaera phrygia	Regent Honeyeater (Foraging)	High
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	Moderate
Calyptorhynchus lathami	Glossy Black-Cockatoo (Foraging)	High
Chthonicola sagittate	Speckled Warbler	High
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	High
Daphoenositta chrysoptera	Varied Sittella	Moderate
Dasyurus maculatus	Spotted-tailed Quoll	High
Falco subniger	Black Falcon	Moderate
Glossopsitta pusilla	Little Lorikeet	High
Grantiella picta	Painted Honeyeater	Moderate
Hieraaetus morphnoides	Little Eagle (Foraging)	Moderate
Hirundapus caudacutus	White-throated Needletail	High
Lathamus discolor	Swift Parrot (Foraging)	Moderate
Lophoictinia isura	Square-tailed Kite (Foraging)	Moderate
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Moderate
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Moderate
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	High
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	High
Neophema pulchella	Turquoise Parrot	High
Ninox connivens	Barking Owl (Foraging)	High
Ninox strenua	Powerful Owl (Foraging)	High
Nyctophilus corbeni	Corben's Long-eared Bat	High
Petroica boodang	Scarlet Robin	Moderate
Petroica phoenicea	Flame Robin	Moderate
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Moderate
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	High
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	High
Stagonopleura guttata	Diamond Firetail	Moderate
Tyto novaehollandiae	Masked Owl (Foraging)	High

5.3 Species credit species

5.3.1 Candidate species assessment

In accordance with Step 3 (Section 5.2.3 of BAM), a field assessment of habitat constraints and microhabitats was undertaken to determine the suitability of habitat within the subject land for:

- candidate species (species credit species associated with specific geographic and landscape feature constraints); and
- species predicted to occur by the EPBC Act Protected Matters Search Tool.

Candidate species predicted by the BAMC are shown in Table 5.2. An assessment of the geographic and landscape constraints has been provided for each species, with a justification provided where species have been excluded, in accordance with Steps 1 to 3 (Section 5.2.1 to 5.2.3) of the BAM.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Acacia pendula-endangered population	Acacia pendula population in the Hunter catchment	-	-	Within Hunter River Catchment	-	Yes	No. Despite potential habitat within the subject land, the conspicuous tree species was not observed during surveys.
Angophora inopina	Charmhaven Apple	-	-	Within Singleton and Cessnock LGAs	-	No	No. The subject land is located within the Muswellbrook LGA.
Anthochaera phrygia	Regent Honeyeater	Important mapped areas (breeding).	-	-	-	No	No. The site is not a mapped important area.
Aprasia parapulchella	Pink-tailed Legless Lizard	Rocky areas, or within 50m of rocky areas.	-	-	-	No	No. No rocky areas within the subject land
Asperula asthenes	Trailing Woodruff	-	Yes	-	-	n/a	No. Habitat is degraded. This species occurs at damp sites often along riverbanks. These features are absent from the PCTs within the subject land.
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs	Yes	-	-	Yes	No. Despite one standing dead tree within the subject land, the habitat is considered too degraded for the species to occur.
Callocephalon fimbriatum	Gang-gang Cockatoo	Eucalypt tree species with hollows greater than 9 cm diameter	-	-	-	No	No. The subject land does not contain eucalypts with hollows greater than 9cm diameter.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Calyptorhynchus lathami	Glossy Black-Cockatoo (breeding)	Living or dead tree with hollows greater than 15cm diameter and greater than 8m above the ground	-	-	-	No	No. The subject land does not contain eucalypts with hollows greater than 15cm diameter.
Cercartetus nanus	Eastern Pygmy-possum	-	Yes	-	-	-	No Habitat within the subject land is degraded, lacks hollows and a does not provide a high complexity of mid storey species as a food source.
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs; Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	-	-	-	No	No. No suitable habitat within the subject land. An existing open cut coal mine (Muswellbrook Coal) occurs approximately 1.2 km from the subject land, however the mine is still operational and not expected to support old mines and tunnels.
Cryptostylis hunteriana	Leafless Tongue Orchid	-	-	-	-	-	Yes. The subject land may contain suitable orchid habitat within PCT 1655. PCT 1603 does not provide a suitable micro-climate for the species.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Cymbidium canaliculatum - endangered population	*Cymbidium canaliculatum* population in the Hunter Catchment	Epiphytes; Epiphytic in a range of eucalypts, Acacia and Angophora. Fallen/standing dead timber including logs, cut stumps or logs on ground	Yes	Hunter catchment as defined by Australia's River Basins (Geoscience Australia 1997))		Yes.	No. The subject land includes one standing dead tree, however this conspicuous species was not observed during surveys.
Cynanchum elegans	White-flowered Wax Plant	-	Yes	-	-	-	No. Habitat is considered too degraded for the species to occur.
Delma impar	Striped Legless Lizard	-	-	-	-	-	Yes. Species records occur from a few locations within proximity to the subject land. Suitable habitat within the subject land.
Diuris tricolor	Pine Donkey Orchid	-	-	-	-	-	Yes. The subject land may contain suitable orchid habitat within PCT 1655. PCT 1603 does not provide a suitable micro-climate for the species.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Diuris tricolor - endangered population	Pine Donkey Orchid population in the Muswellbrook local government area			Muswellbrook LGA		Yes	Yes. The subject land may contain suitable orchid habitat within PCT 1655. PCT 1603 does not provide suitable micro-climate for the species. The subject land is located within the Muswellbrook LGA.
Eucalyptus glaucina	Slaty Red Gum	-	-	-	-	-	Yes. A very small extent of suitable habitat occurs in which a BAM plot was conducted. An individual tree within the subject land has been identified as possibly being *Eucalyptus glaucina.* For the purposes of this BDAR it has been assumed to be *Eucalyptus glaucina.*
Eucalyptus pumila	Pokolbin Mallee	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.
Hieraaetus morphnoides	Little Eagle (Breeding)	Nest trees - live (occasionally dead) large old trees within vegetation.	-	-	-	Yes.	No. No stick nests were observed within the subject land.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Hoplocephalus bitorquatus	Pale-headed Snake	-	Yes	-	-	-	No. Habitat within subject land lacks complexity required by this species and its prey sources.
Lathamus discolor	Swift Parrot (Breeding)	Important mapped areas.	-	-	-	No	No. The site is not a mapped important area.
Litoria aurea	Green and Golden Bell Frog	Semi-permanent, ephemeral wet areas, within 1km of wet areas, swamps and waterbodies	Yes	-	-	Yes	No. The subject land does not contain waterbodies with suitable structure for this species such as open water with emergent vegetation. The subject land is unlikely to support breeding habitat for the species.
Litoria brevipalmata	Green-thighed Frog	Semi-permanent/ephemeral wet areas, swamps and waterbodies	Yes	-	-	Yes	No. Habitat is highly degraded in the form of an unnamed third-order stream which is dominated by Sharp Rush. It is unlikely to support breeding habitat for the species.
Lophoictinia isura	Square-tailed Kite (Breeding)	Nest trees	-	-	-	No	No. No stick nests were observed within the subject land.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Miniopterus orianae oceanensis	Large Bent-winged Bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500.	-	-	-	No	No. No suitable habitat within the subject land.
Monotaxis macrophylla	Large-leafed Monotaxis	-	Yes	-	-	-	No. Habitat is considered too degraded for the species to occur, and a fire regime suitable for the species' persistence is unlikely to be maintained in the subject land.
Myotis macropus	Southern Myotis	Hollow bearing trees; Within 200 m of riparian zone; Bridges, caves or artificial structures within 200 m of riparian zone; Waterbodies- this include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	-	-	-	Yes	No. A third-order stream occurs within the subject land, however it is dominated by Sharp Rush. No hollows occur within the subject land.
Ninox connivens	Barking Owl (Breeding)	Hollow bearing trees; Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	-	-	-	No	No. The subject land does not contain living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Ninox strenua	Powerful Owl	Hollow bearing trees; Living or dead trees with hollow greater than 20cm diameter	-	-	-	No	No. The subject land does not contain living or dead trees with hollows greater than 20 cm diameter.
Ozothamnus tesselatus	Ozothamnus tesselatus	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.
Petaurus norfolcensis	Squirrel Glider	-	Yes	-	-	-	No. Subject land does not contain hollows. It is also considered too degraded for the species to occur, due to its isolated occurrence within the landscape.
Petrogale penicillata	Brush-tailed Rock-wallaby	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines		-	-	No	No. The subject land is not located within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines
Phascogale tapoatafa	Brush-tailed Phascogale	-	Yes	-	-	-	No. Habitat within subject land is highly degraded and isolated from larger areas of potentially suitable habitat.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Phascolarctos cinereus	Koala (Breeding)	Areas identified via survey as important habitat	Yes	-	-	Yes	No. The subject land supports marginal Koala habitat (however, this is not a mapped important habitat area), defined by the density of koalas and quality of habitat determined by on-site survey. The habitat is isolated from large patches of habitat resulting in the species being unlikely to utilise the habitat.
Planigale maculata	Common Planigale	-	Yes	-	-	-	No. Habitat within subject land is highly degraded and isolated from larger areas of potentially suitable habitat. Site lacks suitable complexity of habitat such as logs and debris.
Pomaderris queenslandica	Scant Pomaderris	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.
Pomaderris reperta	Denman Pomaderris	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Prasophyllum sp. Wybong	Prasophyllum sp. Wybong	-	-	-	-	-	Yes. The subject land may contain suitable orchid habitat within PCT 1655. In PCT 1603, however, the habitat is too degraded for the species to occur.
Prostanthera cineolifera	Singleton Mint Bush	-	Yes	-	-	-	No. Subject land lacks suitable sandstone ridges with shallow skeletal sands. The species was not opportunistically recorded within the relatively small area of PCT 1655 in the subject land. However, no targeted surveys were undertaken.
Prostanthera cryptandroides subsp. cryptandroides	Wollemi Mint-bush	-	Yes	-	-	-	No. A very small extent of suitable habitat occurs in which a BAM plot was conducted. The species was not observed during the site visit.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	Breeding camps	-	-	-	No	No. The subject land does not contain a breeding camp.
Pterostylis chaetophora	*Pterostylis chaetophora*	-	-	-	-	-	Yes. The subject land may contain suitable orchid habitat within PCT 1655. PCT 1603 does not provide suitable micro-climate for the species.

Table 5.2 Candidate threatened species assessment

Step 1 – Identify threatened species for assessment		Step 2 – Assessment of habitat constraints and vagrant species					Step 3 – Identify candidate species for further assessment
Scientific name	**Common name**	**Habitat constraints**	**Habitat degraded**	**Geographic constraints**	**Vagrant species?**	**Constraint present in subject land?**	**Candidate species (yes/no) and rationale**
Pterostylis gibbosa	Illawarra Greenhood	-	-	-	-	-	Yes. The subject land may contain suitable orchid habitat within PCT 1655. PCT 1603 does not provide suitable micro-climate for the species.
Thesium australe	Austral Toadflax	-	-	-	-	-	Yes. The subject land may contain suitable habitat within PCT 1655. In PCT 1603, however, the habitat is too degraded for the species to occur.
Tyto novaehollandiae	Masked Owl (Breeding)	Living or dead trees with hollows greater than 20 cm diameter.	-	-	-	No	No. The subject land does not contain living or dead trees with hollows greater than 20 cm diameter.
Vespadelus troughtoni	Eastern Cave Bat	Caves Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds."	-	-	-	No	No. Habitat constraints do not occur within the subject land.

5.3.2 Candidate species credit species requiring further assessment

From the assessment in Table 5.2, the candidate species requiring further assessment are listed in Table 5.3.

Table 5.3 Candidate species credit species requiring further assessment

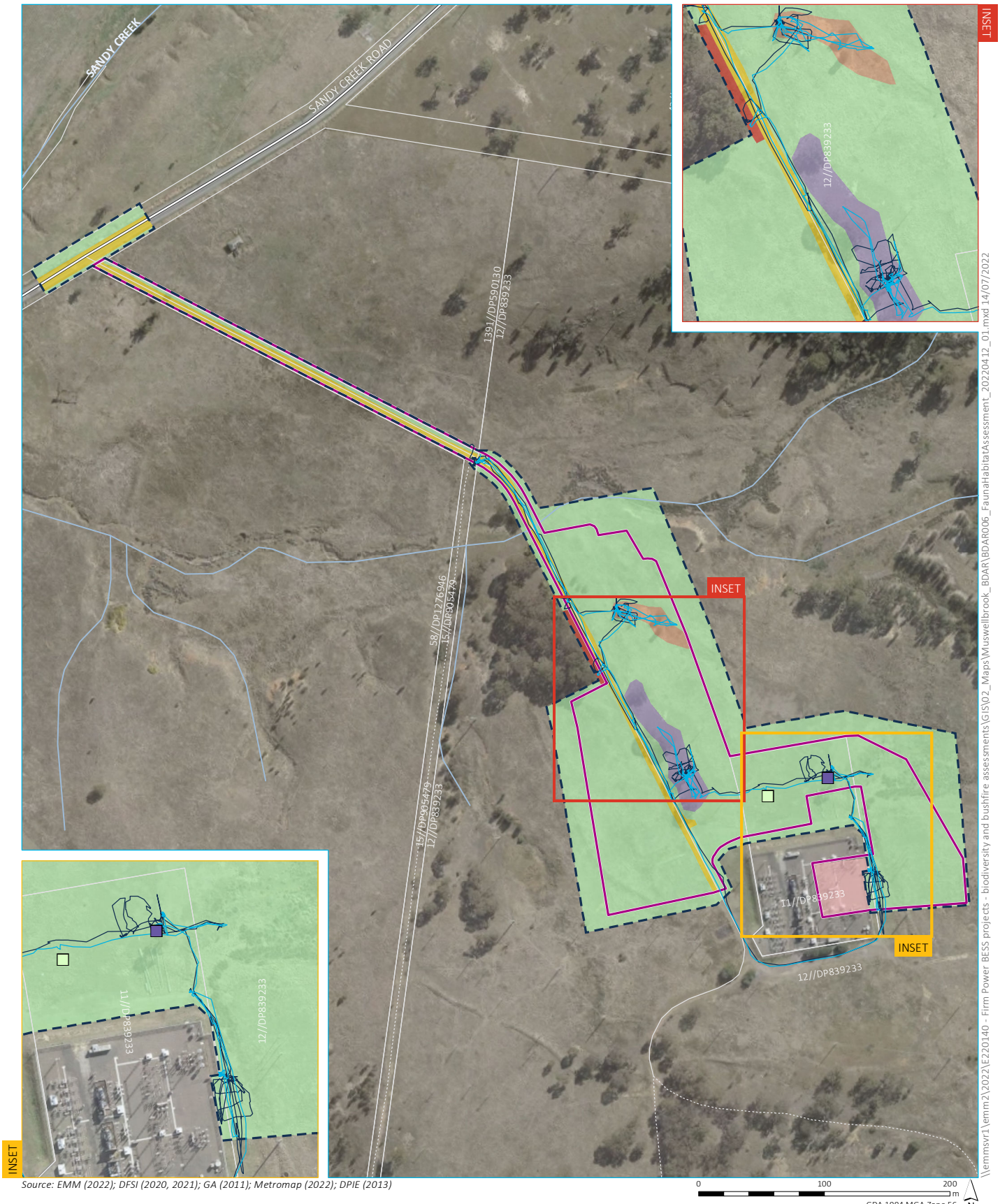
Scientific name	Common name	EPBC Act	BC Act	Flora or fauna
Cryptostylis hunteriana	Leafless Tongue Orchid	Vulnerable	Vulnerable	Flora
Delma impar[1]	Striped Legless Lizard	Vulnerable	Vulnerable	Fauna
Diuris tricolor	Pine Donkey Orchid	-	Vulnerable	Flora
Diuris tricolor - endangered population	Pine Donkey Orchid population in the Muswellbrook local government area	-	Endangered Population	Flora
Eucalyptus glaucina	Slaty Red Gum	Vulnerable	Vulnerable	Flora
Prasophyllum sp. Wybong	*Prasophyllum sp. Wybong*	Critically Endangered	-	Flora
Pterostylis chaetophora	*Pterostylis chaetophora*	-	Vulnerable	Flora
Pterostylis gibbosa	Illawarra Greenhood	Endangered	Endangered	Flora
Thesium australe	Austral Toadflax	Vulnerable	Vulnerable	Flora

Notes: 1. *Delma impar* has been assumed as present, as the newly discovered Hunter Valley Delma (*Delma vescolineata*), has not yet been listed under the BC Act.

It is anticipated that the Hunter Valley Delma will be listed under the BC Act, however, at the time of certifying this BDAR, it has not been listed. Therefore, it has not been included within the credit requirement (assumed presence). The Striped Legless Lizard has been assumed as present as a surrogate for the Hunter Valley Delma.

5.3.3 Targeted surveys

Due to the project timeframe and therefore seasonal constraints, no targeted surveys were conducted as part of this assessment. A habitat assessment for candidate species was conducted during the field surveys on 28 March 2022. Species which require further survey as per Table 5.3 have therefore been assumed as present, and subsequently retained in the BAMC within the vegetation zones identified as suitable habitat or via species polygons, as described in Section 6.



Source: EMM (2022); DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

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KEY

- Study area
- Assessment area (1500 m buffer)
- Subject land

Survey

- Track
- Track

Potential legless lizard habitat

- Embedded concrete deris
- Embedded logs

Existing environment

- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Vegetation mapping

- Exotic vegetation
- Access
- Substation

Plant community type

- 1691 | Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- 1655 | Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin (Vulnerable-BC Act)
- 1603 | Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Fauna habitat assessment

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 5.1

EMM
creating opportunities

Stage 2 – Impact assessment

6 Impact assessment

6.1 Introduction

This chapter identifies the potential impacts of project on the biodiversity values. Measures taken to date to avoid and minimise impacts are summarised and recommendations to assist in the design of the development to further avoid, minimise and mitigate impacts are provided.

6.2 Potential direct and indirect impacts

6.2.1 Direct impacts

The project would result in the following impacts on biodiversity:

- loss of native vegetation; and
- loss and degradation of native fauna habitats.

Wherever possible, direct impacts have been avoided and/or minimised through the design of the subject land. Impacts will be further managed and mitigated through the development of a biodiversity management plan, using the measures recommended in the below sections. Any residual impacts would be offset through implementation of the BOS.

6.2.2 Indirect impacts

Section 8.2 of BAM requires the assessment of indirect impacts on native vegetation, TECs and threatened species habitats.

Without any measures to avoid, minimise or mitigate impacts, the project would be likely to result in the following indirect impacts on biodiversity:

- weed introduction and spread;
- erosion and sedimentation; and
- increased noise, vibration and dust levels during construction resulting in disturbance of fauna species, and consequent abandonment of habitat, or changes in behaviour (including breeding behaviour).

These potential indirect impacts are further discussed below.

i Weed introduction and spread

The project has the potential to facilitate dispersal of weed species during construction activities. As the subject land contains high threat weeds and additional exotic plant species, weed spread has the potential to occur within and outside of the subject land. Uncontrolled movement of vehicles, equipment and personnel within the subject land would pose the highest risk of spreading weeds, in particular vehicles and equipment sourced from regions beyond the subject land which may also introduce new species. Many weed species thrive on ground disturbance and will rapidly colonise disturbed areas, inhibiting native species recolonisation.

Increased weed abundance has adverse impacts on native vegetation and biodiversity, as well as potential negative economic effects on local land uses. If vehicles, machinery, and equipment are clean prior to arrival on site and prior to movement between sites, the potential for significant weed proliferation would be low. Mitigation measures relating to the introduction and spread of weeds are included in Table 6.3.

ii Erosion and sedimentation

Any earthworks undertaken as part of the project may cause sediment to be mobilised and transported by surface water during rainfall events, potentially discharging into watercourses and drainage lines and thereby reducing water quality in downstream aquatic habitats. Increased suspended sediments can reduce light penetration into the water column, reducing photosynthesis of aquatic macrophytes, and decreasing dissolved oxygen levels.

Erosion and sediment control measures will be implemented during the project. Strict controls will be put in place to ensure sediment does not runoff into watercourses. Mitigation measures relating to erosion and sedimentation are included in Table 6.3.

iii Disturbance

Noise and vibration may adversely affect fauna by interfering with communication (eg territorial bird song, reptile behaviour), masking the sound of predators and prey, causing avoidance reactions and displacement from habitat. Noise will be generated by the project using equipment during construction; however, these impacts are temporary. During the operational phase of the project noise and vibration emissions are likely to be minimal.

Increased dust from vegetation clearing and vehicle movements during construction and operation has the potential to temporarily and locally impact flora and fauna values in the vicinity of the subject land. Excess generation of dust and subsequent deposition on leaves can impair plant photosynthesis and productivity (also resulting in reduced habitat quality for fauna) and impact on respiratory systems of fauna. Dust levels will be monitored and when needed dust suppression implemented such as wetting down exposed areas and dirt roads.

Mitigation measures relating to dust and noise are included in Table 6.3.

6.3 Prescribed and uncertain impacts

An assessment of prescribed and uncertain impacts, in accordance with Section 8.3 of the BAM, are provided in Table 6.1. An assessment of the potential impacts to Striped Legless Lizard (*Delma impar*) due to clearing non-native vegetation that may provide habitat for this species is included in Table 6.2.

The project is unlikely to have a significant impact on Striped Legless Lizard given;

- mitigation measures outlined in Section 6.4 are implemented;
- large areas of suitable habitat occur within the assessment area for this species;
- the clearing of up to 4.3 ha of exotic vegetation is unlikely to cause a significant decrease in the long-term viability of the species within the locality; and
- two species credits will be retired to offset impact on 0.21 ha of PCT 1655 and one species credit will be retied to offset impact on 0.094 ha of PCT 1603.

Table 6.1 Assessment of prescribed biodiversity impacts assessment

Prescribed/uncertain impact	Proposed development
Karst, caves, crevices, cliffs and other geological features of significance; rocks; or human-made structures; or non-native vegetation.	The project does not contain geologically significant features, rocky areas that represent habitat for threatened species or ecological communities. There is potential for Striped Legless Lizard to occur within the non - native vegetation within the subject land. Other threatened species (predicted species) may also utilise this habitat for occasional foraging. There are large areas of similar vegetation within the locality, therefore the project is unlikely to cause a significant impact to the Striped Legless Lizard or other threatened species. Species credits will be purchased to offset impacts to native vegetation for the Striped Legless Lizard within the subject land. Mitigation measures have been included in Table 6.3 to reduce the impact to the Striped Legless Lizard during construction. An assessment of the potential impacts to the Striped Legless Lizard is included in Table 6.2
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	Native vegetation and fauna habitats in the subject land are highly fragmented and of limited value except to species that can disperse by flying. Flying species may utilise the habitat on site for foraging or roosting.
Impacts of development on movement of threatened species that maintains their life cycle.	The project will not result in the clearing of large areas of native vegetation or significantly impact the movement of threatened species to the extent that the project impacts the ability of threatened species to maintain their life cycles.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining).	The project is unlikely to impact any water bodies or hydrological processes. Mitigation measures for potential indirect resulting from the project are discussed in Section 6.2.2.
Impacts of wind turbine strikes on protected animals.	The project does not include wind turbines; therefore, this prescribed impact is not relevant to the project.
Impacts of vehicle strikes on animals that are part of a threatened ecological community.	Traffic in the subject land is restricted to less than 40 km / hr and is unlikely to increase substantially during or following construction. Access to the project will be gained via existing roads and not likely increase the frequency of vehicle strikes on animals that are part of a threatened ecological community. Accordingly, management of this prescribed impact is not required.

Table 6.2 Prescribed and indirect impacts on Striped Legless Lizard habitat.

Impact	Vegetation zones	Duration	Consequence	Mitigation measures and offsets
Clearing of exotic vegetation for project construction	Exotic	Short-term	Potential mortality of individuals.	Mitigation measures provided in Section 6.4
Clearing of exotic vegetation for project construction	Exotic	Long-term	Potential decrease in population within locality.	Large areas of suitable habitat occur within the assessment area for this species. The clearing of 4.3 ha of exotic vegetation is unlikely to cause a significant decrease in the long-term viability of the species within the locality. Two species credits will be purchased to offset impact on 0.21 ha of PCT 1655.

6.4 Avoidance and minimisation strategy

The subject land has been located to avoid impacts on native vegetation and habitat where possible by focusing the disturbance footprint in mostly cleared areas and by using the existing access road. The disturbance footprint has been situated close to the current Muswellbrook substation to minimise disturbance to vegetation.

The project has undergone an iterative design process whereby information from desktop assessments and biodiversity field surveys has been considered in the overall design of the proposed development to reduce impacts on biodiversity. This has resulted in modifications in design to reduce the number of trees needed to be removed for the project.

The proposed development retains trees where practicable and has been located to avoid surrounding areas of intact vegetation. In addition, the project has been located to largely avoid the land zoned as C3-Environmental Land. The main risks from the proposed development are indirect impacts from construction on adjacent remnant vegetation. This includes erosion and sedimentation risks during construction, as well as increased pollution of waterways from surface run-off. Table 6.3 summarises the mitigation measures proposed for the project.

Table 6.3 Impact avoidance and minimisation strategy

Impact	Action	Intended outcome	Timing	Responsibility
General	A Site Plan should be included in the construction environmental management plan (CEMP), and should include: • the extent of approved clearing; • stockpile, material laydown areas, and site compounds. This Site Plan is to be placed in an accessible location to be viewed by all site personnel (site office for example).	-	Prior to construction	Contractor
Inadvertent clearing of vegetation to be retained	Clearing is to be to the minimum extent necessary. If parts of the development footprint areas are identified during construction as not necessary for construction activities, clearing will be avoided. Define clearing limits using clearly visible barrier, such as flagging tape. This should be maintained and checked daily through construction.	Reduce risk to retained vegetation during construction	Prior to and during construction	Contractor
Removal of potential habitat for native fauna (logs and debris)	Pre-clearance surveys to be conducted to identify all logs and debris to be removed. Any logs and debris to be removed will be supervised by a qualified ecologist during clearing works.	Mitigate injury to potential fauna species.	During construction	Contractor; Qualified Ecologist
Increased sedimentation due to construction	Sediment controls, including fencing and sediment traps, should be installed in any areas where works will occur in proximity to low lying vegetation or streams.	Minimise indirect impacts on retained vegetation and downstream habitat.	Prior to and during construction	Contractor
Increased run-off from hard surfaces and into adjacent waterways	Detailed design should include adequate design measures for drainage to capture and direct surface flows appropriately.	Protect waterways	Design phase	Contractor
Increased weed encroachment into adjacent vegetation	All priority weeds within the subject land (refer Section 7.2) should be appropriately removed offsite, preferably without stockpiling prior to removal. If stockpiling of weeds is required before removal from site, weeds are to be stockpiled and appropriately covered and located in areas away from vegetation to be retained to minimise the spread of seed and other propagules. Hygiene protocols should be implemented including hygiene procedures for equipment, footwear and clothing. Ensure works vehicles are washed down prior to entering the works area.	Minimise indirect impacts on retained vegetation.	Prior to and during construction	Contractor

Table 6.3 Impact avoidance and minimisation strategy

Impact	Action	Intended outcome	Timing	Responsibility
Pathogen introduction	Hygiene measures should be implemented as part of the CEMP to minimise the risk of pathogen spread on site and should include procedures for equipment, footwear and clothing. Ensure works vehicles are washed down prior to entering the works area.	Minimise indirect impacts on retained vegetation.	Prior to and during construction	Contractor

6.5 Serious and Irreversible Impacts

An impact is to be regarded as serious and irreversible (SAII) if it is likely to contribute significantly to the risk of a threatened species (including endangered populations) or an ecological community becoming extinct based on the following 4 principles:

- Principle 1: The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
- Principle 2: The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
- Principle 3: The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
- Principle 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity, and therefore its members are not replaceable.

Candidate SAII entities with regards to the project are listed in Table 6.4, along with the relevant principles for the listing of the SAII entity, based on information from the Threatened Biodiversity Data Collection (TBDC). No assessment of any other threatened entities at risk of an SAII has been requested by the decision-maker.

Table 6.4 Candidate SAII entities for the project

Threatened community or species	Principle			
	1	2	3	4
Prasophyllum sp. Wybong	-	-	Known from <= 3 locations and/or an AOO < 10 km^2 or EOO <100km^2	-
No candidate TECs	-	-	-	-

6.5.1 Threatened species

Section 9.1.2 of BAM requires additional impact assessment for threatened species that are also listed as candidate entities for Serious and Irreversible Impacts (SAII). An assessment of *Prasophyllum* sp. Wybong against the assessment criteria provided in Section 9.1.2 of BAM is provided below.

The project timeline did not allow for targeted survey for *Prasophyllum* sp *Wybong*. However, targeted surveys in accordance with the TBDC, will be undertaken in the subject land in September 2022, and if not found, again in October 2022. The results of the survey will be provided to Biodiversity and Conservation Division (BCS) - Hunter Central Coast Branch during the response to submissions phase of the project.

i *Prasophyllum* sp. Wybong

Table 6.5 provides details of the current status of *Prasophyllum* sp. Wybong (Critically Endangered) (listed under the EPBC Act only) and Table 6.6 provides details as required under the SAII assessment criteria.

Table 6.5 Current status of *Prasophyllum* sp. Wybong

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate).	Insufficient data to determine historic or current population trends for *Prasophyllum* sp. Wybong. During monitoring of the population near Muswellbrook from 1999 to 2005, substantial population fluctuation was observed. The number of individuals ranged from zero to 10 plants. The fluctuation was expected to be as a result of dormant underground tubers as opposed to population decline.	TSSC 2009	No population trend data after 2005 is available.
Evidence of small population size (Principle 2)			
Current population size in NSW	Surveys conducted in the Wybong population in 2010 resulted in 76 records (TBDC 2022) whilst another conducted in 2017 resulted in 691 individuals (Umwelt 2018 and references therein). There is an expected population size in the Mangoola Coal land holding estimated to be in excess of 15, 000 individuals (Umwelt 2018 and references therein). Surveys within Mangoola Coal owned properties to date have identified approximately 5,806 orchids (Umwelt 2018 and references therein). Previous surveys conducted in 2006 resulted in 460 mature individuals being recorded with the two largest populations containing approximately 100 and 300 individuals (DEWHA; TSSC 2009). The total population size could be larger as suitable habitat surrounding the population near Wybong has not been surveyed. Data on the population size at Manilla, Tenterfield or Inverell is restricted to between 2-40 individuals. .	DEWHA 2009; TSSC 2009; TBDC 2022	No population size data after 2006 available for all populations in NSW- the most recent is 2006.

Table 6.5 Current status of *Prasophyllum* sp. Wybong

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Decline in species' population size in 3 years or one generation	Data is not available on population decline	No data available	Insufficient survey data exists to provide an accurate or current assessment of population trends.
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	Surveys conducted in the Wybong population in 2010 resulted in 76 records (TBDC 2022) whilst another conducted in 2017 resulted in 691 individuals (Umwelt 2018 and references therein). There is an expected population size in the Mangoola Coal land holding estimated to be in excess of 15, 000 individuals (Umwelt 2018 and references therein). Surveys within Mangoola Coal owned properties to date have identified approximately 5,806 orchids (Umwelt 2018 and references therein). Data on the population size at Manilla, Tenterfield or Inverell is restricted to between 2-40 individuals. .	TBDC 2022; Umwelt 2018; TSSC 2019	Data on the population size at Manilla is not available.
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	*Prasophyllum* sp. Wybong is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. The suggested extent of occurrence of *Prasophyllum* sp. Wybong is 48,000 km^2 .	TSSC 2009 and references therein; Umwelt 2018	Extent of occurrence based on one report only.
Area of occupancy (ha)	The species' area of occupancy is estimated to be 1.5 km^2 with an estimated population size based on surveys in 2006.	DEWHA 2009	Lack of current data
Number of threat-defined locations	The BAM (2020) defines threat-defined locations as geographically or ecologically distinct areas in which a single threatening event may rapidly affect species occurrences. Where two or more subpopulations occur in an area that may be threatened by one such event, they are counted as a single location. Where a subpopulation covers an area larger than what a single event is likely to impact, this is counted as two or more locations. The main threats to *Prasophyllum* sp. Wybong are habitat clearance, weed invasion, vehicle traffic, inappropriate disturbance regimes, chemical drift from agricultural properties, illegal collection, trampling by people and climate change.	DEWHA 2009; DPIE 2020a	n/a

Table 6.5 Current status of *Prasophyllum* sp. Wybong

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
	The seven known populations of the species are spatially disjunct from one another and separated by areas of cleared land. Each is likely to represent a separate threat-defined location.		
Whether the species' population is likely to undergo extreme fluctuations	*Prasophyllum* sp. Wybong is an orchid which can occur as dormant underground tubers. Fluctuations in populations are known to occur in response to environmental conditions, particularly rainfall.	TSSC 2009; Umwelt 2018	The species is poorly understood. The population at Wybong is better surveyed than remaining populations in NSW due to development approvals.

Table 6.6 SAII assessment for *Prasophyllum sp. Wybong*

Assessment question	Response
Number of individuals (mature and immature) present in the subpopulation on the subject land	The subject land does not contain any known population of *Prasophyllum* sp. Wybong. The purpose of the SAII assessment is due to potential habitat occurring within the subject land. The nearest recorded *Prasophyllum* sp. Wybong population is located in Wybong, NSW, approximately 19 kilometres west of the subject land.
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	As above, the subject land does not contain any known population of *Prasophyllum* sp. Wybong. Given the small are of potential habitat in the subject land, only a very small proportion of the total NSW population could be present there.
Number of individuals (mature and immature) to be impacted by the proposal	The number of individuals expected to be impacted by the proposal is unknown. This is due to the subject land being potential habitat only, and not containing any known populations of the species. The potential habitat within the subject land occurs across 0.209 ha, which may support a small number of individuals of the species if it was to occur.
Individuals (mature and immature) to be impacted by the proposal as a percentage of total NSW population (%)	As above, the subject land does not contain any known population of *Prasophyllum* sp. Wybong. Given the small are of potential habitat in the subject land, only a very small proportion of the total NSW population could be impacted.
Area of habitat to be impacted (ha) (for species measured by area only)	0.209 ha of potential habitat would be impacted by the proposed development.
Area of the species' geographic range to be impacted by the proposal (ha)	The estimated geographic range of *Prasophyllum* sp. Wybong is 48,000 km^2. 0.209 ha of potential habitat within the subject land represents less than 0.0001 % of the species' geographic range.
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	0.209 ha of potential habitat within the subject land represents 0.14 % of the species known area of occupancy (1.5 km^2).

Table 6.6 SAII assessment for *Prasophyllum sp. Wybong*

Assessment question	Response
Individuals impacted	No known individuals will be impacted. The potential habitat within the subject land occurs across 0.209 ha, which may support a small number of individuals of the species if it was to occur.
Viability of a fragmented population	No known population is likely to be fragmented because of the proposed development. The 0.209 ha of potential habitat within the subject land is already fragmented from woodland patches within the landscape and will be removed because of the proposed development.

6.6 Impacts not requiring offsets

In accordance with Section 9.2.1 of BAM, impacts on native vegetation and threatened ecological communities (TECs) (ecosystem credits) do not require offsets where:

- a vegetation zone representative of a critically endangered or endangered ecological community has a vegetation integrity score less than 15; and
- a vegetation zone representative of a vulnerable ecological community and/or threatened species habitat (as represented by ecosystem credits) has a vegetation integrity score less than 17; and
- a vegetation zone that is not listed as a TEC and is not associated with threatened species habitat, has a vegetation integrity score less than 20.

Table 6.7 provides a summary of the vegetation zones that do not trigger the above thresholds.

Table 6.7 Summary of impacts not requiring offsets – native vegetation

Vegetation zone	PCT	Name	Area (ha)	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
2	1603- Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1603_poor	0.094	13.4	0.0	-13.4	0

Areas not requiring assessment in accordance with Section 9.3 of BAM (DPIE 2020a) include:

- existing roads and access tracks;
- cleared and highly disturbed land, such as exotic vegetation; and
- watercourses.

For clarification, vegetation integrity plots were placed within areas of exotic vegetation and maintained lawn to confirm that the thresholds under the BAM were not met (see Table 4.6 for details).

6.7 Impacts requiring offset

This section provides an assessment of the impacts requiring offsetting in accordance with Section 9.2 of BAM.

i Impacts on native vegetation

Impacts to native vegetation requiring offsets include:

- direct impacts on 0.21 ha of PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin.

A summary of the ecosystem credits required for all vegetation zones, including changes in vegetation integrity score, are provided in Table 6.8. A total of 2 ecosystem credits are required to offset the residual impacts of the project. A credit report is provided in Appendix B.

Table 6.8 Summary of ecosystem credits required for all vegetation zones

Vegetation zone number	PCT	Vegetation zone name	Area	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
1	PCT 1655 - Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	1655_Poor	0.21	21.1	0.0	-21.1	2

Offsets will be provided through implementation of the biodiversity offset scheme.

ii Impacts on threatened species

Impacts to threatened species habitat requiring offsets include:

- direct impacts on 0.21 ha of habitat for:
  - Leafless Tongue Orchid;
  - Pine Donkey Orchid;
  - Pine Donkey Orchid population in the Muswellbrook local government area;
  - *Prasophyllum sp.* Wybong;
  - *Pterostylis chaetophora;*
  - Illawarra Greenhood; and
  - Austral Toadflax.
- direct impacts on 0.3 ha of habitat for Striped Legless Lizard;
- one individual Slaty Red Gum.

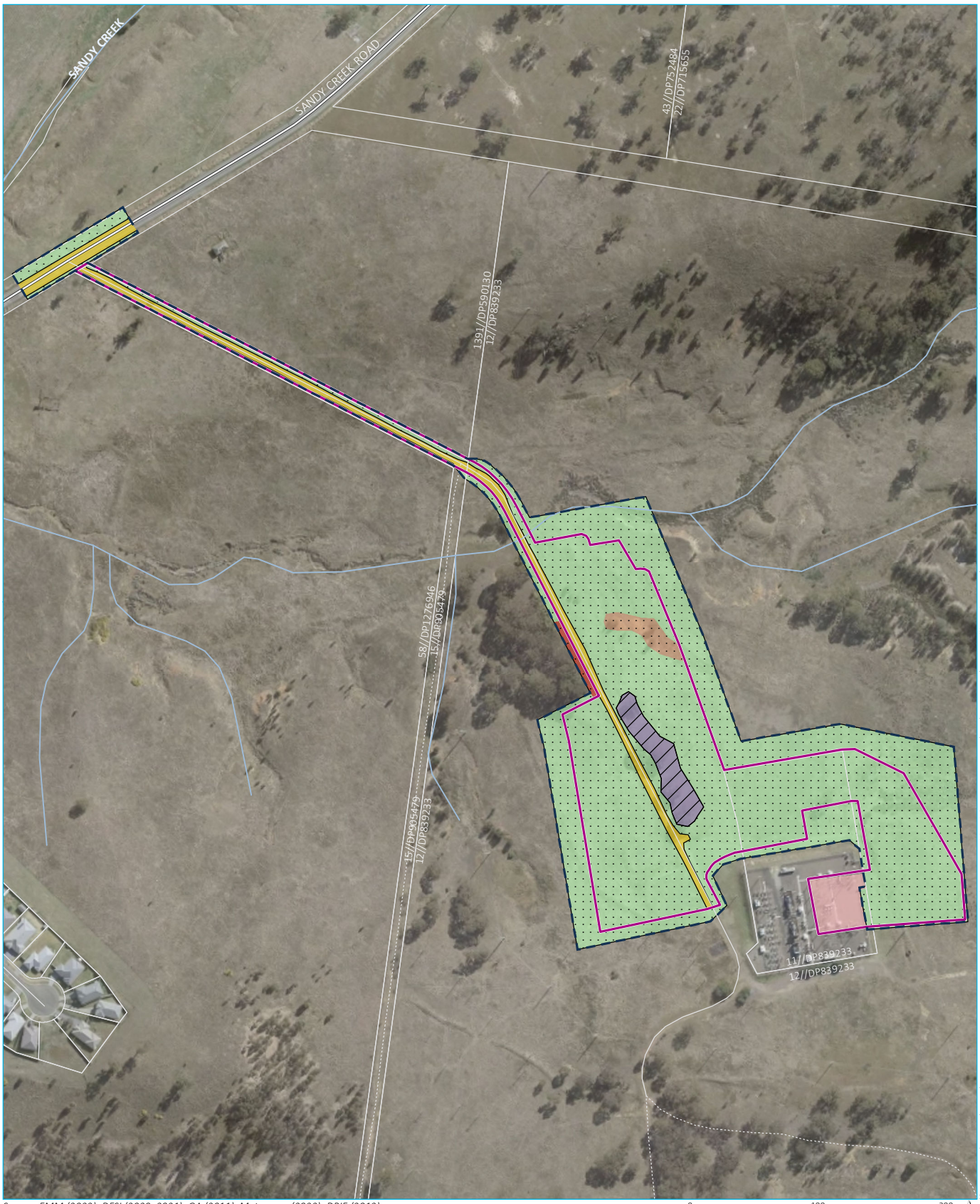
A summary of the species credits required for all vegetation zones occupied by the threatened species, including changes in vegetation integrity score, are provided in Table 6.9. A total of 20 species credits are required to offset the residual impacts of the project. A credit report is provided in Appendix B.

Offsets will be provided in accordance with the biodiversity offset scheme.

Table 6.9 Summary of species credits required

Species	Vegetation zone name	Area (ha)/individual (HL)	Habitat condition	Future habitat condition	Loss of habitat condition	Candidate SAII	Species credits
Leafless Tongue Orchid	1655_poor	0.21	21.1	0.0	-21.1	No	2
Striped Legless Lizard[1]	1655_poor, 1603_poor	0.21, 0.09	21.1, 13.4	0.0, 0.0	-21.1, -13.4	No	2, 1
Pine Donkey Orchid	1655_poor	0.21	21.1	0.0	-21.1	No	2
Pine Donkey Orchid population in the Muswellbrook local government area	1655_poor	0.21	21.1	0.0	-21.1	No	2
Slaty Red Gum	1655_poor	1	21.1	0.0	-21.1	No	2
Prasophyllum sp. Wybong	1655_poor	0.21	21.1	0.0	-21.1	Yes	3
Pterostylis chaetophora	1655_poor	0.21	21.1	0.0	-21.1	No	2
Illawarra Greenhood	1655_poor	0.21	21.1	0.0	-21.1	No	2
Austral Toadflax	1655_poor	0.21	21.1	0.0	-21.1	No	2

Notes: 1. Striped Legless Lizard has been assumed as present, as the newly discovered Hunter Valley Delma (*Delma vescolineata*), has not yet been listed under the BC Act.



Source: EMM (2022); DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

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GDA 1994 MGA Zone 56

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KEY

- Subject land
- Study area
- Assessment area (1500 m buffer)
- PCT requiring offset
- Vegetation not requiring offset

Vegetation mapping

- Access
- Exotic vegetation
- Substation

Plant community type

- 1691 | Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- 1655 | Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin (Vulnerable-BC Act)
- 1603 | Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

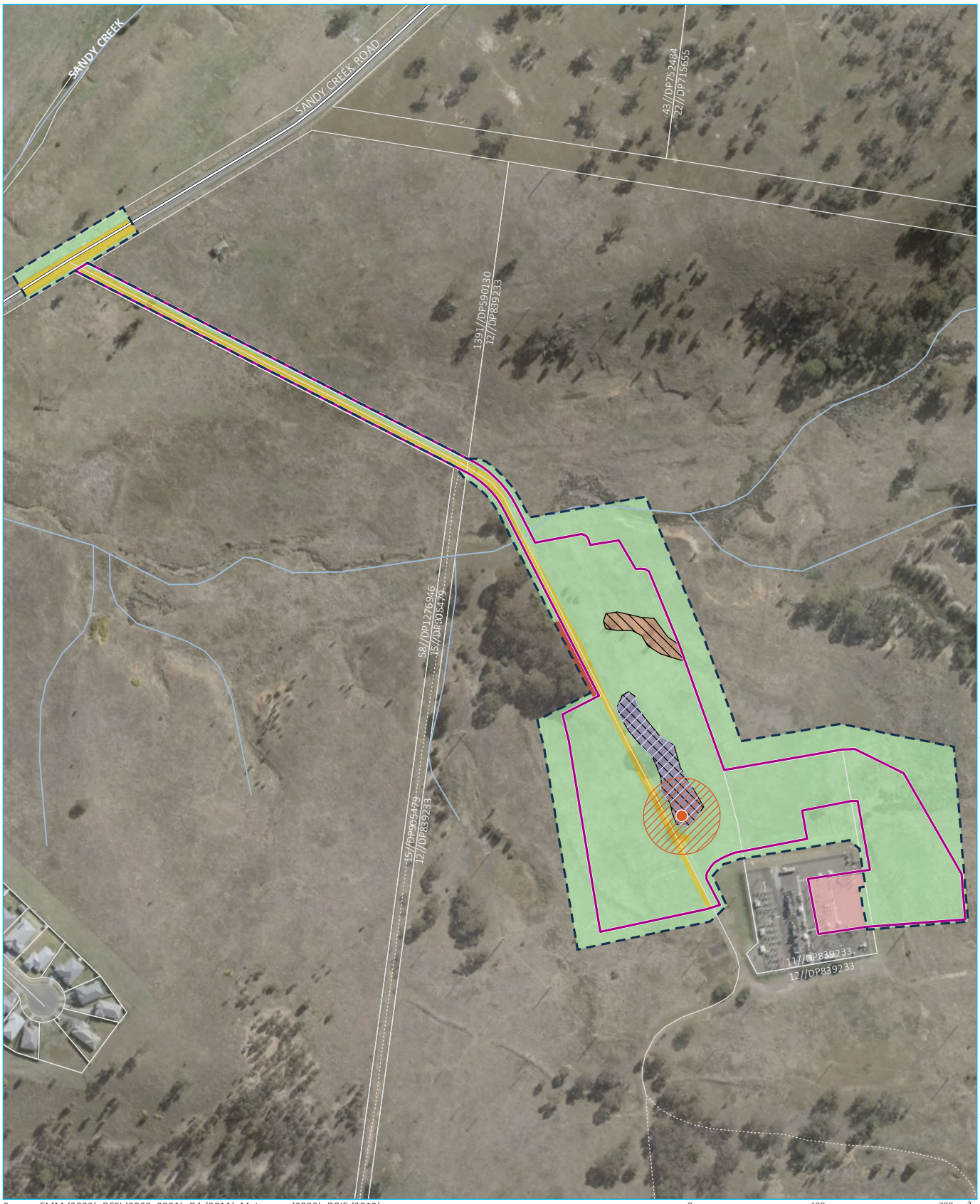
Existing environment

- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Impacts requiring offset

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 6.1

EMM
creating opportunities



Source: EMM (2022); DFSI (2020, 2021); GA (2011); Metromap (2022); DPIE (2013)

0 100 200 m

GDA 1994 MGA Zone 56

N

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KEY

- Subject land
- Study area
- Slaty Red Gum (*Eucalyptus glaucina*) (uncomfirmed)
- Species assumed present in PCT 1655:
  - Leafless Tongue Orchid (*Cryptostylis hunteriana*)
  - Pine Donkey Orchid (*Diuris tricolor*)
  - Pine Donkey Orchid population in the Muswellbrook LGA (*Diuris tricolor* - endangered population)
  - *Prasophyllum sp. Wybong*
  - *Pterostylis chaetophora*
  - Illawarra Greenhood (*Pterostylis gibbosa*)
  - Austral Toadflax (*Thesium australe*)
- Slaty Red Gum buffer
- Striped Legless Lizard (*Delma impar*)

Existing environment

- Major road
- Minor road
- Vehicular track
- Watercourse/drainage line
- Cadastral boundary

Vegetation mapping

- Substation
- Access
- Exotic vegetation

Plant community type

- 1691 | Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
- 1655 | Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin (Vulnerable-BC Act)
- 1603 | Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Species polygons

Muswellbrook Battery Energy Storage System
Biodiversity Development Assessment Report
Figure 6.2

EMM
creating opportunities

7 Assessment of other relevant biodiversity legislation

7.1 Environment Protection and Biodiversity Conservation Act 1999

This chapter provides an assessment of the project's impacts specific to species and communities listed under the EPBC Act.

The PMST (DAWE 2022a) produced a list of MNES that may occur within the subject land. A likelihood of occurrence (LoO) assessment was undertaken to assess the likelihood that these MNES could occur within or adjacent to the subject land. The criteria for assessing LoO for the list of MNES predicted by the PMST is listed in Table 7.1.

Table 7.1 Likelihood of occurrence criteria

Likelihood	Description	Further assessment conducted?
Absent	• The species or community was targeted and was concluded to be absent from the subject land.	No
Negligible	• The potential for the species to occur in the subject land is considered so unlikely as to not be worth considering.	No
Low	• Based on data collected during field investigations it was considered that the species was unlikely to occur in the subject land or use habitats in the subject land; or • The species may utilise the study area on rare occasions; or • The species is considered vagrant in the bioregion and is thus considered unlikely to occur in the subject land.	No
Moderate	• The species is known to occur in the bioregion and the subject land provides some habitat value for the species. Habitat values are somewhat degraded and considered suboptimal.	Yes
High	• The species is known to occur in the bioregion and the subject land supports optimal habitat features for the species.	Yes
Recorded	• The species has been recorded during current surveys; or • The species has been recorded in the subject land previously and there has not been any change in habitat values since this time.	Yes

A likelihood of occurrence assessment for protected matters is presented in Section Appendix C.

7.1.1 Threatened ecological communities

Five PCTs were identified as having potential to occur within the subject land by the Protected Matters Search Tool (PMST):

- Central Hunter Valley eucalypt forest and woodland;
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland
- Hunter Valley Weeping Myall (*Acacia pendula*) Woodland
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland; and

- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria;

None of the PCTs recorded across the subject land are consistent with the TECs predicted to occur, and these TECs are not considered further.

7.1.2 Threatened species

The PMST and/or BAMC predicted that 49 species and 28 species listed under the EPBC Act could occur within the subject land, respectively.

The likelihood of occurrence for these species is assessed in Appendix C, with those species having a moderate, or higher, likelihood rating listed in Table 7.2.

Table 7.2 Species considered to have moderate to known likelihood of occurrence

Scientific name	Common name	EPBC status	Likelihood of occurrence	Significant impact?
Delma impar	Striped Legless Lizard	Vulnerable	High	Unlikely
Eucalyptus glaucina	Slaty Red Gum	Vulnerable	Known/assumed	Unlikely
Prasophyllum sp. Wybong	-	Critically Endangered	Moderate	Unlikely
Pteropus *poliocephalus*	Grey-headed Flying-fox	Vulnerable	Moderate	Unlikely
Pterostylis gibbosa	Illawarra Greenhood	Endangered	Moderate	Unlikely
Thesium australe	Austral Toadflax	Vulnerable	Moderate	Unlikely

Assessments of significance were prepared in accordance with the requirements of *Matters of National Environmental Significance - Significant Impact Guidelines 1.1* (DoE 2013) for the species listed in Table 7.2 and are provided in Appendix D.

These assessments concluded that the project is unlikely to result in a significant impact on the MNES and referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

7.1.3 Migratory species

Eleven species listed as migratory under the EPBC Act were predicted to occur in the subject land based on database searches undertaken. Appendix C provides an assessment of the likelihood of these species utilising habitat within the subject land.

No species listed as migratory under the EPBC Act were recorded as being present in subject land or assessed as having a moderate or high likelihood of occurring within the subject land.

7.2 Biosecurity Act 2015

One priority weed identified in the *Hunter Regional Strategic Weed Management Plan 2017-2022* (Hunter LLS, 2017) was recorded in the subject land:

- Fireweed (*Senecio madagascariensis*).

Priority weeds are widely distributed in some areas of the state. As Weeds of National Significance (WONS), their spread should be minimised to protect priority assets. The plants should not be imported into the state or sold. The weeds should be managed in accordance with published weed management plans.

One additional species of concern (Hunter LLS, 2017) was recorded within the subject land:

- Prickly Pear (*Opuntia* sp.)

This species is of concern to the Hunter community or is a high priority for several current programs, though not feasible to contain or eradicate.

Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated, or minimised, so far as is reasonably practicable. Any priority weed species must not be imported into NSW or sold. In addition, there is a regional recommended measure for land managers in the Hunter region to mitigate the risk of new weeds being introduced to, and spread from, their land.

8 Conclusion

This BDAR has been prepared based on the requirements of, and information provided under, the BAM and clause 6.15 of the BC Act.

The mitigation actions recommended within this BDAR have been developed in parallel with, and have informed the evolution of, the project design. This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable. Residual impacts include:

- loss of 0.21 ha of PCT 1655 in poor condition, and associated habitat for flora and fauna species, and
- loss of 0.09 ha of PCT 1603 in poor condition, and associated habitat for flora and fauna species.

Mitigation and management measures have been proposed to address predicted impacts on biodiversity. These include pre-clearance, construction, and operational phase measures to avoid impacts at all stages of the project.

The offset requirements determined for the project are summarised in Table 8.1.

Table 8.1 Summary of credit requirements

Entity	Area (ha)/Count	Number of credits
PCT 1655	0.21	2
Leafless Tongue Orchid habitat (assumed present)	0.21	2
Striped Legless Lizard habitat (assumed present)[1]	0.30	3
Pine Donkey Orchid habitat (assumed present)	0.21	2
Pine Donkey Orchid population in Muswellbrook LGA (assumed present)	0.21	2
Slaty Red Gum tree (recorded)	1	2
Prasophyllum sp. Wybong habitat (assumed present)	0.21	3
Pterostylis chaetophora habitat (assumed present)	0.21	2
Illawarra Greenhood habitat (assumed present)	0.21	2
Austral Toadflax habitat (assumed present)	0.21	2

Notes: 1. Striped Legless Lizard has been assumed as present, as the newly discovered Hunter Valley Delma (*Delma vescolineata*), has not yet been listed under the BC Act.

This BDAR has included an assessment for potential SAII to *Prasophyllum* sp. Wybong if it were to be present within the subject land. The project timeline did not allow for targeted survey for *Prasophyllum* sp *Wybong.* However, targeted surveys in accordance with the TBDC, will be undertaken in the subject land in September 2022, and if not found, again in October 2022. The results of the survey will be provided to BCS - Hunter Central Coast Branch during the response to submissions phase of the project. No other entities at risk of SAII are present, or likely to be present within the subject land.

The proponent, Firm Power, propose to purchase credits from the market, or pay into the Biodiversity Conservation Fund (BCF) to fulfill their offset obligations for the project.

The BDAR has also considered impacts on species and ecological communities listed under the EPBC Act. The proposed development is not expected to result in significant impacts to MNES including threatened ecological communities and species, and migratory species. A referral under the EPBC Act is not required.

References

DAWE 1999, *National Recovery Plan for the Striped Legless Lizard (Delma impar)* 1999-2003. NSW National Parks and Wildlife Service & Wildlife Profiles Pty Ltd.

- 2022a, Protected Matters Search Tool (PMST), Australian Government Department of Agriculture, Water and the Environment, Canberra.

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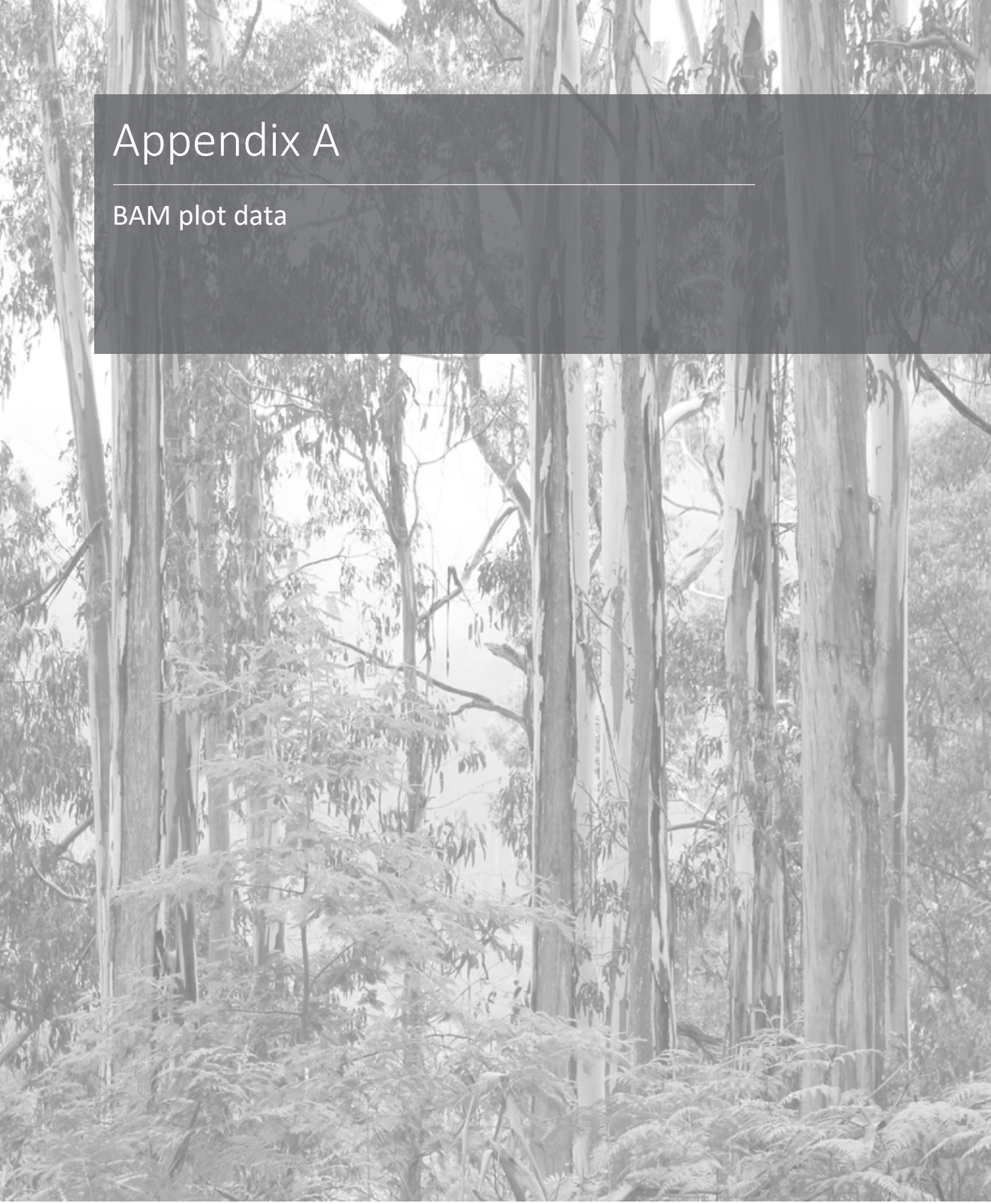


Appendix A

BAM plot data

BAM Site – Field Survey Form

Plot ID:	Plot 1	**Date:**	28/03/22	**Project number:**	E220140	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	303,268	**Recorders:**	LO BS		
Zone:	56	**Northing:**	6,430,464	**IBRA region:**		**Midline bearing:**	178
Plant Community Type:		1655: Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin		**Condition class:**	exotic	**PCT confidence:**	
Vegetation Class:		Western Slopes Dry Sclerophyll Forests		**EEC:**		**EEC confidence:**	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	4
	Forbs:	3
	Ferns:	0
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	15.8
	Forbs:	2.8
	Ferns:	0
	Other:	0.1
High Threat Weed cover:		3.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	0
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	5	2	5	5
Average litter cover (%):	4.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E220140				
Recorders:	LO BS	**Plot ID:**	Plot 1	**Date:**	28/03/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	15	2000	no	N
	Conyza bonariensis (Flaxleaf Fleabane)	0.1	20	no	E
Forb (FG)	*Portulaca oleracea (Pigweed)*	2.5	100	no	N
Forb (FG)	*Oxalis spp.*	0.2	20	yes	N
	Galenia pubescens (Galenia)	2.5	100	yes	HTE
	Sida rhombifolia (Paddy's Lucerne)	0.1	20	no	E
	Cyperus aggregatus	0.1	10	yes	E
	Solanum nigrum (Black-berry Nightshade)	0.1	5	yes	E
	Medicago sativa (Lucerne)	0.2	20		E
	Plantago lanceolata (Lamb's Tongues)	0.5	20		E
	Cirsium vulgare (Spear Thistle)	0.1	10	no	E
	Modiola caroliniana (Red-flowered Mallow)	1	10	yes	E
	Setaria pumila (Pale Pigeon Grass)	0.2	20		E
	Paspalum dilatatum (Paspalum)	0.5	50	no	HTE
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.5	50	no	N
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.2	40	yes	N
	Chloris gayana (Rhodes Grass)	0.1	10	no	HTE
	Digitaria sanguinalis (Crab Grass)	0.5	40	yes	E
	Verbena rigida var. rigida (Veined Verbena)	0.5	40	yes	E
Grass & grasslike (GG)	*Sporobolus creber (Slender Rat's Tail Grass)*	0.1	10	yes	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	10	yes	N
Other (OG)	*Glycine clandestina (Twining glycine)*	0.1	1	no	N
	Silybum marianum (Variegated Thistle)	0.1	2		E
	Verbena bonariensis (Purpletop)	0.1	5		E
	Lysimachia arvensis (Scarlet Pimpernel)	0.1	4	no	E
	Tagetes minuta (Stinking Roger)	0.1	10	yes	E
Forb (FG)	*Calotis lappulacea (Yellow Burr-daisy)*	0.1	1	yes	N
	Verbascum spp.	0.1	2	yes	E

BAM Site – Field Survey Form

Plot ID:	Plot 2	**Date:**	28/03/22	**Project number:**	E220140	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	303,235	**Recorders:**	LO BS		
Zone:	56	**Northing:**	6,430,542	**IBRA region:**		**Midline bearing:**	250
Plant Community Type:	1655: Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin			**Condition class:**	DNG	**PCT confidence:**	low
Vegetation Class:	Western Slopes Dry Sclerophyll Forests			**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	0
	Shrubs:	1
	Grasses etc.:	6
	Forbs:	4
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	0
	Shrubs:	0.1
	Grasses etc.:	4.3
	Forbs:	11.1
	Ferns:	0
	Other:	0
High Threat Weed cover:		21.1

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	3
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	0		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	5	3	5	5	10
Average litter cover (%):	5.6				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E220140				
Recorders:	LO BS	**Plot ID:**	Plot 2	**Date:**	28/03/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Galenia pubescens (Galenia)	20	1000	yes	HTE
	Tagetes minuta (Stinking Roger)	0.1	10	yes	E
	Lepidium africanum (Common Peppercress)	2	100	yes	E
	Conyza bonariensis (Flaxleaf Fleabane)	20	1000	no	E
Grass & grasslike (GG)	*Cynodon dactylon (Common Couch)*	1	1000	no	N
	Solanum nigrum (Black-berry Nightshade)	0.2	10	no	E
	Sida spinosa	0.2	20	yes	E
Forb (FG)	*Portulaca oleracea (Pigweed)*	1	50	no	N
	Medicago sativa (Lucerne)	0.1	20	no	E
Forb (FG)	*Oxalis spp.*	5	100	no	N
Forb (FG)	*Commelina cyanea (Native Wandering Jew)*	5	100	no	N
Grass & grasslike (GG)	*Sporobolus creber (Slender Rat's Tail Grass)*	2	100	no	N
	Modiola caroliniana (Red-flowered Mallow)	2	50	no	E
	Cirsium vulgare (Spear Thistle)	0.1	2	no	E
	Gomphocarpus fruticosus (Narrow-leaved Cotton Bush)	0.1	1	yes	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	10	yes	N
	Tradescantia fluminensis (Wandering Jew)	1	20	yes	HTE
	Verbena bonariensis (Purpletop)	0.1	20	no	E
	Sida rhombifolia (Paddy's Lucerne)	0.2	20	no	E
	Digitaria sanguinalis (Crab Grass)	0.1	1	yes	E
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	1	50	yes	N
Forb (FG)	*Rumex spp. (Dock)*	0.1	1	yes	N
	Cyperus aggregatus	0.1	10	yes	E
Shrub (SG)	*Prostanthera spp.*	0.1	4	yes	N
	Paspalum dilatatum (Paspalum)	0.1	20		HTE
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	1	no	N
Grass & grasslike (GG)	*Cymbopogon refractus (Barbed Wire Grass)*	0.1	1	no	N

BAM Site – Field Survey Form

Plot ID:	Plot 3	**Date:**	28/03/22	**Project number:**	E220140	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	303,120	**Recorders:**	LO BS		
Zone:	56	**Northing:**	6,430,535	**IBRA region:**		**Midline bearing:**	327
Plant Community Type:	1655: Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin			**Condition class:**	poor	**PCT confidence:**	high
Vegetation Class:	Western Slopes Dry Sclerophyll Forests			**EEC:**	yes	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	5
	Shrubs:	4
	Grasses etc.:	16
	Forbs:	8
	Ferns:	0
	Other:	0
Sum of Cover of native vascular plants by growth form group	Trees:	10.8
	Shrubs:	1
	Grasses etc.:	2.4
	Forbs:	1.2
	Ferns:	0
	Other:	0
High Threat Weed cover:		40.6

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	2
80 + cm:	0		
50 – 79 cm:	3		
30 – 49 cm:	1		
20 – 29 cm:	0	Tree hollow count	0
10 – 19 cm:	0		
5 – 9 cm:	1		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	90	10	15	80	95
Average litter cover (%):	58				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E220140				
Recorders:	LO BS	**Plot ID:**	Plot 3	**Date:**	28/03/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Eucalyptus dawsonii (Slaty Gum)*	10	1	yes	N
	Schinus areira (Pepper Tree)	0.1	1	yes	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.2	30	yes	N
	Galenia pubescens (Galenia)	20	200	yes	HTE
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	50	yes	N
Shrub (SG)	*Commersonia spp.*	0.3	15	yes	N
	Paspalum dilatatum (Paspalum)	0.1	1	no	HTE
	Solanum nigrum (Black-berry Nightshade)	0.5	15	yes	E
	Lepidium africanum (Common Peppercress)	0.1	20	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.2	100	no	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	50	yes	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	50	no	N
Tree (TG)	*Acacia salicina (Cooba)*	0.3	1	yes	N
Grass & grasslike (GG)	*Bothriochloa decipiens var. decipiens (Pitted Bluegrass)*	0.1	20	yes	N
	Setaria pumila (Pale Pigeon Grass)	0.1	20	no	E
	Chloris gayana (Rhodes Grass)	0.1	10	no	HTE
	Cyperus aggregatus	0.2	30	yes	E
	Sida rhombifolia (Paddy's Lucerne)	0.5	20	no	E
	Solanum nigrum (Black-berry Nightshade)	0.1	1	no	E
	Lysimachia arvensis (Scarlet Pimpernel)	0.1	15	no	E
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	10	no	N
Forb (FG)	*Calotis lappulacea (Yellow Burr-daisy)*	0.2	10	yes	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.2	20	yes	N
	Cirsium vulgare (Spear Thistle)	0.1	5		E
Grass & grasslike (GG)	*Cymbopogon refractus (Barbed Wire Grass)*	0.2	20	no	N
	Senecio madagascariensis (Fireweed)	0.1	5		HTE
Grass & grasslike (GG)	*Chloris ventricosa (Tall Chloris)*	0.1	10	no	N
Tree (TG)	*Notelaea spp.*	0.1	1	yes	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.1	10	yes	N
	Verbena bonariensis (Purpletop)	0.2	50	no	E
Forb (FG)	*Oxalis perennans*	0.2	50	yes	N
	Silybum marianum (Variegated Thistle)	0.1	1		E
Forb (FG)	*Geranium retrorsum (Cranesbill Geranium)*	0.1	3	yes	N
	Tagetes minuta (Stinking Roger)	0.1	1	yes	E
	Schinus areira (Pepper Tree)	0.1	1	yes	E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.2	30	yes	N
	Galenia pubescens (Galenia)	20	200	yes	HTE
Grass & grasslike (GG)	*Digitaria divaricatissima (Umbrella Grass)*	0.2	50	yes	N
Shrub (SG)	*Commersonia spp.*	0.3	15	yes	N
	Paspalum dilatatum (Paspalum)	0.1	1	no	HTE
	Solanum nigrum (Black-berry Nightshade)	0.5	15	yes	E
	Lepidium africanum (Common Peppercress)	0.1	20	no	E
	Conyza bonariensis (Flaxleaf Fleabane)	0.2	100	no	E
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.2	50	yes	N
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	50	no	N
Tree (TG)	*Acacia salicina (Cooba)*	0.3	1	yes	N
Grass & grasslike (GG)	*Bothriochloa decipiens var. decipiens (Pitted Bluegrass)*	0.1	20	yes	N
	Setaria pumila (Pale Pigeon Grass)	0.1	20	no	E

Project name:	E220140				
Recorders:	LO BS	Plot ID:	Plot 3	Date:	28/03/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
	Chloris gayana (Rhodes Grass)	0.1	10	no	HTE
	Cyperus aggregatus	0.2	30	yes	E
	Sida rhombifolia (Paddy's Lucerne)	0.5	20	no	E
	Solanum nigrum (Black-berry Nightshade)	0.1	1	no	E
	Lysimachia arvensis (Scarlet Pimpernel)	0.1	15	no	E
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	10	no	N
Forb (FG)	*Calotis lappulacea (Yellow Burr-daisy)*	0.2	10	yes	N
Grass & grasslike (GG)	*Austrostipa scabra (Speargrass)*	0.2	20	yes	N
	Cirsium vulgare (Spear Thistle)	0.1	5		E
Grass & grasslike (GG)	*Cymbopogon refractus (Barbed Wire Grass)*	0.2	20	no	N
	Senecio madagascariensis (Fireweed)	0.1	5		HTE
Grass & grasslike (GG)	*Chloris ventricosa (Tall Chloris)*	0.1	10	no	N
Tree (TG)	*Notelaea spp.*	0.1	1	yes	N
Grass & grasslike (GG)	*Aristida ramosa (Purple Wiregrass)*	0.1	10	yes	N
	Verbena bonariensis (Purpletop)	0.2	50	no	E
Forb (FG)	*Oxalis perennans*	0.2	50	yes	N
	Silybum marianum (Variegated Thistle)	0.1	1		E
Forb (FG)	*Geranium retrorsum (Cranesbill Geranium)*	0.1	3	yes	N
	Tagetes minuta (Stinking Roger)	0.1	1	yes	E

BAM Site – Field Survey Form

Plot ID:	Plot 4	**Date:**	28/03/22	**Project number:**	E220140	**Plot dimensions:**	20x50
Datum:	GDA94	**Easting:**	303,068	**Recorders:**	LO BS		
Zone:	56	**Northing:**	6,430,673	**IBRA region:**		**Midline bearing:**	87
Plant Community Type:	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter			**Condition class:**	poor	**PCT confidence:**	high
Vegetation Class:	Coastal Valley Grassy Woodlands			**EEC:**	no	**EEC confidence:**	high

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m2 plot)		Sum values
Count of Native Richness	Trees:	1
	Shrubs:	1
	Grasses etc.:	9
	Forbs:	4
	Ferns:	1
	Other:	1
Sum of Cover of native vascular plants by growth form group	Trees:	10
	Shrubs:	0.1
	Grasses etc.:	2.9
	Forbs:	2.4
	Ferns:	0.1
	Other:	0.1
High Threat Weed cover:		0.3

BAM Attribute (1000 m2 plot) DBH			
DBH	Tree stem count	Length of logs (m) (≥10 cm diameter, >50 cm in length)	5
80 + cm:	0		
50 – 79 cm:	0		
30 – 49 cm:	1		
20 – 29 cm:	4	Tree hollow count	0
10 – 19 cm:	3		
5 – 9 cm:	0		
< 5 cm:	0		

Counts apply when no. of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For multi-stemmed tree, only largest living stem is included in the count. Tree stems must be living.
For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)				
Subplot:	1	2	3	4	5
Subplot score (%):	50	5	1	1	5
Average litter cover (%):	12.4				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

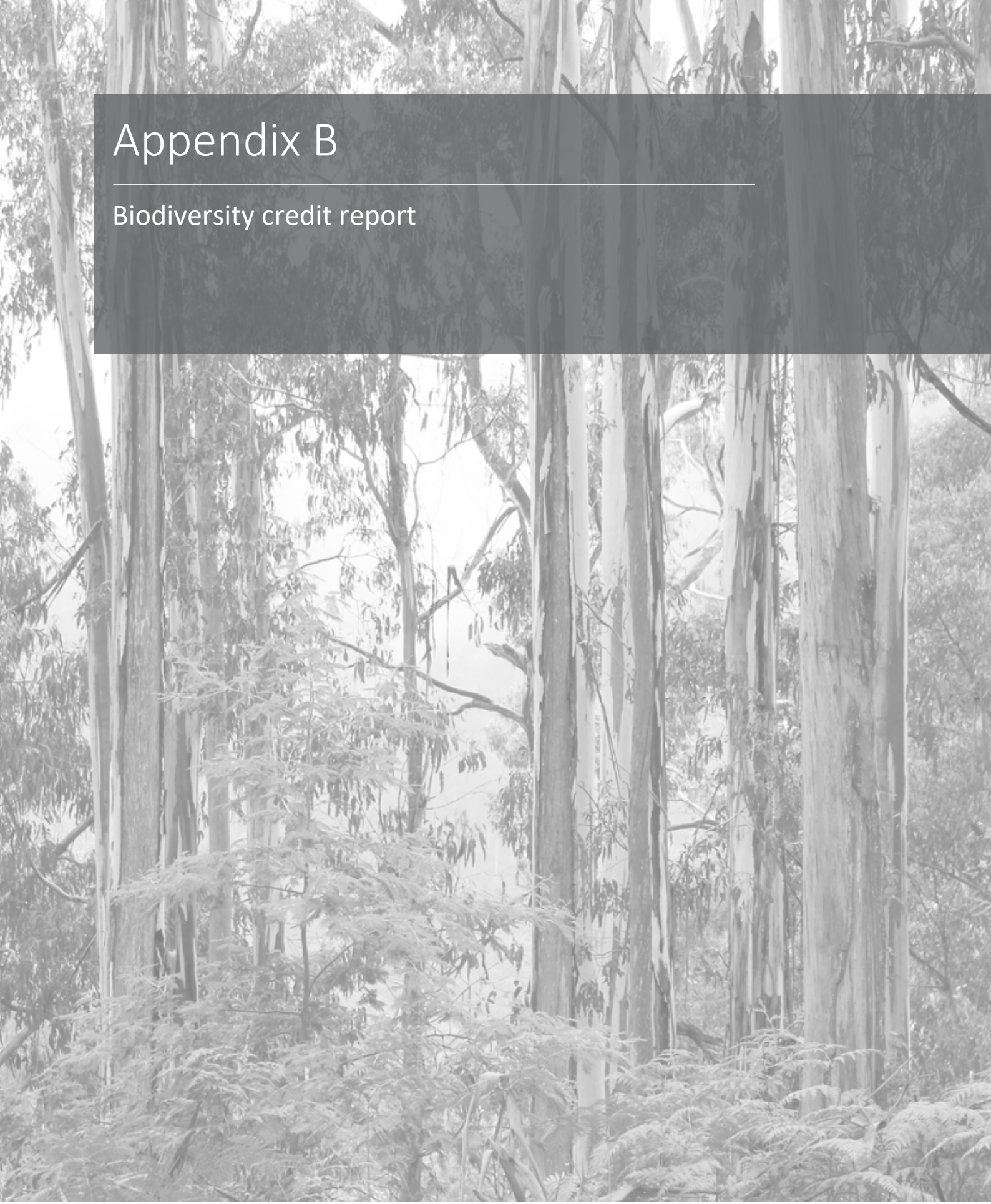
Physiography and site features

Plot Disturbance

GF Code: see Growth Form definitions in Appendix 1; N: native, E: exotic, HTE: high threat exotic; GF – circle code if 'top 3'; Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover)
Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Project name:	E220140				
Recorders:	LO BS	**Plot ID:**	Plot 4	**Date:**	28/03/22

GF Code	Scientific name	Cover	Abundance	Voucher	N, E or HTE
Tree (TG)	*Allocasuarina luehmannii (Bulloak)*	10	5	yes	N
Forb (FG)	*Calotis lappulacea (Yellow Burr-daisy)*	2	100	no	N
Grass & grasslike (GG)	*Eragrostis brownii (Brown's Lovegrass)*	1	100	no	N
Forb (FG)	*Wahlenbergia communis (Tufted Bluebell)*	0.1	20		N
	Setaria pumila (Pale Pigeon Grass)	8	1000		E
	Sida rhombifolia (Paddy's Lucerne)	0.2	50		E
	Trifolium spp. (A Clover)	0.1	10		E
	Senecio madagascariensis (Fireweed)	0.1	10		HTE
	Galenia pubescens (Galenia)	0.1	20		HTE
Grass & grasslike (GG)	*Bothriochloa decipiens var. decipiens (Pitted Bluegrass)*	0.2	100		N
Grass & grasslike (GG)	*Sporobolus creber (Slender Rat's Tail Grass)*	0.2	100		N
Grass & grasslike (GG)	*Cymbopogon refractus (Barbed Wire Grass)*	0.1	50		N
Grass & grasslike (GG)	*Dichanthium sericeum (Queensland Bluegrass)*	0.5	80		N
	Plantago lanceolata (Lamb's Tongues)	0.1	100		E
	Verbena bonariensis (Purpletop)	0.1	10		E
Other (OG)	*Glycine clandestina (Twining glycine)*	0.1	10		N
	Opuntia stricta (Common Prickly Pear)	0.1	2		E
	Cirsium vulgare (Spear Thistle)	0.1	10		E
Grass & grasslike (GG)	*Eriochloa pseudoacrotricha (Early Spring Grass)*	0.1	50		N
Grass & grasslike (GG)	*Panicum spp. (Panicum)*	0.5	100	yes	N
Shrub (SG)	*Enchylaena tomentosa (Ruby Saltbush)*	0.1	50		N
Grass & grasslike (GG)	*Aristida spp. (A Wiregrass)*	0.2	50		N
	Polygonum aviculare (Wireweed)	0.5	5		E
Fern (EG)	*Cheilanthes sieberi (Rock Fern)*	0.1	1		N
	Cyperus aggregatus	0.1	10		E
	Paspalum dilatatum (Paspalum)	0.1	10		HTE
Forb (FG)	*Portulaca oleracea (Pigweed)*	0.1	10		N
Forb (FG)	*Sida corrugata (Corrugated Sida)*	0.2	20		N
Grass & grasslike (GG)	*Chloris truncata (Windmill Grass)*	0.1	1		N



Appendix B

Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00032312/BAAS17058/22/00032313

Proposal Name
Muswellbrook BESS BDAR

BAM data last updated *
16/06/2022

Assessor Name
Erin Lowe

Assessor Number
BAAS18135

BAM Data version *
54

Proponent Names

Report Created
24/08/2022

BAM Case Status
Finalised

Assessment Revision
3

Assessment Type
Major Projects

Date Finalised
24/08/2022

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Prasophyllum sp. Wybong / Prasophyllum sp. Wybong

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	0.2	0	2	2
1603-Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Not a TEC	0.1	0	0	0

1603-Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Coastal Valley Grassy Woodlands This includes PCT's: 116, 618, 760, 761, 762, 830, 834, 838, 849, 850, 1326, 1395, 1603, 1604, 1691	Coastal Valley Grassy Woodlands >=70% and <90%	1603_poor	No	0	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1655-Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion This includes PCT's: 1176, 1655	-	1655_poor	No	2	Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Cryptostylis hunteriana / Leafless Tongue Orchid	**1655_poor**	0.2	2.00
Delma impar / Striped Legless Lizard	**1655_poor, 1603_poor**	0.3	3.00
Diuris tricolor / Pine Donkey Orchid	**1655_poor**	0.2	2.00
Diuris tricolor - endangered population / Pine Donkey Orchid population in the Muswellbrook local government area	**1655_poor**	0.2	2.00
Eucalyptus glaucina / Slaty Red Gum	**1655_poor**	1.0	2.00
Prasophyllum sp. Wybong / Prasophyllum sp. Wybong	**1655_poor**	0.2	3.00
Pterostylis chaetophora / Pterostylis chaetophora	**1655_poor**	0.2	2.00
Pterostylis gibbosa / Illawarra Greenhood	**1655_poor**	0.2	2.00
Thesium australe / Austral Toadflax	**1655_poor**	0.2	2.00

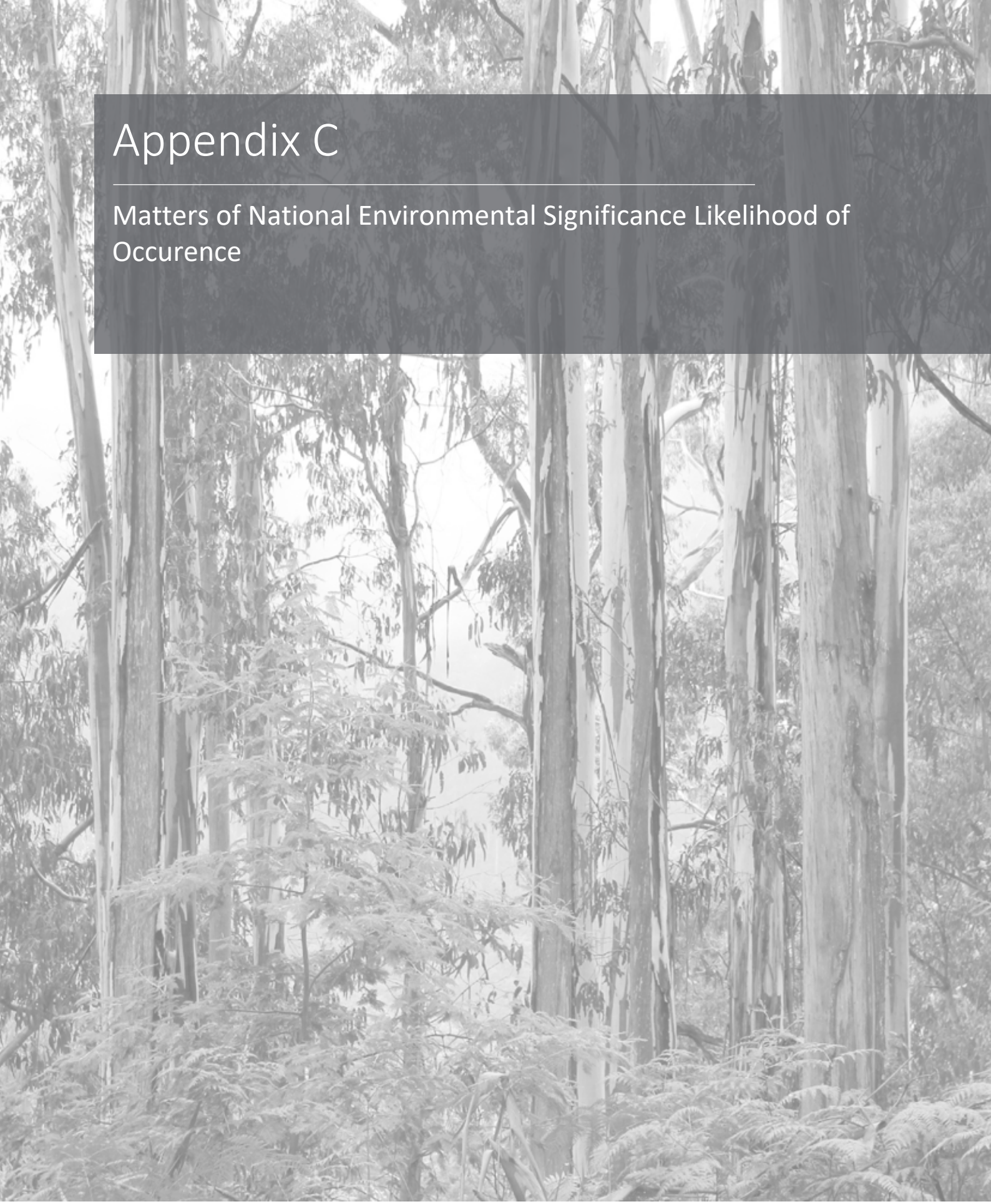
Credit Retirement Options

Like-for-like credit retirement options

Cryptostylis hunteriana / Leafless Tongue Orchid	Spp	IBRA subregion
	Cryptostylis hunteriana / Leafless Tongue Orchid	Any in NSW
Delma impar / Striped Legless Lizard	Spp	IBRA subregion
	Delma impar / Striped Legless Lizard	Any in NSW

Diuris tricolor / Pine Donkey Orchid	Spp	IBRA subregion
	Diuris tricolor / Pine Donkey Orchid	Any in NSW
Diuris tricolor - endangered population / Pine Donkey Orchid population in the Muswellbrook local government area	Spp	IBRA subregion
	Diuris tricolor - endangered population / Pine Donkey Orchid population in the Muswellbrook local government area	Any in NSW
Eucalyptus glaucina / Slaty Red Gum	Spp	IBRA subregion
	Eucalyptus glaucina / Slaty Red Gum	Any in NSW
Prasophyllum sp. Wybong / Prasophyllum sp. Wybong	Spp	IBRA subregion
	Prasophyllum sp. Wybong / Prasophyllum sp. Wybong	Any in NSW
Pterostylis chaetophora / Pterostylis chaetophora	Spp	IBRA subregion
	Pterostylis chaetophora / Pterostylis chaetophora	Any in NSW
Pterostylis gibbosa / Illawarra Greenhood	Spp	IBRA subregion
	Pterostylis gibbosa / Illawarra Greenhood	Any in NSW

Thesium australe / Austral Toadflax	Spp	IBRA subregion
	Thesium australe / Austral Toadflax	Any in NSW



Appendix C

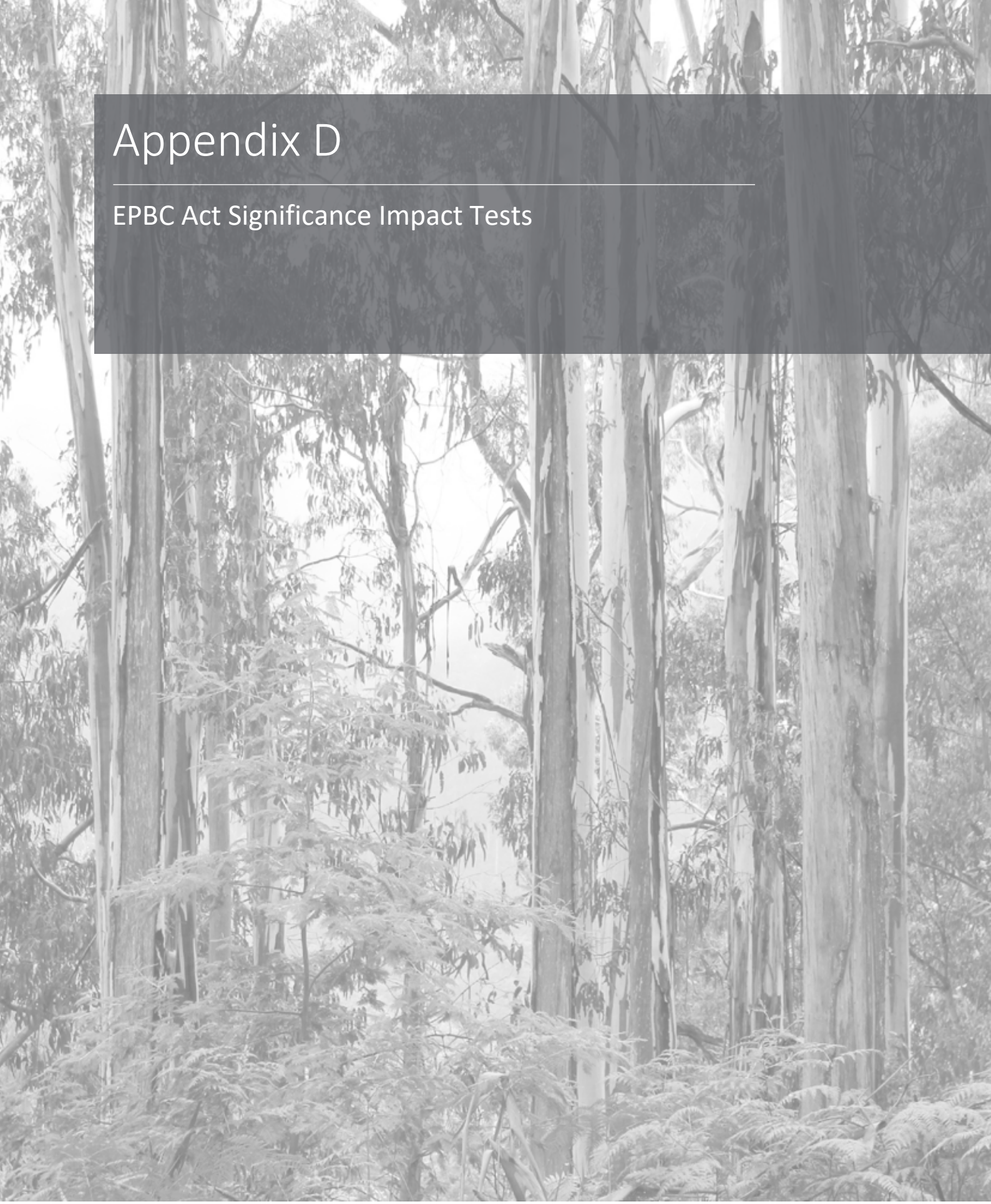
Matters of National Environmental Significance Likelihood of Occurence

Class	Scientific name	Common name	BC Act	EPBC Act	Habitat association	Likelihood of occurrence	Futher assessment required?
Bird	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. These birds are also found in drier coastal woodlands and forests in some years. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany (Eucalyptus robusta) and Spotted Gum (Corymbia maculata) forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast.	Low	No- Subject land does not contain a significant amount of breeding or foraging resources for this species. The species may occur within the subject land on a very rare occasion but is highly unlikely to be resident.
Bird	*Botaurus poiciloptilus*	Australasian Bittern	E	E	The Australasian Bittern is widespread and found over most of NSW except for far north-west. Preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds or cutting grass (Gahnia sp.) growing over a muddy or peaty substrate (OEH 2018).	Negligible	No - No wetlands or suitable water bodies within subject land.
Bird	*Erythrotriorchis radiatus*	Red Goshawk	CE	V	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia.	Negligible	No- species not likely to occur within subject land due to lack of riparian areas and prey species habitat. No records within the locality.
Bird	*Falco hypoleucos*	Grey Falcon	E	V	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	Negligible	No- The subject land is not unlikely to provide habitat for this species. The subject land is small in comparison to the home range of this highly mobile species that is unlikely to be impacted by the project.
Bird	*Grantiella picta*	Painted Honeyeater	V	V	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution.	Low	No- this species is not known from the locality. The site does not provide a significant amount of foraging resources and negligible breeding habitat
Bird	*Lathamus discolor*	Swift Parrot	E	CE	Migrates to the Australian south-east mainland between February and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes.	Negligible	No- no records in the locality. Species unlikely to forage within the subject land. Species breeds in Tasmania.
Bird	*Rostratula australis*	Australian Painted Snipe	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	Negligible	No- species not likely to occur within subject land due to lack of swamp, dam or marshy habitat.
Bird, migratory terrestrial species	*Hirundapus caudacutus*	White-throated Needletail	-	V, Mi	Migratory and usually seen in eastern Australia from October to April. Breeds in forests in south-eastern Siberia, Mongolia, the Korean Peninsula and northern Japan June-August. Most often seen in eastern Australia before storms, low pressure troughs and approaching cold fronts and occasionally bushfire. These conditions are often used by insects to swarm (e.g. termites and ants) or tend to lift insects away from the surface which favours sighting of White-throated Needletails as they feed. More common in coastal areas, less so inland.	Low	No- species may forage aerially over the subject land on a rare occasion. This species is unlikely to ever land within the subject land.

Class	Scientific name	Common name	BC Act	EPBC Act	Habitat association	Likelihood of occurrence	Futher assessment required?
Bird, migratory wetland species	*Calidris ferruginea*	Curlew Sandpiper	E	CE, Mi	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin.	Negligible	No- study area lacks littoral or estuarine habitats.
Bird, migratory wetland species	*Numenius madagascariensis*	Eastern Curlew	-	CE, Mi	It generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. Within Australia, the Eastern Curlew has a primarily coastal distribution.	Negligible	No- study area lacks littoral or estuarine habitats.
Frog	*Litoria booroolongensis*	Booroolong Frog	E	E	Lives along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge.	Negligible	No- This species only occurs within riparian habitat along rivers with cobble banks and fringing vegetation. These habitat features are absent from the subject land.
Mammal	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	In NSW this species has been recorded from a large range of vegetation types including: dry and wet sclerophyll forest; Cyprus Pine (Callitris glauca) dominated forest; tall open eucalypt forest with a rainforest sub-canopy; sub-alpine woodland; and sandstone outcrop country. The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites, particularly box gum woodlands or river/rainforest corridors which are used for foraging. Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin (Hirundo ariel) nests, also possibly roosts in the hollows of trees.	Low	No- There is no cave or other suitable roosting habitat for this species within the subject land. This species may on the rare occasion forage within or fly over the subject land.
Mammal	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	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.	Low	No- the subject land may form part of a home range of this species within the wider region, however this species has a home range of between 180 ha to 5000 ha and is unlikely to be significantly impacted by the project.
Mammal	*Nyctophilus corbeni*	Corben's Long-eared Bat	V	V	Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.	Low	No- There is no tree hollows or other suitable roosting habitat for this species within the subject land. This species may on the rare occasion forage within or fly over the subject land.
Mammal	*Petaurus australis australis*	Yellow-bellied Glider	V	V	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Negligible	No- this sepcies requires mature eucalpty forest with abundant hollows. These features are absent from the subject land.
Mammal	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night when foraging. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Highly territorial and have strong site fidelity with an average home range size of about 15 ha. Males tend to have larger home ranges than females.	Negligible	No- this sepcies is not known from the locality. There are no steep rocky areas, caves or overhangs within the subject land.

Class	Scientific name	Common name	BC Act	EPBC Act	Habitat association	Likelihood of occurrence	Futher assessment required?
Mammal	*Phascolarctos cinereus*	Koala	V	E	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. haemastoma and E. signata. They are solitary with varying home ranges. The Koala is a tree-dwelling, medium-sized marsupial, distributed from Cairns to South Australia, however, the listed population does not include Victoria or South Australia. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus Eucalyptus. The distribution of Koalas is also affected by altitude, with the species limited to below 800 m ASL.	Low	No- This species may pass through the site on a rare occasion, however the site does not provide significant foraging resources in comparison to the availability of more suitable habitat within the locality.
Mammal	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km.	Moderate	No - Subject land does not contain a significant amount of breeding or foraging resources for this species.
Migratory Terrestrial Species	*Monarcha melanopsis*	Black-faced Monarch	-	Mi	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland.	Low	No- species not known from the area. The subject land has poor connectivity and is mostly cleared which is unfavourable for this species.
Migratory Terrestrial Species	*Motacilla flava*	Yellow Wagtail	-	Mi	Migrants from the Northern Hemisphere to Australia. There are few sightings in southern Australia although in recent years, the wetlands of the Hunter River estuary in NSW have proved to be a reliable area to see them. In the north they are regularly seen in the summer months, especially around Broome and Darwin.	Negligible	No- species not known from the locality. Species known from the Hunter estuary
Migratory Terrestrial Species	*Myiagra cyanoleuca*	Satin Flycatcher	-	Mi	The Satin Flycatcher inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species can occur at elevations of up to 1,400 m ASL. The Satin Flycatcher breeds in heavily vegetated gullies.	Negligible	No- species inhabitats heavily vegetated gullies. No suitable habitat wihitn the subject land.
Migratory Terrestrial Species	*Rhipidura rufifrons*	Rufous Fantail	-	Mi	Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	Negligible	No- species inhabitats wet sclerophyll forests. No suitable habitat wihitn the subject land.
Migratory Wetlands Species	*Actitis hypoleucos*	Common Sandpiper	-	Mi	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	Negligible	No- study area lacks litoral or esturine habitats.
Migratory Wetlands Species	*Calidris acuminata*	Sharp-tailed Sandpiper	-	Mi	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry.	Negligible	No- study area lacks litoral or esturine habitats.
Migratory Wetlands Species	*Calidris melanotos*	Pectoral Sandpiper	-	Mi	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Negligible	No- study area lacks or suitable wetland habitats.
Migratory Wetlands Species	*Gallinago hardwickii*	Latham's Snipe	-	Mi	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies).	Low	No- study area lacks litoral, esturine or suitable wetland habitats.
Plant	*Cynanchum elegans*	White-flowered Wax Plant	E	E	The rare species is known in rainforest gullies scrub and scree slopes. Associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub.	Negligible	No- subject land is highly disturbed with a high cover of exotic species, species unlikely to occur. Not known from the locality

Class	Scientific name	Common name	BC Act	EPBC Act	Habitat association	Likelihood of occurrence	Futher assessment required?
Plant	*Dichanthium setosum*	Bluegrass	V	V	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.	Low	No- Species not asscoiated with IBRA sub-region or PCT's within subject land.
Plant	*Eucalyptus glaucina*	Slaty Red Gum	V	V	Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils. Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland.	Known/assumed	Yes - species possibly recorded within subject land.
Plant	*Euphrasia arguta*	-	CE	CE	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Euphrasia arguta was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Prior to this, it had not been collected for 100 years.	Negligible	No- species not known from the locality. Subject land is highly disturbed.
Plant	*Lepidium aschersonii*	Spiny Pepper-cress	V	V	Found on ridges of gilgai clays dominated by Brigalow (Acacia harpophylla), Belah (Casuarina cristata), Buloke (Allocasuarina luehmanii) and Grey Box (Eucalyptus microcarpa). In the south has been recorded growing in Bull Mallee (Eucalyptus behriana). Often the understorey is dominated by introduced plants. The species grows as a a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter. Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and potentially the south western plains).	Negligible	No- species not known to occur within the locality. Subject land lacks preferred habitat attributes.
Plant	*Pomaderris brunnea*	Brown Pomaderris	E	V	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria.	Low	No- subject land does not occur wihtin known geographic distribution. The subject land also lacks moist woodland or suitable riparian habitat
Plant	*Prasophyllum sp. Wybong*	-	-	CE	A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland. Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.	Moderate	Yes- Species known to occur in disturbed areas and woodland in the Muswellbrook area.
Plant	*Pterostylis gibbosa*	Illawarra Greenhood	E	E	In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark E. crebra, Forest Red Gum and Black Cypress Pine Callitris endlicheri.	Moderate	Yes- potential habitat within subject land
Plant	*Thesium australe*	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region.	Moderate	Yes- species not known from the locality however there is potenital habitat within the subject land.
Reptile	*Aprasia parapulchella*	Pink-tailed Worm-lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis). The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory.	Negligible	No- site lacks suitable rocky habitat and tussock native grassland.
Reptile	*Delma impar*	Striped Legless Lizard	V	V	Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma, Muswellbrook and Tumut areas. Also occurs in the ACT, Victoria and south-eastern South Australia.	High	Yes- species records from less than one kilometre from the subject land. Some habitat features such as woody debris and concrete rubble within subject land.



Appendix D

EPBC Act Significance Impact Tests

D.1 Striped Legless Lizard (*Delma impar*) - Vulnerable

Table D.1 Significant impact assessment – Striped Legless Lizard

Criteria	Discussion
Lead to a long-term decrease in size of an important population	There are 18 important populations of the Striped Legless Lizard identified in the Conservation Advice for the species (DAWE 2022c). One of these populations occurs within the Muswellbrook area and is likely to include the subject land. The native PCTs and exotic grassland within the subject land may contain suitable foraging and breeding habitat for this species. However, given the amount of similar habitat remaining in the locality it is unlikely that the removal of up to 4.5 ha of foraging or breeding habitat for the project will cause a significant decrease in the size of a population of this species long-term. Mitigation measures have been proposed in Section 6.4 to avoid impacts to individuals that my occur within the site during clearing works.
Reduce the area of occupancy of an important population	The removal of up to 4.5 ha of potential habitat is unlikely to reduce the area of occupancy for this species as substantial areas of habitat outside of the subject land will be unaffected by the project.
Fragment an existing important population into two or more populations	The removal of 4.5 ha is a small area compared to the available habitat in the broader locality. In addition, the species is moderately mobile and likely able to self-relocate outside of the direct impact area. Therefore, the loss of the habitat would not isolate any populations or individuals of this species.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the striped legless lizard is likely to include sites that possess more than one of the following characteristics: • provides breeding habitat; • provides foraging habitat; • provides refuge from disturbance events; • provides for long-term protection from development; • has connectivity value and contributes to the evolutionary potential of the species in the wild across its natural geographical range; • occurs at the edge of the species known and likely modelled distribution • represents a newly discovered range extension; • has not been subject to adverse practices in the last 10 years such as ploughing, cropping, cultivation, fertiliser use or intense farming; or • contains a high density of lizards found through surveys on the site. (DAWE 2022c); Considering the above criteria, the subject land is unlikely to be considered habitat critical to the species survival due to the highly degraded exotic vegetation and previous impacts form land uses such as farming. The project will result in the removal of up to 4.5 ha of potential habitat for the striped legless lizard.
Disrupt the breeding cycle of an important population	As the project will only clear a small (up to 4.5 ha) of habitat for this species in comparison to available similar habitat within the locality the project is unlikely to significantly disrupt the breeding cycle of any Striped Legless Lizards within the locality. Mitigation measures are proposed in Section 6.4 to address potential indirect impacts. The removal of up to 4.5 ha of habitat within the locality is unlikely to significantly impact on the breeding cycle of this species.

Table D.1 Significant impact assessment – Striped Legless Lizard

Criteria	Discussion
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 result in the clearing of up to 4.5 ha of habitat for the Striped Legless Lizard. However, the extent of the clearing is unlikely to significantly contribute to the decline of the species within the locality due to the availability of similar habitat outside of the subject land. Mitigation measures outlined in Section 6.4 reduce the likelihood of injury or mortality of individuals during clearing works.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Clearing vegetation may result in the spread of exotic species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the proposed activity is unlikely to result in an increase in invasive species into the adjacent vegetation and agricultural landscapes.
Introduce disease that may cause the species to decline	There are no known diseases that affect the Stiped Legless Lizard. Therefore, the project is unlikely to introduce diseases to the subject land. However, basic hygiene protocols will be implemented as outlined in Section 6.4.
Interfere substantially with the recovery of the species	A national recovery plan has been developed for the Striped Legless Lizard. Generally, the plan aims to minimise habitat loss, population and ecology studies, revise and update management prescriptions, raise public awareness, encourage conservation efforts. Given the small size of the proposed impact (up to 4.5 ha), the project is unlikely to significantly interfere with the recovery of this species.
Conclusion	The project may; • result in slightly reduce the area of occupancy of this species by 4.3 ha; The project is unlikely to: • adversely affect habitat critical to the survival of the species. • lead to a long-term decrease in size of an important population; • fragment an existing important population into two or more populations; • disrupt the breeding cycle of an important population; • modify, destroy, remove, 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 The impacts on Striped Legless Lizard would be offset in accordance with the BOS and would result in the retirement of the required number and class of like-for-like credits. This species is classed as a 'Species credit species' in the TBDC (OEH, 2022)

D.2 Slaty Red Gum (*Eucalyptus glaucina*) – Vulnerable

Table D.2 Significant impact assessment – Slaty Red Gum

Criteria	Discussion
Lead to a long-term decrease in size of an important population	The subject land may contain one individual Slaty Red Gum (insufficient plant material to confirm identification). This individual occurs in a fragmented landscape and is not likely to be considered an important population or part thereof. The removal of up to 0.094 ha of potential habitat from the subject land is unlikely to have a significant impact and unlikely to place a local viable population of this species at risk of extinction.
Reduce the area of occupancy of an important population	Only one potential individual Slaty Red Gum occurs within the subject land. The removal of this induvial will reduce the area of occupancy of this species by a negligible amount in comparison to its known range.
Fragment an existing important population into two or more populations	The subject land may contain one individual Slaty Red Gum within a fragmented landscape. Removing this individual will not cause an important population to be fragmented into two or more populations.
Adversely affect habitat critical to the survival of a species	No habitat critical to the survival of the species has been identified in the species SPRAT profile or the Conservation Advice. It is highly unlikely the project will adversely affect habitat critical to the survival of this species.
Disrupt the breeding cycle of an important population	The subject land may contain one individual Slaty Red Gum within a fragmented landscape. Removing this individual is unlikely to cause any significant disruption to the breeding cycle of a population.
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 result in a reduction of the species habitat extent by an estimated <0.1% relative to similar habitat within the region. This is a negligible impact on the extent of this species' habitat.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Clearing vegetation may result in the spread of exotic species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the project is unlikely to result in an increase in invasive species into the adjacent vegetation.
Introduce disease that may cause the species to decline	Mitigation measures such as hygiene protocols will reduce the potential risk of these diseases being indirectly introduced to potential habitat of this species. As a result, the proposed activity is unlikely to introduce disease to this species or potential habitat.
Interfere substantially with the recovery of the species	The proposed development may exacerbate existing impacts on this species, namely: • Clearing of native vegetation • Invasion of exotic flora species Mitigation measures will be implemented to manage indirect impacts on native vegetation during of the clearing and construction phase of the project.
Conclusion	The project is unlikely to cause a significant impact on Slaty Red Gum.

D.3 Prasophyllum sp. Wybong – Critically endangered

Table D.3 Significant impact assessment – *Prasophyllum sp.* Wybong

Criteria	Discussion
Lead to a long-term decrease in size of a population.	The project is not within a known area of occupancy for this species. Records of this species from Bionet indicate there is a small area of occupancy around Wybong. approximately 22 km from the subject land. The removal of up to 0.21 ha of potential habitat from the subject land is unlikely to have a significant impact and unlikely to place a local viable population of *Prasophyllum sp.* Wybong at risk of extinction.
Reduce the area of occupancy of the species.	The project occurs approximately 22 km away from the known area of occupancy for this species. The estimated area of occupancy for this species is 1.5 km^2 (DEWHA 2009). The project will not cause any direct or indirect impacts to this area. Therefore, the removal of 0.21 ha of potential habitat is unlikely to have a significant impact on the area of occupancy of *Prasophyllum sp.* Wybong.
Fragment an existing population into two or more populations	The subject land does not contain a known population of *Prasophyllum sp.* Wybong. The project would not split an area of potential habitat into isolated fragments. Therefore, the project is unlikely to result in the fragmentation of any populations of *Prasophyllum sp.* Wybong.
Adversely affect habitat critical to the survival of a species	No habitat critical to the survival of the species has been identified in the species SPRAT profile or the Conservation Advice. It is unlikely the project will adversely affect habitat critical to the survival of *Prasophyllum sp.* Wybong as the affected potential habitat is disturbed and of a very small extent.
Disrupt the breeding cycle of a population	The subject area of potential habitat for the species that would be affected is very small and is unlikely to affect a large proportion of any population that may be present. Substantial areas of vegetation will not be impacted by the project, including areas where the species in known to occur approximately 22 km to the west of the subject land. It is unlikely there will be any disruption to the breeding cycle of a population.
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 result in a reduction of the species potential habitat extent by an estimated <0.1% relative to similar habitat within the region. This is a negligible impact on the extent of this species' habitat.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Clearing vegetation may result in the spread of exotic species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the project is unlikely to result in an increase in invasive species into the adjacent vegetation.
Introduce disease that may cause the species to decline	Mitigation measures such as hygiene protocols and sediment controls will reduce the potential risk of these diseases being indirectly introduced to potential habitat of this species. As a result, the proposed activity is unlikely to introduce disease to this species or potential habitat.

Table D.3 Significant impact assessment – *Prasophyllum sp.* Wybong

Criteria	Discussion
Interfere substantially with the recovery of the species	The proposed development may slightly exacerbate existing impacts on *Prasophyllum sp.* Wybong, namely: • Clearing of native vegetation • Invasion of exotic flora species Mitigation measures will be implemented to manage indirect impacts on native vegetation during of the clearing and construction phase of the project.
Conclusion	The project is unlikely to cause a significant impact on *Prasophyllum sp.* Wybong.

D.4 Grey-headed Flying-fox (*Pteropus poliocephalus*) - Vulnerable

Table D.4 Significant impact assessment – Grey-headed Flying-fox

Criteria	Discussion
Lead to a long-term decrease in size of an important population	Grey-headed Flying-fox populations are most at risk of extinction if their breeding and roosting habitat (camp sites) is impacted. Camp sites are readily detectable due to their size, and the loudness of their occupants. No camp sites for the Grey-headed Flying-fox are located within or adjacent to the investigation envelope. Potential foraging habitat for this species is abundant in the locality and is of moderate importance to the local occurrence of this species. Therefore, the removal of up to 0.21 ha of potential foraging habitat is unlikely to impact the Grey-headed Flying-fox given the larger, higher quality habitat being retained in the broader locality. Given that the potential overhead sub-transmission line for the project would only be of short length and not located close to high quality foraging habitat, the risk of substantial levels of mortality to individuals of the species is low. Therefore, the proposed activity is unlikely to lead to a long-term decrease in size of an important population
Reduce the area of occupancy of an important population	The proposed activity will remove up to 0.21 ha of potential Grey-headed Flying-fox habitat. This is considered a relatively minor amount of vegetation removal in comparison the available habitat that will remain within the locality. Therefore, the proposed activity is unlikely to reduce the area of occupancy of an important population
Fragment an existing important population into two or more populations	The proposed development will contribute to the fragmentation of habitat by removing up to 0.21 ha of potential Grey-headed Flying-fox habitat. As the Grey-headed Flying-fox is highly mobile, the species is considered unlikely to be significantly affected by the minor additional habitat fragmentation that would occur because of the proposed activity.

Table D.4 Significant impact assessment – Grey-headed Flying-fox

Criteria	Discussion
Adversely affect habitat critical to the survival of a species	The National Recovery Plan for the Grey-headed Flying-fox (DoE 2021) states that all foraging habitat has potential to be productive during general food shortages and therefore provide a critical resource. On this basis, the removal of foraging habitat for the species could be an adverse impact on habitat critical to the species; however, the removal of 0.21 ha of potential foraging habitat is unlikely to significantly affect resource supply as it is part of a larger and more substantial foraging area within the locality that will not be affected by the proposed activity.
Disrupt the breeding cycle of an important population	No breeding camps were recorded within the study area. Therefore, the proposed activity will not disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Only 0.21 ha of marginal, fragmented habitat for the species would be removed. Therefore, the species is not likely to experience a decline from modification, destruction, removal, isolation or decrease in the availability or quality of habitat.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The clearing of up to 0.21 ha of vegetation may result in the spread of exotic plant species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the proposed activity is unlikely to result in an increase in invasive species into the adjacent remnant vegetation.
Introduce disease that may cause the species to decline	The proposed activity is unlikely to introduce disease including Australian Bat Lyssavirus, Menangle virus or Hendra virus.
Interfere substantially with the recovery of the species	Recovery actions for the Grey-headed Flying-fox aim to identify, protect, and enhance native foraging and roosting habitat, determine population trends, build community capacity to coexist with the species in urban environments, develop and implement threat abatement strategies and increase community involvement and awareness of the recovery program, and improve camp management in sensitive areas. The project will interfere with recovery objectives to protect and enhance native foraging and roosting habitat. However, the proposed activity will affect a small area of potential foraging habitat and not interfere with known camps or likely roosting habitat.
Conclusion	The project is unlikely to have a significant impact on Grey-headed Flying Fox.

D.5 Illawarra Greenhood (*Pterostylis gibbosa*) - Endangered

Table D.5 Significant impact assessment – Illawarra Greenhood

Criteria	Discussion
Lead to a long-term decrease in size of a population.	No important populations have been identified within the locality. The nearest population is known from Milbrodale approximately 50 km South-east of the subject land. Therefore, it is unlikely that the project will lead to a local viable population of Illawarra Greenhood being placed at risk of extinction.
Reduce the area of occupancy of the species.	The project is not within a known area of occupancy for this species. The removal of 0.094 ha of potential habitat is unlikely to have a significant impact on the area of occupancy of this species.
Fragment an existing population into two or more populations	No Illawarra Greenhood orchids have been recorded from the Muswellbrook area. The removal of 0.094 ha of degraded potential habitat is unlikely to cause fragmentation of populations of this species.
Adversely affect habitat critical to the survival of a species	No habitat critical to the survival of the species has been identified in the species SPRAT profile or the Conservation Advice. It is unlikely the project will adversely affect habitat critical to the survival of this species. The removal of 0.094 ha of degraded potential habitat is unlikely significantly fragment or isolate the habitat for this species.
Disrupt the breeding cycle of a population	Substantial areas of vegetation will be retained across the locality and will maintain connectivity between different vegetation communities for pollination to occur. It is unlikely that the project would cause any disruption to the breeding cycle of a population of Illawarra Greenhood.
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 result in a reduction of the species habitat extent by an estimated <0.1% relative to similar habitat within the region. This is a negligible impact on the extent of this species' habitat.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Clearing vegetation may result in the spread of exotic species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the project is unlikely to result in an increase in invasive species into the adjacent remnant vegetation.
Introduce disease that may cause the species to decline	Mitigation measures such as hygiene protocols and sediment controls will reduce the potential risk of these diseases being indirectly introduced to potential habitat of this species. As a result, the proposed activity is unlikely to introduce disease to this species or potential habitat.
Interfere substantially with the recovery of the species	The project may exacerbate existing impacts on this species, namely: • Clearing of native vegetation • Invasion of exotic flora species Mitigation measures will be implemented to manage indirect impacts on the adjacent native vegetation during of the clearing and works phase of the project.
Conclusion	The project is unlikely to cause a significant impact on Illawarra Greenhood within the local area.

D.6 Austral Toadflax (*Thesium australe*) - Vulnerable

Table D.6 Significant impact assessment – Austral Toadflax

Criteria	Discussion
Lead to a long-term decrease in size of an important population	The project is not within an area deemed as an important population for this species. The removal of 0.094 ha of potential habitat is unlikely to have a significant impact and unlikely to place a local viable population of this species at risk of extinction.
Reduce the area of occupancy of an important population	The project is not within a known area of occupancy for this species. The removal of 0.094 ha of potential habitat is unlikely to have a significant impact on the area of occupancy of this species.
Fragment an existing important population into two or more populations	The project is not within an area deemed as an important population for this species. The removal of 0.094 ha of potential habitat is unlikely significantly fragment a population of Austral Toadflax into two or more populations.
Adversely affect habitat critical to the survival of a species	No habitat critical to the survival of the species has been identified in the species SPRAT profile or the Conservation Advice. It is unlikely the project will adversely affect habitat critical to the survival of this species.
Disrupt the breeding cycle of an important population	Substantial areas of vegetation will be retained across the locality and will maintain connectivity between different vegetation communities for pollination to occur. It is unlikely that the project would cause any disruption to the breeding cycle of a population of Austral Toadflax.
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 result in a reduction of the species habitat extent by an estimated <0.1% relative to similar habitat within the region. This is a negligible impact on the extent of this species' habitat.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Clearing vegetation may result in the spread of exotic species. This will be mitigated by weed hygiene measures and wash down protocols. Therefore, the project is unlikely to result in an increase in invasive species into the adjacent remnant vegetation.
Introduce disease that may cause the species to decline	Mitigation measures such as hygiene protocols and sediment controls will reduce the potential risk of these diseases being indirectly introduced to potential habitat of this species. As a result, the proposed activity is unlikely to introduce disease to this species or potential habitat.
Interfere substantially with the recovery of the species	The project may exacerbate existing impacts on this species, namely: • Clearing of native vegetation • Invasion of exotic flora species Mitigation measures will be implemented to manage indirect impacts on the adjacent native vegetation during of the clearing and works phase of the project.
Conclusion	The project is unlikely to cause a significant impact on Austral Toadflax within the local area.