YANCOAL
兖煤澳大利亚有限公司

NORTHERN
Management Plan

Yancoal Warkworth Mine, New South Wales | July 2022

This Management Plan is the framework for the protection and management of a 341 hectare offset area under a legally binding conservation mechanism to satisfy conditions of Warkworth Mining Limited's Commonwealth approval (EPBC 2009/5081) and NSW approval (NSW SSD-6464).

This document has been prepared using maps prepared by:
Cambium Group

Cover Photo: Northern Biodiversity Area, 2014

Declaration of accuracy

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying this Northern Biodiversity Area Management Plan is complete, current and correct.

2. I am duly authorised to sign this declaration on behalf of the approval holder.

3. I am aware that:

a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.

b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.

c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed

Darin (Bill) Baxter

Full name (please print)

Warkworth Mining Ltd

Organisation (please print)

28 July 2022
Date

Document Title	Version	Date effective	Comment
Northern BA Management Plan,	1	December 2016	Submitted for approval to DoEE and DPIE on 17 February 2017. DPIE approved on 26/6/2017.
Northern BA Management Plan	2	December 2017	DAWE provided comments on 13/04/2017 and 22/06/2017 on the Southern BA Management Plan. The final text was approved by DAWE and these agreed changes have been made to V2 of the Northern BA Management Plan. Also changes to reflect the new ownership of Coal & Allied by Yancoal Australia.
Northern BA Management Plan	3	August 2018	Updated with revised Warkworth Sands Woodland Performance Criteria (Appendix B)
Northern BA Management Plan	4	September 2018	Revision following review by DPIE
Northern BA Management Plan	5	July 2021	Revision of planting area and timing and inclusion of salinity information. Incorporate DPIE comments on the updated NBA MP

			originally submitted 13/11/2020. DPIE approved on 20/07/2021
Northern BA Management Plan	6	July 2022	Update to Figures, other minor revisions

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Abbreviations and Definitions

asl	Above sea level
BA	Biodiversity Area (includes the offset area, infrastructure and other land)
BB	Braun-Blanquet (cover abundance score)
BC Act	NSW *Biodiversity Conservation Act 2016*
BFMP	Bushfire Management Plan
BVT	BioMetric Vegetation Type
CE	Critically Endangered
CEEC	Critically Endangered Ecological Community
CHWG	Cultural Heritage Working Group
CHGBIW	Central Hunter Grey Box – Ironbark Woodland
CHVEF	Central Hunter Valley Eucalypt Forest
Coal & Allied	Coal & Allied Industries Limited
COPs	National Codes of Practice
DAWE	Australian Government Department of Agriculture, Water and the Environment (previously Department of the Environment (DoEE))
DPE	NSW Department of Planning and Environment
DPE-EES	DPE – Environment, Energy and Science
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act* 1979
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999
GDP	Ground Disturbance Permit
ha	Hectare
HLLS	Hunter Local Land Services
km	Kilometre
LLS Act	*Local Land Service Act* 2013
Ma	Marine Migratory
MNES	Matters of National Environmental Significance
MZ	(BioBanking) Management Zone
NPW Act	*National Parks and Wildlife Act* 1974
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (now DPE-EES – refer above)
offset area	Area of vegetation and habitat secured by legally binding mechanism.
RCA	Rapid Condition Assessment
SDS	Safety Data Sheets
SOPs	Standard Operating Procedures
TSC Act	NSW *Threatened Species Conservation Act* 1995
WON	Weed of National Significance
WSW	Warkworth Sands Woodland
WS Grassland	Warkworth Sands Grassland
Yancoal	Yancoal Australia Limited
Yancoal MTW	Yancoal Mount Thorley Warkworth

1 Introduction

This Management Plan (Plan) details the management activities to protect and enhance the conservation and habitat values of the offset areas located within the Northern Biodiversity Area (BA). This Plan outlines conservation management actions and a monitoring programme for the Northern BA to achieve conservation objectives.

This Plan has been prepared to satisfy the conditions of Commonwealth and New South Wales (NSW) environmental approvals held by Warkworth Mining Limited for the Warkworth Coal Mine located in the Hunter Valley NSW. The Warkworth Mine forms part of Mount Thorley Warkworth operated by Coal & Allied (NSW) Pty Limited (wholly owned subsidiary of Yancoal Australia Ltd.) (Yancoal MTW).

The Plan's conservation objectives include a short term objective to measure the effectiveness of initial restoration efforts and longer term outcomes from the continued implementation of the Plan. The short term conservation objective is to protect and enhance the condition and extent of the conservation and habitat values of the offset areas within 10 years. The Plan details active restoration to promote the regeneration of degraded grassland into woodland communities to increase the extent and enhance habitat for the Critically Endangered woodland birds, the Regent Honeyeater and Swift Parrot, and increasing connectivity and resilience to climate change. This regeneration will also contribute to increasing the extent of Critically Endangered Ecological Communities, including Central Hunter Grey Box-Ironbark Woodland and Warkworth Sands Woodlands. Section 2 provides a full description of the conservation values, including their baseline condition. In terms of measuring success of the Plan the conservation values have been identified as:

- Ironbark woodland and grassland;
- Warkworth Sands woodland and grassland;
- Hunter Lowland Red Gum Forest; and
- Fauna habitat (in particular habitat for Regent Honeyeater and Swift Parrot).

The regeneration of grasslands to woodlands will be measured by using monitoring to demonstrate their regeneration trajectory and improved condition. Key performance criteria have been set for each of the conservation values, and a full description is provided in section. Attainment of the objective and performance criteria is measured using targeted monitoring, which is detailed in section 5. The following points outline the monitoring programme to measure the regeneration pathway and enhancement of habitat condition;

- Habitat restoration monitoring –27 key variables are measured every two years by an external Biodiversity Auditor to track changes in vegetation and habitat condition. The data is analysed to assess the trajectory towards the benchmark description for the vegetation community and improved condition in woodland habitats.
- Bird assemblages monitoring –systematic surveys are completed every two years by an external Biodiversity Auditor to collect data on bird usage, assemblages and habitat. Monitoring of bird assemblages is also indicative of biodiversity as a whole and environmental change.
- Rapid Condition Assessment –photo monitoring and rapid assessment of woodland condition is undertaken every year; and
- Property inspections – monitoring for early detection of potential threats to the conservation values and failures of the Plan.

The conservation management actions to be implemented are described in section 4. Each action has a specific Performance Criteria and Trigger, Response and Action plan to ensure the actions deliver the intended outcome and are adaptable. The actions are guided by relevant National Recovery Plans, as well as the requirements of the legally binding conservation mechanism. To demonstrate this alignment the conservation

management actions are listed in Table 1 against the National Recovery Plan objectives or strategy for the Regent Honeyeater and Swift Parrot.

Table 1 Plans correlation to the National Recovery Plans for Regent Honeyeater and Swift Parrot

Actions	National Recovery Plan for the Regent Honeyeater (2016)	National Recovery Plan for the Swift Parrot (2011)	Alignment / Contribution
Controlled activities (Section 4.1)	Improve the extent and quality of regent honeyeater habitat.	To identify and prioritise habitats and sites used by the species across its range, on all land tenures. To implement management strategies to protect and improve habitats and sites on all land tenures	Protection of habitat in Hunter Valley identified as Priority habitat for conservation for both species. The prohibited activities address key threatening processes such as: habitat loss and alteration; forestry and firewood collection; and competition from honey bees.
Management of grazing for conservation (Section 4.2)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	The grazing controls address key threatening processes such as: habitat loss and fragmentation; habitat degradation; and regeneration suppression.
Weed control (Section 4.3)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	Control of weeds addresses key threatening process such as: regeneration suppression; encourage regeneration; and habitat loss.
Management of fire for conservation (Section 4.4)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	Control of fuel loads to address key threatening process such as: frequent fire; and high intensity fires
Infrastructure improvement (Section 4.5)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	Infrastructure to protect offset areas such as: fencing to exclude persons and grazing; safe access to implement management activities; and fire protection infrastructure.
Supplementary planting, (Section 4.8)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	Active restoration of areas within the offset areas that have limited regenerative capacity and require introduction of plants to trigger regeneration to establish more and enhanced habitat.
Vertebrate Pest and Overabundant Native Animal Control. (Section 4.10)	Improve the extent and quality of regent honeyeater habitat.	To implement management strategies to protect and improve habitats and sites on all land tenures	Pest control to addresses key threatening process such as: Predation– cats; and Competition – noisy miners, starlings.
Ecological Monitoring – Bird Assemblages (Section 5.3.2)	Increase understanding of the size, structure, trajectory and viability of the wild population.	To monitor population trends and distribution throughout the range.	Biennial monitoring contributing to records of sighting, breeding and numbers.

The Plan requires the preparation of an Annual Report, to review all activities undertaken and review the monitoring data against the key performance criteria and conservation management actions performance criteria. The Trigger, Response and Action plans for each action and the risk assessment in section 6 ensure the Plan is comprehensive and adaptive to new risks and changing circumstances. Key risks identified include:

- Unlawful damage;
- Bushfire;
- Suppression of regeneration from weeds and / or uncontrolled grazing; and
- Climate change impacting supplementary planting.

Consistent management of the offset area is best achieved through the implementation of one plan and, therefore, this Plan has been prepared to satisfy a range of requirements including:

- compliance with Commonwealth and State environmental approvals;
- legally binding conservation mechanism;
- contractual to engage consultants and contractors; and
- operational guide for Yancoal staff.

The Northern BA is located near the township of Singleton in NSW. The land is owned and managed by Yancoal. The total area of the BA is 344 hectares (ha) and contains 341ha of native vegetation (offset area). Figure 1 provides the location of the BA and its proximity to Warkworth Mine, as well as the other BAs containing biodiversity offsets areas.

The BA is currently managed in accordance with the Local Offset Management Plan (2014). This Plan will supersede the Local Offset Management Plan once it is approved by the Commonwealth and NSW regulators.

1.1 Intent

The intent of the Plan, is to ensure compliance with all environmental approvals and support the legally binding conservation mechanism by:

- implementing the conservation management actions in Section 4 and monitoring in Section 5, to meet and measure attainment of the conservation objectives set out in Section 3.

The legally binding conservation mechanism must remain on the land title in perpetuity, for the cadastral blocks listed in Table 3.

1.2 Environmental Approvals

1.2.1 Commonwealth

The Commonwealth Minister for the Environment, under provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), has issued two approvals for the Warkworth Mine; the first in February 2004 (EPBC 2002/629) and the second in August 2012 (EPBC 2009/5081).

These approvals require Warkworth Mine to offset the impact upon Matters of National Environmental Significance by protecting and managing habitat for the Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*).

Under these approvals, the Northern BA is to be secured with a legally binding mechanism for enduring protection of 341ha of suitable habitat for these species for Phase 2 of EPBC2009/5081. This Plan satisfies the requirement to prepare an Offset Management Plan and Re-establishment Management Plan for the EPBC 2009/5081 approval.

1.2.2 New South Wales

The Warkworth Mine was granted the NSW Development Approval (SSD-6464) issued under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 26th November 2015. This approval requires the Northern BA to be secured under a legally binding mechanism (Condition 30). This includes the Warkworth Sands Woodland (WSW) Offset Area (39ha) as identified in the prior approval DA 300-9-2002i. Offset Areas outside of the WSW Offset Area can be used to retire ecosystem and species credits to satisfy Condition 28. This Plan satisfies the requirement under Condition 36, for a Biodiversity Management Plan to implement the biodiversity offset strategy.

To ensure this Plan satisfies the requirement of all approvals Section 7 provides a compliance table to demonstrate attainment of the relevant conditions.

1.3 Function of the Management Plan

The Plan will provide the management framework for the BA with the aim to protect and enhance conservation values through the implementation of conservation management actions.

For the Plan to be successful it needs to define the baseline ecological condition of the BA, provide clear conservation objectives, detail the conservation management actions and measure success. To that end the Plan comprises the following sections:

- Biodiversity Areas: description of the BAs and baseline ecological condition of the vegetation communities and habitats, including the biodiversity credits to be retired;
- Conservation Objectives, Key Performance Indicators and Completion Criteria: outlines the conservation objectives for the Plan, conservation values and key performance indicators that have guided the development of conservation management actions and the monitoring programme;
- Conservation Management Actions: lists the primary management actions to be implemented to increase the extent, connectivity and condition of the plant community types and habitats, including Trigger, Response and Action plans;
- Monitoring: details the approach to data collection, analysis and interpretation to measure impacts of the conservation management strategies, to guide adaptive management, to identify positive trends in conservation values and assess attainment of Key Performance Indicators; and
- Risk Assessment: matrix of key risks in the implementation of the Plan and attainment of the objectives.

1.3.1 Information Management

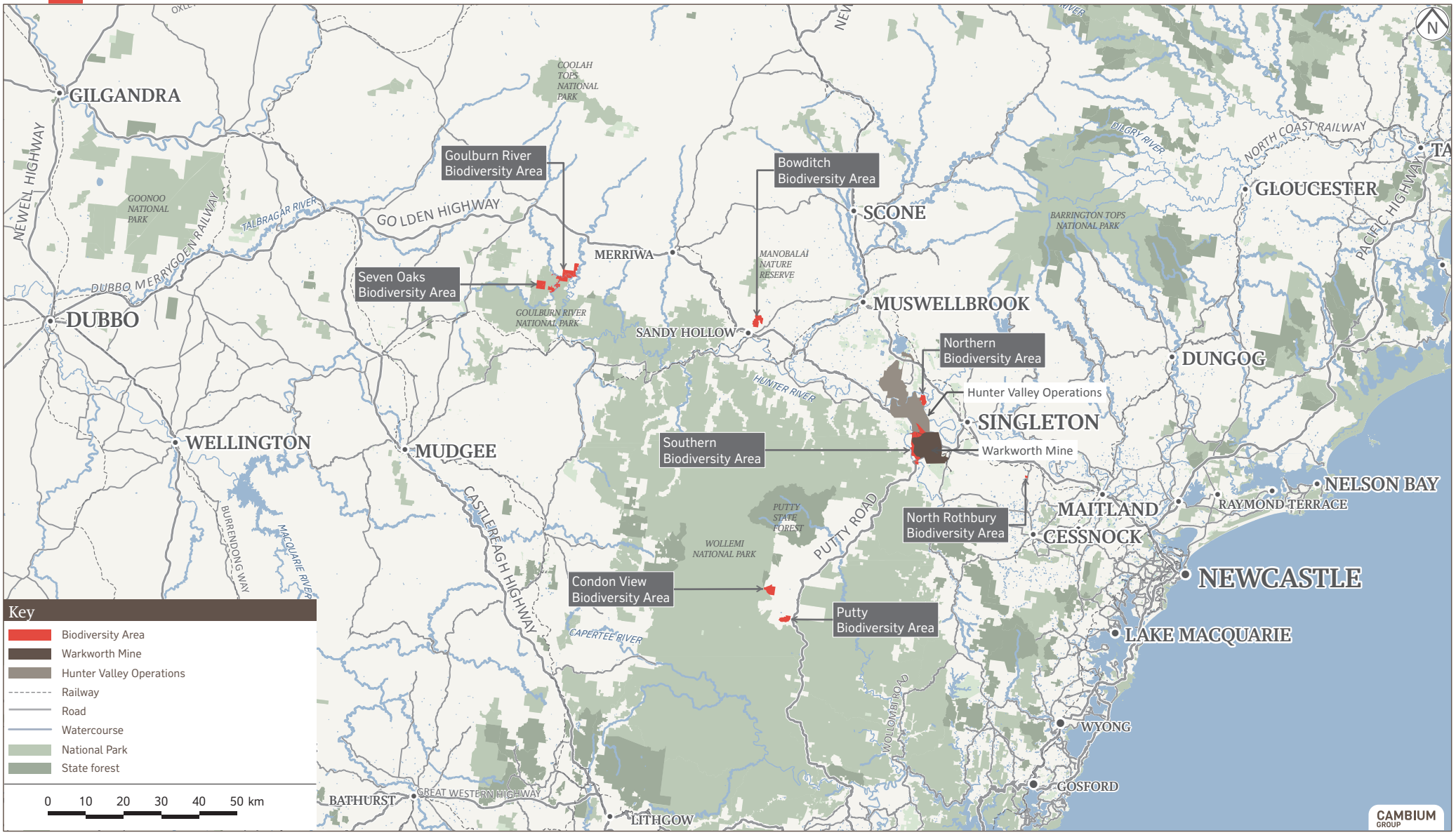
To secure monitoring data and assist in the management of the BA, Yancoal will maintain the online Biodiversity Offsets Portal whilst the BA is under their direct management. This Portal has been designed to centralise and share information among authorised users including regulators, and will include spatial data, an image library, Annual Reports, plans, BioBanking reports, survey results, records of management activities such as planting and weed control and other non-spatial data. The Portal will, improve communication among stakeholders, provide transparency of management and monitoring activities and will ensure data security and integrity (e.g. preventing risks of data loss due to staff turnover and minimising the risk of using superseded information). Ultimately, this will result in improved decision making and adaptive management that is responsive to seasonal conditions and current operational challenges.

The Portal will also provide access to an Interactive Map that will allow users to visualise data in a geo-spatial context, assisting in data interpretation. This data will include aerial imagery, site information (e.g. cadastral, site access, topographic, infrastructure, geology) and data relating to management and monitoring activities. The Interactive Map will allow users to query information, turn layers on and off, mark up and print maps. This is an easy to use but powerful tool that does not require knowledge of Geographic Information Systems on the part of the user.

Location of the Warkworth Mine Biodiversity Areas

Management Plan

Figure 1



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1.3.2 Key Stakeholders and Roles

The key stakeholders are identified by their roles in Table 2.

Table 2 Key Stakeholders Roles and Responsibilities

Roles	Responsible Entity	Details
NSW Regulator: Administers approvals granted under the EP&A Act – SSD-6464	Department of Planning & Environment (DPE)	Compliance (Mining) Mining & Industry Projects Department of Planning Industry & Environment http://www.planning.nsw.gov.au
NSW Regulator: Administers the NPW Act and the Biodiversity Conservation Act 2016 (BC Act)	DPE – Environment, Energy and Science (DPE-EES)	Newcastle Office Conservation and Regional Delivery www.environment.nsw.gov.au
Commonwealth Regulator: Administers approvals granted under the EPBC 2009/5081.	Australian Government Department of Agriculture, Water and the Environment (DAWE)	PostApproval@environment.gov.au (for submission of plan and matters related to the EPBC approval) EPBCMonitoring@environment.gov.au (for submission of Annual Report and EPBC Annual Compliance reports)
Land owner: Holds the title for the land.	Coal & Allied Operations Ltd whose operations are managed and operated by Yancoal MTW	Manager -Environment & Community Mount Thorley Warkworth
Project Proponent: Prepare and implement the Plan and complete reporting.	Warkworth Mining Limited, whose operations are managed and operated by Yancoal MTW	Manager -Environment & Community Mount Thorley Warkworth
Biodiversity Auditor: Monitor improvement in condition of the biodiversity values and completes ecological monitoring.	Yancoal MTW	Yancoal MTW to engage suitably qualified person/s.

1.3.3 Review and reporting

The Plan will be reviewed within four years from the date the Plan is approved by the Commonwealth and NSW regulators. The purpose of the review is to: incorporate suggestions from the Biodiversity Auditor after completing the Ecological Monitoring; update information on the ecological condition and extent of the plant community types and habitats across the BA; and refine conservation management actions. The review will incorporate any updated National Recovery Plans and other literature to ensure the management actions of the Plan are aligned and consistent with current science and conservation management practice.

At the end of year 10 an Advisory Group comprising representatives for each of the stakeholders listed in Table 2 will be invited to complete a review of the implementation of the Plan. The review will be informed by the Annual Reports, all monitoring reports, EPBC Annual Compliance reports and NSW Independent Audit results. The outcomes from the 10 year review will include a revised timeframe for the conservation objective, conservation management actions, and monitoring programme and reporting schedule. All revisions of the Plan are to be approved by DAWE and DPE. The document will be updated to amend contact details, agency names or other secondary information.

Annual Reports will include a summary of monitoring data, and analysis of that data and management highlights.

The Annual Reports will be prepared and submitted to DAWE and DPE in **May 2018** following implementation of the first year (2017) and then each year following. The report will be prepared with input from a suitably qualified ecologist or environmental scientist.

Annual Reports will include the following information as a minimum:

- name and contact details of the Landholder and/or Leaseholder;
- list of conservation management actions undertaken, describing scope of works, skill and expertise of the responsible entity/ies completing the works and performance;
- monitoring results, all data will be correctly labelled with date, location and GPS points;
- analysis of monitoring results with recommendations for modifications, if any, to the management or monitoring activities;
- assessment of any new risks or potential threats to the BA and actions to be undertaken to manage these threats and/or risks; and
- assessment of the progress in attainment of the conservation objectives and key performance indicators.

2 Biodiversity Area

2.1 Location and Description

The Northern BA is approximately located 12 kilometres (km) west of Singleton in NSW, approximately 7km north of Warkworth Mine, accessed via Comleroi Road. It is situated on the western side of a loop on the Hunter River, near the confluence with Glennies Creek.

The Northern BA is 344 hectares in size. It is comprised of 3 cadastral lots owned by Coal & Allied Operations Pty Ltd, as summarised in Table 3. Figure 2 shows the location of the BA and the cadastral boundaries.

This Plan identifies the 341ha offset area including 39ha of the WSW Offset Area, as identified in the prior approval DA 300-9-2002i. The BioBanking Assessment Report (Niche 2015) identified 341ha of vegetation and described Plant Community Types within 4 Management Zones (MZs) based on the vegetation and condition. Figure 3 shows the location of these areas. The remaining areas are infrastructure or within road easements that were excluded for the estimation of the area to generate species and ecosystem credits.

A summary of the credits generated for ecosystem credits is provided in Section 2.3 and species credits in Section 2.5.

Table 3 Northern Biodiversity Area owner and Lot and Deposited Plan (DP) summary

Land owner	Lot	DP	Area inside Northern BA (ha)
Coal & Allied Operations Limited			
	2	723248	3.7
	2	48646	2.4
	2	876447	337.4
Total			**343.5**

The Northern BA is located within the Sydney Basin Bioregion, with Wollemi National Park situated to the south-west and west. The BA contributes to a south to north or ‘stepping stones’ of existing native vegetation that provide connectivity at a landscape scale for flora and fauna. They are important in the ongoing conservation and protection of flora and fauna, as they enable migration, improved resilience to environmental and climatic variability and support genetic diversity. The Northern BA provides an important habitat refuge within the Hunter Valley floor as a ‘stepping stone’. The BA is situated in the Singleton Local Council and Table 4 provides the regional geographic context. The majority of the land to the south and west of the Northern BA is owned by Coal & Allied. The remaining adjacent land to the east and north is privately owned.

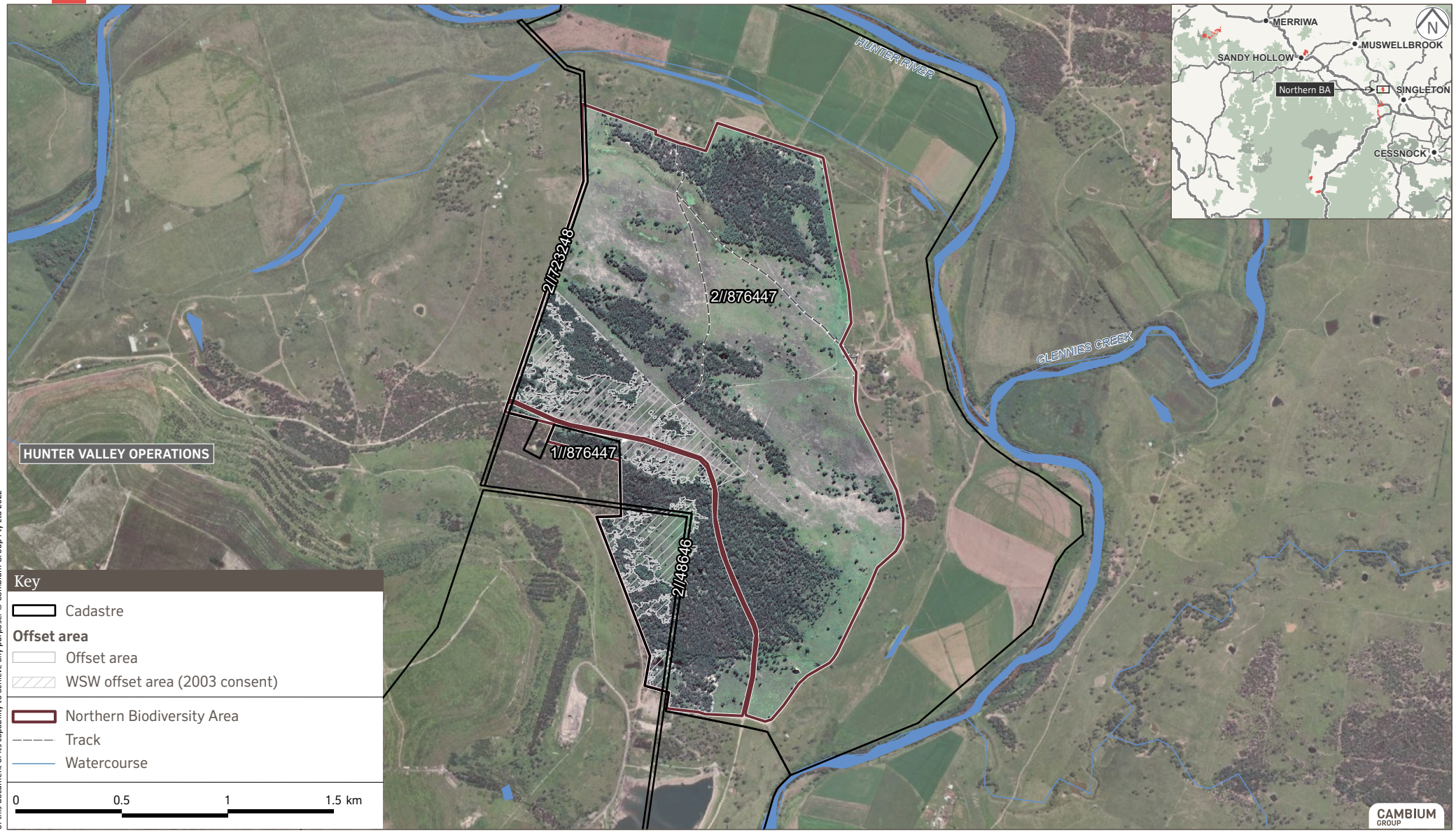
Table 4 Regional Biophysical Context

Geographical Feature	Description
Bioregion	Sydney Basin
Local Land Services Region	Hunter
CMA subregion	Hunter
Mitchell Landscape	Central Hunter Foothills Central Hunter Alluvial Plains
Watercourses	Near the Hunter River and Glennies Creek
Elevation	110 - 300 metres
Geology	Permian / Triassic
Nearby conservation areas	Wollemi National Park (approximately 12 km to the south-west) Yengo National Park (approximately 22 km to the south) Belford National Park (approximately 25 km to the south-east)

Cadastral boundaries and offset areas at the Northern Biodiversity Area

Management Plan 2022

Figure 2



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Vegetation communities, management zones and monitoring sites at the Northern Biodiversity Area

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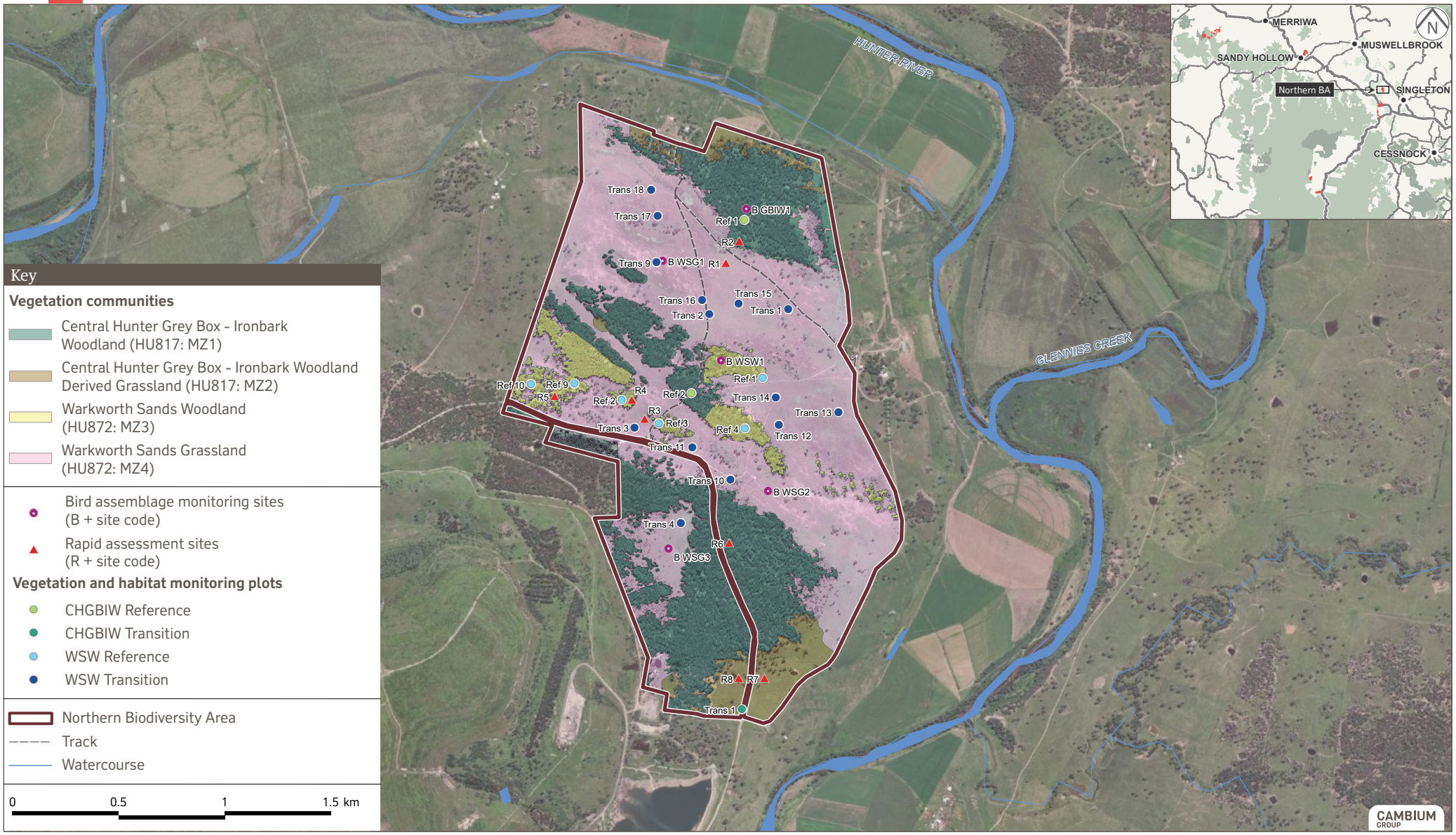
Figure 3



Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User

2.2 Vegetation communities

Significant native vegetation occurs within the Northern BA, however it is highly fragmented due to past agricultural land use. The extensive past land clearing has resulted in a mixture of cleared pasture and regrowth woodland/open woodland of various ages. It includes remnant patches of vegetation dominated by canopy species such as Rough-barked Apple (*Angophora floribunda)* and scattered Coastal Banksia (*Banksia integrifolia)*, together with scattered isolated trees and understorey on cleared former grazing land. The main native pioneer species on the more disturbed land include Common Bracken (*Pteridium esculentum)*, Showy Guinea-flower (*Hibbertia linearis)* and Common Everlasting *(Chrysocephalum apiculatum)*. A key exotic pioneer species in the open areas is Red Natal Grass (*Melinis repens*). The removal of livestock in 2008 has resulted in significant regeneration.

The Northern BA supports 4 vegetation communities as shown in Table 5 and lists the Plant Community Types code and Management Zones used in the BioBanking Assessment Report. Figure 3 shows the distribution of the vegetation communities within the Northern BA.

Table 5 Vegetation Communities across Northern BA

Code	Vegetation Community	Management Zone	BioBanking condition	Area (ha)
HU817	Central Hunter Grey Box - Ironbark Woodland EEC	MZ1	Moderate to Good	103.6
	Central Hunter Grey Box - Ironbark Grassland	MZ2	Low	23.1
HU872	Warkworth Sands Woodland EEC	MZ3	Moderate to Good	19.5
	Warkworth Sands Grassland	MZ4	Low	194.5
Total				340.7

2.2.1 Central Hunter Grey Box-Ironbark Woodland

The Central Hunter Grey Box-Ironbark Woodland (CHGBIW) is listed as Endangered Ecological Community (EEC) under the *Biodiversity Conservation Act 2016* (BC Act) and forms part of the Central Hunter Valley Eucalypt Forest ecological community listed as Critically Endangered (CE) under the EPBC Act.

The Central Hunter Grey Box-Ironbark Woodland dominant canopy species are Grey Box (*Eucalyptus molucanna*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). There are also local abundances of Bulloak (*Allocauarina luehmannii*) and White Feather Honeymyrtle (*Melaleuca decora*) in the midstorey. Common understorey species include Fan Wattle (*Acacia amblygona*), *Acacia falcata*, Native Blackthorn (*Bursaria spinosa*) and Coffee Bush (*Breynia oblongifolia*). Common groundcover species include Purple Burr-Daisy (*Calotis cuneifolia*), Blue Trumpet (*Brunoniella australis*), Kidney Weed (*Dichondra repens*), Blue Flax Lily (*Dianella revoluta*), Threeawn Speargrass (*Aristida vagans*), Wattle Matt-rush (*Lomandra filiformis*), Common Fringe-sedge (*Fimbristylis dichotoma*) and Rock Fern (*Cheilanthes sieberi*).

2.2.2 Central Hunter Grey Box-Ironbark Grassland

This community typically lacks the dominant canopy species of Grey Box (*Eucalyptus molucanna*) and Narrow-leaved Ironbark (*Eucalyptus crebra*). The groundcover is generally dominated by native grass species, however some herbs also occur. There is a low to moderate incursion of weed species within this community, particularly along areas that have been disturbed. Significant regeneration is evident in some areas of this community.

2.2.3 Warkworth Sands Woodland

The Warkworth Sands Woodland (WSW) community is listed as an EEC under the BC Act and in 2016 was listed as CE under the EPBC Act. Vegetation mapped as WSW conforms to the NSW Scientific Committee (2002) final determination. The final determination describes WSW as being confined to aeolian sand deposits in the vicinity of Warkworth, south-east of Singleton in the mid Hunter Valley. The determination characterises the community by the assemblage of species that are listed in Table 6. The determination recognises one community, however indicates that the community has sub communities where there is a dominant abundance of the species of the WSW. This

is generally where a thin sandy veneer overlies the Permian substrate. The NSW BioMetric Vegetation Type Database (OEH, 2012), which provides a state wide overview and definitions of NSW plant community types, also defines a single WSW community as 'Rough-barked Apple - Coast Banksia shrubby woodland on Warkworth Sands of the central Hunter Valley, Sydney Basin'.

Table 6 Species assemblage listed in the NSW Scientific Committee final determination (2002) to characterise Warkworth Sand Woodland

Scientific Name	Common Name	Strata
Acacia falcata	Hickory Wattle	Shrub
Acacia filicifolia	Fern-leaved wattle	Canopy / Mid storey
Ajuga australis	Austral Bugle	Ground cover
Allocasuarina littoralis	Black She-oak	Canopy / Mid storey
Allocasuarina luehmannii	Bulloak	Canopy / Mid storey
Amyema pendulum	Mistletoe	Shrub
Angophora floribunda	Rough-barked Apple	Canopy / Mid storey
Aristida calycina		Ground cover
Aristida ramosa	Purple Wiregrass	Ground cover
Aristida vagans	Threeawn Speargrass	Ground cover
Aristida warburgii		Ground cover
Banksia integrifolia	Coast Banksia	Canopy / Mid storey
Brachyloma daphnoides	Daphne Heath	Shrub
Breynia oblongifolia	Coffee Bush	Shrub
Callitris endlicheri	Black Cypress Pine	Canopy / Mid storey
Calotis cuneifolia	Purple Burr-daisy	Ground cover
Cheilanthes sieberi	Poison Rock Fern	Ground cover
Chrysocephalum apiculatum	Common Everlasting	Ground cover
Desmodium varians		Ground cover
Dianella revoluta	Blue Flax Lily	Ground cover
Dichondra species A	Kidney Grass	Ground cover
Echinopogon caespitosus	Bushy Hedgehog-grass	Ground cover
Echinopogon intermedius	Erect Hedgehog Grass	Ground cover
Einadia trigonos	Fishweed	Ground cover
Entolasia stricta	Wiry Panic	Ground cover
Eucalyptus blakelyi/tereticornis	Forest Red Gum	Canopy / Mid storey
Eucalyptus crebra	Narrow-leaved Ironbark	Canopy / Mid storey
Eucalyptus glaucina	Slaty Red Gum	Canopy / Mid storey
Exocarpos cupressiformis	Cherry Ballart / Native Cherry	Canopy / Mid storey
Exocarpos strictus	Pale-fruit Ballart / Dwarf Cherry	Canopy / Mid storey
Hardenbergia violacea	Purple Coral Pea	Ground cover
Hibbertia linearis	Showy Guinea-flower	Shrub
Hovea linearis	-	Shrub
Hypoxis hygrometrica	Golden Weather-grass	Ground cover
Imperata cylindrical	Blady grass	Ground cover
Indigofera australis	Australian Indigo	Shrub
Jacksonia scoparia	Winged Broom-pea	Shrub
Lomandra glauca	Pale Mat-rush	Ground cover
Lomandra leucocephala	Woolly Mat-rush	Ground cover
Lomandra muticus		Ground cover
Melaleuca decora	White Feather Honeymyrtle	Shrub
Melaleuca thymifolia	Thyme Honey-myrtle	Shrub
Persoonia linearis	Narrow-leaved Geebung	Shrub

Scientific Name	Common Name	Strata
Pimelea linifolia	Wedding Bush / Slender Rice-flower	Shrub
Pomax umbellata		Ground cover
Pteridium esculentum	Common Bracken	Ground cover
Solanum prinophyllum	Forest Nightshade	Ground cover
Vittadina sulcata		Ground cover

Field surveys in the Northern and Southern BAs observed dominant canopy species including Rough-barked Apple (*Angophora floribunda*) and the small tree Coastal Banksia (*Banksia integrifolia*). Other small trees recorded in the canopy of this community include Bulloak (*Allocasuarina luehmannii*), Black She-Oak (*Allocasuarina littoralis*), Blakely's Red Gum/Forest Red Gum intergrades (*Eucalyptus blakelyi/tereticornis*), Black Cypress Pine (*Callitris endlicheri*) and White Cypress Pine (*Callitris glaucophylla*).

Common understorey species included Coffee Bush (*Breynia oblongifolia*), *Hibbertia linearis*, Slender Rice Flower (*Pimelea linifolia*), Silver-stemmed Wattle (*Acacia parvipinnula*) and Dogwood (*Jacksonia scoparia*). The groundcover is characterised by Bracken (*Pteridium esculentum*). Common grasses in this community are Three-awn Speargrass (*Aristida vagans*), Weeping Meadow Grass (*Microlaena stipoides*), Purple Wiregrass (*Aristida ramosa*), Brown's Lovegrass (*Eragrostis brownii*), Blady Grass (*Imperata cylindrica*) and Hairy Panic (*Panicum effusum*). Other common groundcovers include Rock Fern (*Cheilanthes sieberi*), Berry Saltbush (*Einadia hastata*), Pomax (*Pomax umbellata*) and Variable Glycine (*Glycine tabacina*).

2.2.4 Warkworth Sands Grassland

The Warkworth Sands Grassland areas are located on sand and have some representation of the understorey components of WSW but have been greatly disturbed by previous land management and have demonstrated limited capacity to regenerate naturally. These grassland areas will be the focus of the active restoration or re-establishment and control of Red Natal grass. The Northern BA includes 39ha of the WSW Offset Area. This area consists of WS grassland currently being regenerated to WSW.

2.3 BioBanking Ecosystem credits

The Northern BA BioBanking Assessment Report (Niche 2015) calculated a total of 4,776 ecosystem credits. However after the exclusion of credits from the WSW Offset Area only 4,214 credits are available for retirement by Warkworth Mine, as shown in Table 7.

Table 7 Ecosystem credits created across the Northern BA

Vegetation communities	PCT	MZ	Area (ha)	Ecosystem Credits
Central Hunter Grey Box - Ironbark Woodland EEC	HU817_Mod/Good	MZ1	103.6	1,364
Central Hunter Grey Box - Ironbark Grassland	HU817_Low	MZ2	23.1	306
Warkworth Sands Woodland EEC	HU872_Mod/Good	MZ3	19.5	304
Warkworth Sands Grassland	HU872_Low	MZ4	155.5	2,240
Total			**301.7**	**4,214**

2.4 Threatened Species

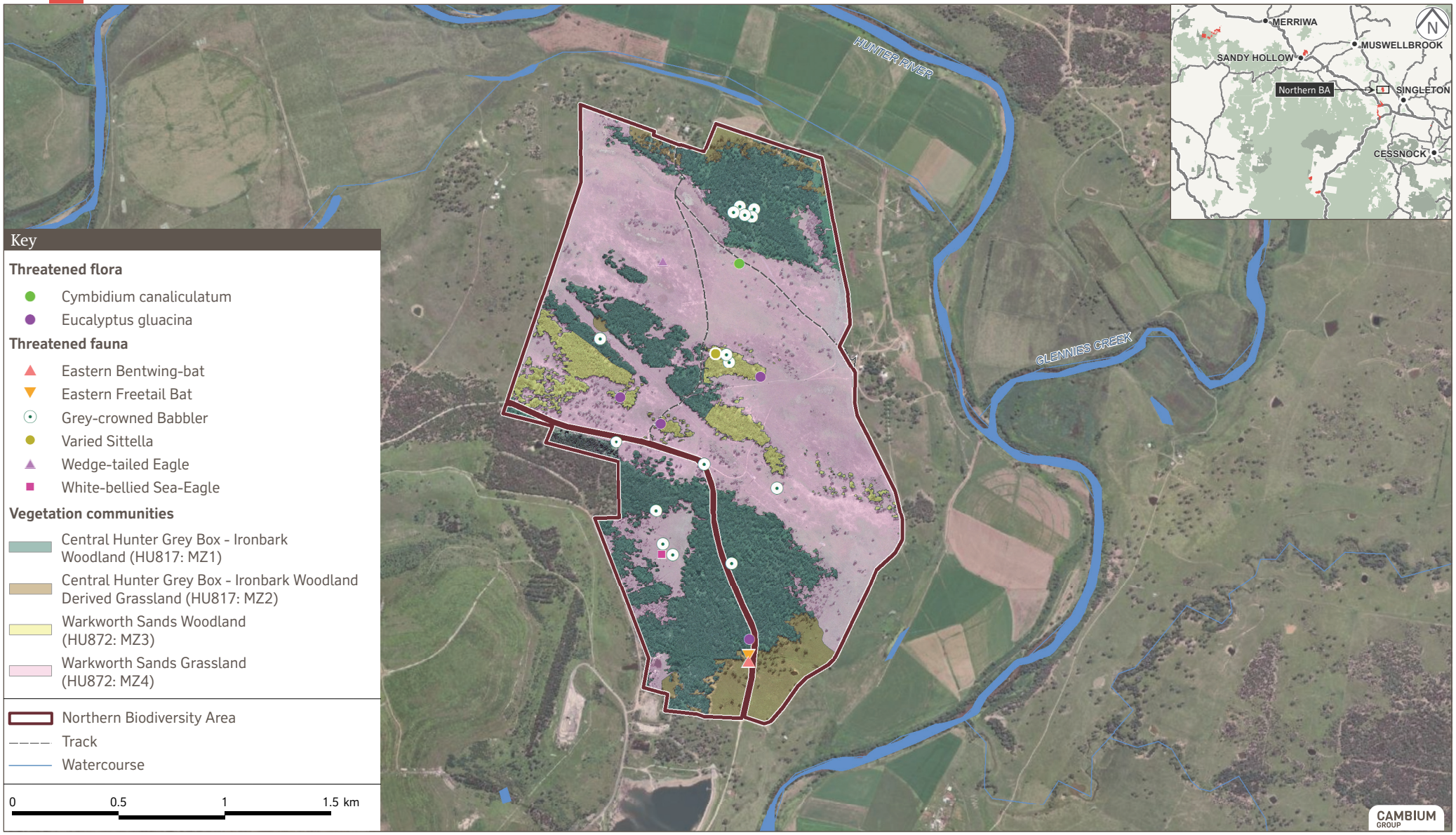
A number of threatened flora and fauna species have been recorded within the BA. Threatened species records for the Northern BA are shown in Figure 4. The threatened species that have been recorded within the Northern BA include:

Common name	Scientific name	Status
Tiger Orchid	*Cymbidium canaliculatum*	E - BC Act
Slaty red gum	*Eucalyptus glaunina*	V – EPBC and BC Act
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	V -BC Act
Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*	V -BC Act
Eastern Freetail Bat	*Mormopterus norfolkensis*	V -BC Act
Notes: E – Endangered; V - Vulnerable		

Threatened species records at the Northern Biodiversity Area

Management Plan 2022

Figure 4



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Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User

There is potential habitat within the Northern BA for a number of threatened fauna species previously recorded in the locality. These include the:

- Brown Treecreeper (*Climacteris picumnus victoriae*);
- Diamond Firetail (*Stagonopleura guttata*);
- Hooded Robin (*Melanodryas cucullata*); and
- Speckled Warbler (*Pyrrholaemus saggitatus*).

An Expert Report (Cumberland Ecology and Merops Services 2015) was prepared to accompany the BioBanking submission, which confirms the presence of habitat for both species within the Northern BA.

Table 8 provides a summary of the suitable habitat, both existing and restoring, within the offset area for Phase 2 of the EPBC2009/5081 approval. The Expert Report is available on the Biodiversity Offset Portal.

Table 8 Area of suitable habitat within the offset area

Biodiversity Area	Regent Honeyeater Habitat (ha)			Swift Parrot Habitat (ha)		
	Existing	Restoring	Total	Existing	Restoring	Total
Northern – Phase 2	123.1	217.6	340.7	123.1	217.6	340.7

A brief description of these two species is provided below with a summary of the habitat suitability assessment provided in the Expert Report (Cumberland Ecology and Merops Services 2015).

A brief description of these two species is provided below with a summary of the habitat suitability assessment provided in the Expert Report (Cumberland Ecology and Merops Services 2015).

2.4.1 Swift Parrot

The Swift Parrot is a predominantly nectarivorous, migratory species endemic to south eastern Australia (Birds Australia 2013) and is listed as CE under the EPBC Act and Endangered under the BC Act. The species breeds in Tasmania and migrates to the mainland in winter, where it is most commonly found in dry, open eucalypt forests and woodlands containing Grey Box, White Box and Yellow Gum (Garnett and Crowley 2000; OEH 2012). The species is reliant on Box-Ironbark communities for winter foraging and movement is strongly associated with the availability of lerps and winter-flowering eucalypt species. Swift Parrots often occur in urban areas, including farmland with remnant patches of eucalypt woodland (DEC (NSW) 2005; Saunders and Heinsohn 2008).

Swift Parrots recorded approximately 10 km to the South. Several tree species that provide feeding resources for the Swift Parrot are present within the Southern BA, including Rough-barked Apple (*Angophora floribunda*) and Grey Box (*Eucalyptus moluccana*). These species could be used on occasion by the Swift Parrot for foraging, depending on flowering intensity. Based on this and several other factors, the Expert Report (Cumberland Ecology and Merops services 2015) concluded that the Swift Parrot is moderately-highly likely to occur in the following communities within the BA:

- HU817 – Narrow-leaved Ironbark - Bull Oak - Grey Box shrub-grass open forest; and
- HU872 – Rough-barked Apple - Coast Banksia woodland on Warkworth sands.

2.4.2 Regent Honeyeater

The Regent Honeyeater is a winter migrant endemic to south eastern Australia where it is widespread but sparsely scattered, and strongly associated with the western slopes of the Great Dividing Range (Garnett and Crowley 2000) and is listed as CE under the EPBC Act and the BC Act. The species is also known to forage and breed in Box-Ironbark woodland in the Hunter Valley region It is found in temperate eucalypt forests and woodlands but prefers Box-Ironbark associations and River Oak riparian forest in wet, fertile sites along creek lines and river valleys (DEC (NSW) 2006).

The Regent Honeyeater is strongly nomadic and follows blossoming trees and mistletoe (Franklin, Menkhorst *et al*. 1989; NSW Scientific Committee 2004). Numbers fluctuate greatly between years and sites, and movement outside of breeding season is poorly understood. Only 1,500 individuals are thought to make up the single subpopulation of this species. Regent Honeyeaters forage in the canopy tops of mature feed trees, but roost in saplings (Oliver, 1998). This suggests that the species requires a more extensive area of habitat than other similar nectarivorous species.

The nearest record of the Regent Honeyeater is 6km to the south. A range of tree species that provide feeding resources for the Regent Honeyeater are present within the Northern BA, including some that are abundant. These feed trees include Blakely's Red Gum (*Eucalyptus blakelyi*), Rough-barked Apple (*Angophora floribunda*), *Banksia* ssp, Grey Box (*E. moluccana*) and *Melaleuca sp.* These species, and other shrub species, could be used on occasion by the Regent Honeyeater for foraging, depending on flowering intensity.

These species, and other shrub species, could be used on occasion by the Regent Honeyeater for foraging, depending on flowering intensity.

Based on this and several other factors, the expert report (Cumberland Ecology and Merops services 2015) concluded that the Regent Honeyeater is moderately-highly likely to occur in the following communities within the BA:

- HU817: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub-grassy open forest; and
- HU872: Rough-barked Apple – Coast Banksia woodland on Warkworth Sands.

Photo: Swift Parrot (Chris Tzaros)

Photo: Regent Honeyeater (Murray Chambers)

2.5 BioBanking Species Credits

The Northern BA BioBanking Assessment Report (Niche 2015) identified a total of 895 species credits are available for retirement by Warkworth Mine, as shown in Table 9. There were no species credits were generated for the WSW Offset area.

Table 9 Species credits created across the Northern BA

Scientific name	Common name	Extent of habitat in ha (fauna) or no. individuals (plants)	Number of species credits created
Eucalyptus glaunina	Slaty red gum	3 individuals	21
Anthochaera phrygia	Regent Honeyeater	123.1ha	874
Total			**895**

2.6 Baseline Ecological Condition

2.6.1 Woodland condition

A Rapid Condition Assessment (RCA) technique is used as a preliminary assessment of woodland condition within the BA. **Appendix A** provides details on the RCA methodology.

Eight permanent RCA sites were established across the Northern BA in November 2013 and data has been collected annually since. All RCA were undertaken in areas of suitable habitat for woodland birds. Sites were selected near access tracks so that future access to the sites will be maintained. Additionally, these sites might act as early indicators of emerging threats given the greatest risks from threats are often at the more easily accessible areas. Four grassland sites have been included for monitoring purposes.

Photo reference points were established at each RCA site where a series of photos (north, east, south, west and ground) are taken. This will provide a visual record of any changes in vegetation and habitat condition.

All RCA plot data and the photo monitoring plots can be accessed from the online Biodiversity Offsets Portal.

Table 10 provides the number of RCA sites along with the average health rating. All woodland RCA sites received a health rating of >16/20 with the average being 18/20 in 2019 indicating these areas are healthy and sustainable under current management. Figure 3 indicates the location of the plots.

Table 10 Rapid Condition Assessment summary results

RCA Plot	MZ	2013	2014	2015	**2016**	**2017**	**2018**	**2019**
1	MZ4	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland
2	MZ1	16	18	18	19	19	18	18
3	MZ4	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland
4	MZ3	16	18	18	18	19	19	19
5	MZ3	17	17	18	20	19	18	18
6	MZ1	18	18	19	20	20	18	18
7	MZ2	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland
8	MZ2	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland	Grassland
Average		**17/20**	**18/20**	**18/20**	**19/20**	**19/20**	**18/20**	**18/20**

2.6.2 Habitat condition

In October 2014, 11 permanent Habitat Restoration Monitoring plots were established within the Northern BA, across four MZs. Section 5 describes the programme and the methodology to assess changes in habitat values within the offset area through time and relative to the benchmark values associated with the BioMetric Vegetation Type (BVT). In addition the monitoring aims to observe the transition from grassland to woodlands in the CHGBIW (HU817) and WSW (HU872) vegetation communities. Monitoring plots include a series of transition (trans) and reference (ref) plots.

The results are shown in Table 11 and have been compared against the benchmark, Figure 3 indicates the location of the plots. A full description of the baseline monitoring results is provided in the Habitat Restoration Monitoring Report 2014, 2016 and 2018 are available on the Biodiversity Offsets Portal.

Central Hunter Grey Box - Ironbark Woodland assessment
Three monitoring plots were established including two reference plots in MZ1 and one transition plot in MZ2.

When compared with the benchmark values, the plot data for the CHGBIW (reference plots) indicate native species richness approaching the benchmark range, but lower than the minimum value. The percent cover of the canopy is relatively sparse as is the mid-storey which is often absent. The per cent cover of native ground stratum (grasses) is mostly within the benchmark range but the native ground stratum (shrubs) and native ground stratum (other) is considerably lower than benchmark. The per cent cover of exotic species is consistently low and logs are abundant and exceed the benchmark criteria. The lack of tree hollows within this regenerating community relative to the benchmark is also evident.

On average, Central Hunter Grey Box-Ironbark grassland (transition plot) is considerably modified away from the benchmark values for all site attributes except the per cent cover of native ground stratum (grasses). In addition to the structural impact of the cleared canopy and mid-storey, the native plant species richness is very low. The ground cover

composition has shifted to a very high per cent cover of exotic plants and reduced per cent cover of native shrubs and other ground cover species relative to the benchmark values. Habitat features such as hollows and logs are absent and therefore do not meet the benchmarks.

Warkworth Sands Woodland

Eight monitoring plots were established including four reference plots in MZ3 and four transition plots in MZ4.

The monitoring plot data for the WSW indicates a relatively sparse canopy cover and a depleted mid-storey, when compared with the benchmark values. The per cent cover of native grasses is consistently above the benchmark range with other ground cover and exotic species cover within or close to the benchmark. Habitat features such as rocks, hollows are generally absent/rare and the presence of fallen logs is variable among the monitoring plots.

The WS grasslands retain some ground stratum components of WSW, but have been disturbed by previous land management and consequently native species richness is low. The ground cover composition has shifted to an elevated per cent cover of native grasses and reduced per cent cover of native shrubs and other ground cover species relative to the benchmark values. As would be expected, exotic plants are more abundant in the grasslands than the woodland and habitat features such as trees and logs are absent.

Table 11 Summary of Habitat Restoration Monitoring Result 2014 compared to benchmark values

Attributes		NPSR	NOS	NMS	NGCG	NGCS	NGCO	EPC	Logs(m)	Hollows
MZ1 HU817: Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion (IBW)										
Benchmark	**min**	**41**	**15**	**5**	**30**	**5**	**20**	**<5**	**5**	**3**
	max		**40**	**20**	**50**	**10**	**40**			
Ref 1		11	7.8	0	69.18	2.02	2.08	4.04	8	0
Ref 2		21	5.17	0.5	41.33	2	1.3	3.67	7	0
average		***16***	***6.5***	***0.2***	***55.3***	***2***	***1.6***	***3.8***	***7.5***	
MZ2 HU817: Narrow-leaved Ironbark +/- Grey Box grassy woodland of the upper Hunter Valley, mainly Sydney Basin Bioregion										
Trans 1		7	2.33	0.83	20	0.67	0	46.67	15	1
MZ3 HU872: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area (WSW)										
Benchmark	**min**	**26.0**	**13.0**	**10.0**	**4.0**	**5.0**	**5.0**	**<5**	**20.0**	**0.8**
	max		**40.0**	**50.0**	**15.0**	**30.0**	**25.0**			
Ref 1		18	6.5	0.0	22.7	21.3	6.0	3.3	0	0
Ref 2		22	9.3	0.0	80.0	2.0	8.0	3.3	0	0
Ref 3		23	4.8	0.0	28.7	10.0	22.7	4.0	0	1.0
Ref 4		18	5.2	0.3	38.7	2.0	17.3	4.0	22.0	0
average		***20.2***	***6.4***	***0.1***	***42.5***	***8.8***	***13.5***	***3.6***	***5.5***	***0.2***
MZ4 HU872: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area (WSW)										
Trans 1		11	0.0	0.0	28.7	0.7	0.0	66.7	0.0	1.0
Trans 2		4	4.8	0.0	28.7	10.0	22.7	4.0	0.0	0.0
Trans 3		11	0.0	0.0	20.3	4.0	4.1	42.6	0.0	0.0
Trans 4		3	0.0	0.0	79.7	0.0	0.0	10.2	0.0	0.0
average		***7.2***	***1.2***	***0.0***	***39.3***	***3.7***	***6.7***	***30.9***	***0.0***	***0.3***

	0-10% or >200% of benchmark (>66% cover for EPC)
	10-50% or 150-200% of benchmark (33-66% cover for EPC)
	50-100% or 100-150% of benchmark (5-33% cover for EPC)
	within benchmark or > benchmark for NPSR, Hollows and Logs (0-5% cover for EPC)

NPSR	Native plant species richness	NGCO	Native ground cover (other) % cover
NOS	Native over-storey % cover	EPC	Exotic plant cover % cover
NMS	Native mid-storey % cover	Logs (m)	Length of logs (m)
NGCG	Native ground cover (grass) % cover	Hollows	No. trees with hollows

2.6.3 Bird usage

In 2014 bird assemblages monitoring as described in Section 5 of this Plan was commenced with surveys undertaken from 28 July to 02 August (AECOM 2014). The location of the nine monitoring plots is shown on Figure 3. The monitoring is designed to observe changes ongoing habitat usage by woodland birds and a decrease in the abundance of bird species typical of forest margins and grasslands. The monitoring will also assess the status of Swift Parrot and Regent Honeyeater within the BA and their movements and habitat usage.

Regent Honeyeater and Swift Parrot were not detected during 2014, 2016 or 2018 monitoring. The non-detection of the two species during monitoring does not confirm that the species do not use the sites. The Northern BA supports potential habitat for the two species which could visit any of the areas to forage when trees are in flower.

Thirty-six species of birds were recorded at the Northern BA sites during this monitoring. The highest diversity was in woodland habitats and the lowest in grassland and rehabilitating sites. Threatened birds recordered were:

- Grey-crowned Babbler (*Pomatostomus temporalis);* and
- Varied Sittella (*Daphoenositta chrysoptera*).

3 Objectives, Key Performance Indicators and Completion Criteria

3.1 Conservation Objectives

The conservation objective for this Plan is to protect and enhance the condition and extent of the conservation values of the offset area within 10 years at the Northern BA.

The conservation management actions described in the following Section 4 outline activities to achieve the conservation objectives.

The methods to monitor the attainment of these objectives are described in Section 5. The monitoring data will be annually reviewed to adapt conservation management actions through continual improvement.

The key conservation outcomes from the long term management and protection of the offset areas include:

- enhanced landscape connectivity within the surrounding landscape;
- improved fauna movement and flora dispersal opportunities within the surrounding landscape;
- increased condition and area of suitable habitats for threatened fauna species within protected reserves, specifically for the Regent Honeyeater and Swift Parrot; and
- enhanced the existing network of protected vegetation within the Hunter Valley.

3.2 Key Performance Indicators

The Key Performance Indicators will measure conservation values, being woodland and grassland vegetation attributes and habitat to indicate an enhancement of ecological and habitat condition. The woodland area to be measured contains habitat for the Regent Honeyeater and Swift Parrot and long term conservation gains will be achieved through the regeneration of the grassland to create additional woodland habitat for these birds. Table 12 lists the key conservation values within the offset area, as well as their Key Performance Indicators and Completion Criteria. The monitoring programme, outlined in Section 5, details the attributes to be measured to provide evidence and demonstrate achievement of the Key Performance Indicators from the implementation of the conservation management actions detailed in Section 4.

Table 12 Northern BA Conservation Values and Key Performance Indicators

Conservation Value	Key Performance Indicator	Completion Criteria
Ironbark Woodland	Extent and condition of woodland extent of 103.6ha over 10 years.	Observed and measured increase and / or maintained Rapid Condition Assessment scores over 10 years (measured annually) in MZ1.
Ironbark Grassland	Transition 23.1ha of grassland to woodland.	Observed and measured trajectory towards and / or attainment of benchmark values or reference site attributes at MZ2 (Table 11) over 10 years (measured biennially).
WSW	Maintain woodland extent of 19.5ha over 10 years.	Observed and measured increase and / or maintained Rapid Condition Assessment scores over 10 years (measured annually) in MZ3.
WS Grassland	Transition 194.5ha of grassland to woodland.	Observed and measured trajectory towards and / or attainment of benchmark values or reference site attributes at MZ4 (Table 11) over 10 years (measured biennially).
Fauna Habitat	Bird usage over 10 years.	Observed increased or maintained species richness and usage by woodland birds over 10 years (measured biennially).

3.3 Completion Criteria

The objectives will be deemed to be attained when the Completion Criteria defined in Table 12 have been met to the satisfaction of the DAWE and DPE.

This will also be dependent upon achievement of the WSW Performance Criteria (2016) as required by Condition 32 of the NSW Environmental Approval, a copy of the WSW Performance Criteria is in **Appendix B.**

4 Conservation Management Actions

This Section outlines the management actions to protect and increase the extent and condition of the conservation values in the offset area, the offset area is defined by the vegetation community and Biobanking Management Zones as shown in Figure 3. They focus on addressing the key threats to the conservation values, such as unauthorised activity, clearing, altered fire regimes, weeds, feral animals, and overgrazing.

The following details the purpose, scope and methodology for the actions. Each action has been assigned Performance and Completion Criteria (noting Year 1 is 2017), and Trigger, Response and Action plan, to identify corrective actions in the event of unexpected outcomes from implementing the Plan, and support adaptive implementation.

Figure 5 highlights key management infrastructure this includes:

- approximately 14.5km boundary fences;
- 6 boundary gates; and
- approximately 7.4km of access tracks.

Yancoal is accountable for the implementation of the conservation management actions, as shown in Table 2, this key responsibility rest with the Manager, Environmental. The Manager is supported by staff who engage and supervise qualified consultants and contractors to complete the Biodiversity Auditor role, other monitoring, weed and pest animal control, supplementary planting, construction and maintenance of infrastructure and other works as described in the following Section.

4.1 Controlled activities

4.1.1 Prohibited actions

The offset area will have legal protection that includes penalties to enforce its protection. Yancoal will ensure that all employees or representatives, contractors, consultants and visitors are aware of these legal protections and penalties prior to entering the offset area.

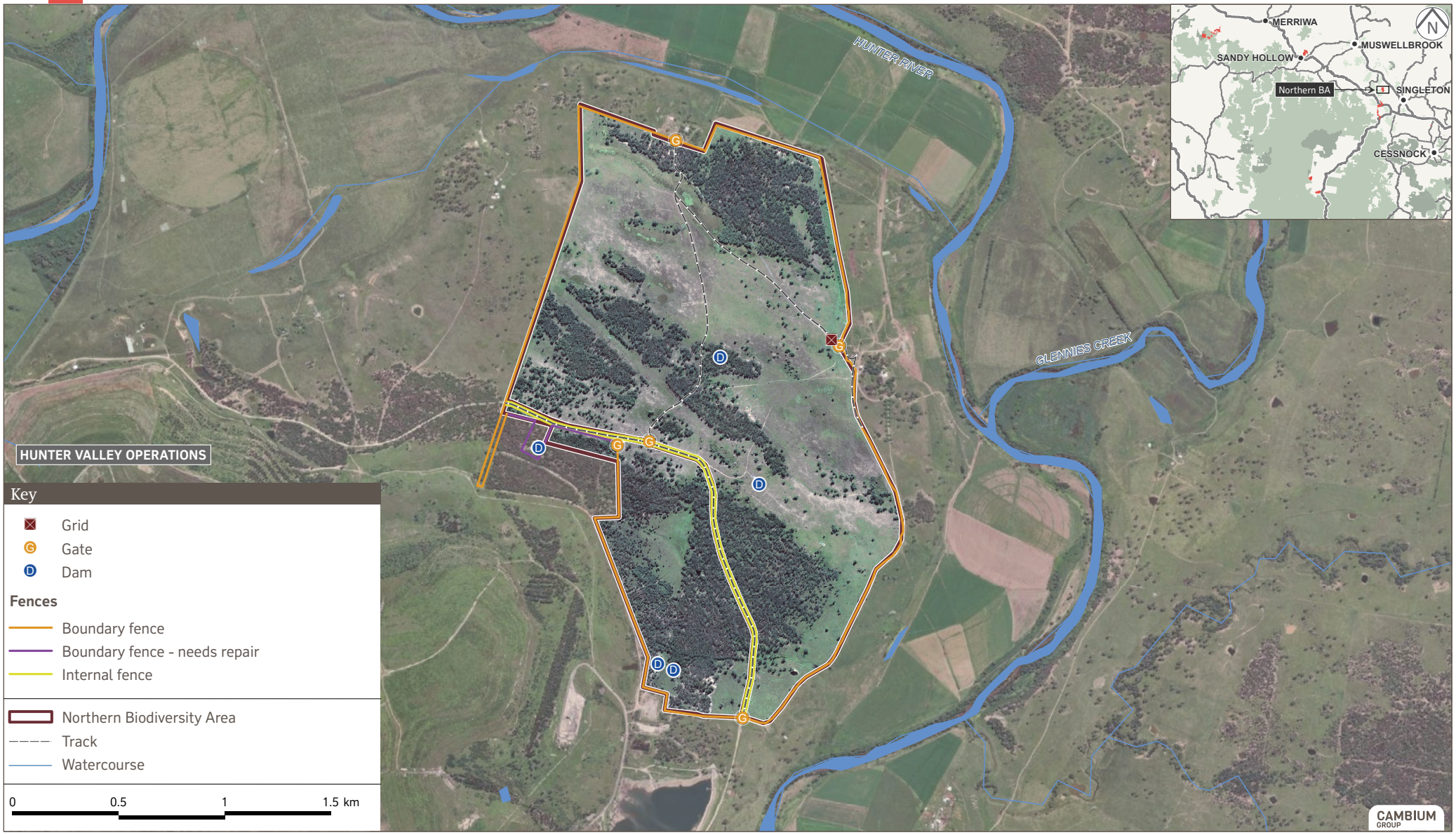
The following activities will not be permitted within the offset area (Figure 3):

- littering or dumping of waste;
- removal of standing or fallen dead timber, firewood, native plants or animals;
- removal of rocks, sand or gravel;
- clearing or destruction of native vegetation (unless required to implement conservation management actions, such as infrastructure construction or re-vegetation);
- hunting;
- trapping or shooting (unless controlling pest animals);
- broad-acre use of fertilisers;
- broad-acre aerial application of pesticide from planes or helicopters;
- continuous grazing;
- use of livestock feed; or
- keeping of European bee hives, domestic cats and/or dogs.

Key Infrastructure at the Northern Biodiversity Area

Management Plan 2022

Figure 5



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4.1.2 Exemption for clearing vegetation

Native vegetation cannot be cleared or disturbed within the offset area with the exception of:

- clearing to implement the conservation management actions described in this Section, being:
    a) infrastructure improvements;
    b) control of weeds and vertebrate pests;
    c) protect personal safety;
    d) establish and/or maintain firebreaks, to manage fuel loads; and
    e) ground preparation or thinning to support revegetation activities, including care and maintenance of planting areas (even if not currently prescribed in this Plan)

To ensure compliance with all legal and environmental protection measures the Yancoal Ground Disturbance Permit (GDP) process will be adopted prior to any planned disturbance.

The GDP process is a checklist that considers the impact of the disturbance on:

- cultural heritage – search relevant sources to determine their presence;
- land ownership and tenement – ensure action is located on land owned or managed by Yancoal;
- environment – search relevant sources to identify presence of listed ecological communities, flora or fauna;
- regulatory approval – legal authority for the action;
- rehabilitation – requirement for rehabilitation; and
- water – potential water impacts and mitigation.

4.1.3 Access

Access to the offset area will be controlled through locked gates and fences and signs at main access points to inform all visitors they are entering a protected area. Routine inspections and maintenance of infrastructure (access/fire tracks, fence lines and gates) will be undertaken to ensure they are to standard and fit for purpose.

Vehicles may cause soil compaction, dispersal of weeds and vegetation disturbance. To minimise the impact of vehicles on the BA, vehicle access will be restricted to authorised personnel only and vehicle speed will not exceed a maximum of 40km/h.

4.1.4 Recreation activities and residences

Passive recreation activities are permitted, where they do not negativity impact upon the conservation values being protected, and only after permission is granted by Yancoal and a risk assessment is completed and approved.

The residences within the BA may be leased to provide increased security to deter detrimental activities such as illegal harvesting of firewood, rubbish dumping and hunting. The residences are outside the offset areas and the lease arrangement will provide clear directions to ensure protection of the BA.

4.1.5 Cultural Heritage

No cultural heritage sites will be disturbed by any management actions implemented through the provisions of this Plan. Any identified cultural heritage sites or values have been recorded and will be managed to ensure their protection.

4.1.6 Waste

Periodic waste removal to be completed as required.

4.1.7 Performance Criteria

Controlled Activities	Annual Criteria from Year 1 to Year 10
Prohibited actions	No reported incidents of prohibited actions undertaken by Yancoal, contractors, consultants or other agents of Yancoal.
Exemption of clearing vegetation	Any clearing of vegetation reported in Annual Report.
Access	Signage and locks (where required) maintained.
Recreation and residences	Completed risk assessment for any recreation activities. All occupants of residences compliant with requirements of the Plan
Cultural heritage	No Cultural heritage sites knowingly disturbed and any protective barricading maintained.
Waste	Removal as required.
Monitoring	All Property Inspections (Section 5.4) completed.

4.1.8 Trigger, Response and Action plan

Trigger	Response and Action
Damage to conservation values by persons undertaking controlled activities – reported through Management Monitoring (Section 5.4) or other visitors to the BA.	Report incident to relevant authority within 30 days. Include incident report in the Annual Report complete self-assessment of the significant residual impact from the damage. In situations where there is assessed to be a significant residual impact a rehabilitation plan including active and or passive restoration works is to be prepared and implemented. Review security measures and offset induction procedure.

4.2 Management of grazing for conservation

Strategic grazing will be used as a management tool to promote regeneration, control weeds, and reduce excessive fire fuel loads. Strategic grazing is preferred because the short duration and intensive regimes that prevent or minimise selective grazing and thereby ensure that overall gains in biodiversity can be achieved.

Grazing will be excluded from the Northern BA, except to improve conservation values or reduce fire risk. Grazing will only be implemented where prescribed by the biodiversity auditor or BioBanking accredited assessor. The trigger point to cease grazing will be less than 70 % ground cover (i.e. no greater than 30% bare ground) and average height of ground cover of less than 12cm (approximately 2500kg dry matter per/ha). The trigger point will be measured using the following quadrat sampling method for ground cover and herbage mass (Lang 2005) by the Biodiversity Auditor:

Using a wooden or metal square (quadrat) of at least 0.5m x 0.5m internal dimensions, undertake the following steps:

a. Walk at random path within each area to be assessed and throw the quadrat a short distance.

b. For each throw look only at the area within the quadrat and assess and record the following:

   A = the percentage of total pasture cover (living and dead);

   B = the percentage cover of live native plants;

   C = the percentage cover of live non-native plants; and

   D = measure height of pasture cover using Meat and Livestock Australia Pasture Ruler to estimate herbage mass.

c. Take at least 10 random samples for each assessment area (the number of sample will be increased by 1 for each addition 5ha for areas greater than 50ha).

d. Calculate the percentage of the assessment area covered by vegetation (living or dead): Sum of A / Number of samples.

e. Calculate the percentage of the living vegetation that is live native groundcover by: (Sum of B x 100) / (Sum of B + Sum of C).

f. Calculate average mass by: Sum of D / Number of samples.

This quadrat data will be provided for the commencement and at the completion of grazing in the annual reports along with the following information:

- livestock movement including dates of entry and removal from the grazing area;
- a map of the grazed offset area;
- number of livestock, type and condition;
- quantity of supplement (if any);
- any livestock health or other management issues; and
- daily rainfall data.

Grazing periods will not exceed four weeks and temporary watering points and fencing will be used to protect sensitive areas, such as planting areas.

4.2.1 Performance Criteria

Strategic Grazing	Annual Criteria from Year 1 to Year 10
Grazing	Grazing is conducted in accordance with this Plan and reported in annual report
Unauthorized stock grazing is prevented	Boundary fences maintained
Monitoring	Complete Rapid Condition Assessment and Property Inspections (Section 5.4)

4.2.2 Trigger and Response

Trigger	Response and Action
Fence damaged and not excluding stock from neighbouring property– impact reported through Management Monitoring (Section 5.4) or visitor to BA.	Repair fence within 15 days and inspect fence at least one month after repair completed and continue Management Monitoring. Return stock to owner and discuss the importance of maintaining stock exclusion from the offset area and options to improve the efficacy of the fencing.
Over grazing – groundcover less than 70 % ground cover and average height of ground cover of less than 12cm as reported by Ecological monitoring or trigger point exceeded under strategic grazing.	Undertake ground cover survey, advise auditor and determine whether/not the trigger values are exceeded (ie less than 70% groundcover, less than 12 cm height). If confirmed remove stock from affected management area.
Biodiversity Audit recommends strategic grazing is required to reduce weed competition and / or encourage regeneration of native plants when completing Ecological Monitoring.	Biodiversity auditor or BioBanking accredited assessor to prepare plan to implement strategic grazing to control weeds, manage fire hazard and/or encourage regeneration. Record and report all strategic grazing activities and outcomes.
Neighbour raises concerns over high biomass increasing fire risk - observed high levels of biomass/grass prior to fire season.	Review monitoring reports and Bushfire Management Plan. Discuss appropriate course of action with neighbour and Rural Fire Service. Review and update Bushfire Management Plan.

4.3 Weed Control

Control of weed species is critical to restoring the natural species composition, diversity and structure of the vegetation communities across the BA. Weeds are typically non-indigenous plants that invade areas after significant disturbance, such as land clearing or over grazing. Weed control will focus on species that exclude or have the potential to exclude native species, disrupt recruitment of native species, impede ecological processes, or impact native animals.

The aim of weed control is to incorporate a variety of control methods and reduce the reliance on herbicides to keep un-infested areas clear of weeds and control the spread of existing weed infestations.

4.3.1 Control areas

There has been ongoing weed control actions since 2006 within the Northern BA and actions in this Plan have been informed by this this work. Weed control efforts will be focused on targeted weed species and to limit weed dispersal from tracks. Weed containment zones of 50m from the tracks will be maintained. Any weeds outside of these areas will be controlled based on the observations from the monitoring programme. The weed control areas are shown in Figure 6 along with the observation of noxious weeds

from all of the BioBanking assessment data collected in 2014 to further target control efforts.

4.3.2 Control methods and target weed species

An integrated weed management approach will be implemented utilising a range of suitable control methods that include:

- biological control - a long term technique;
- herbicide control - a short to medium technique;
- land management – a medium to long term technique; and
- manual control – a short term technique.

The preferred control methods are described in Table 13.

All noxious weeds declared under the *Noxious Weeds Act 1993* will be given priority for weed control. In addition, environmental weeds and/or exotic plants recorded with a relatively high Braun-Blanquet (BB) cover abundance ranking (Braun Blanquet 1928) will also be controlled only where they pose a risk to native species recruitment particularly of native grasses.

The BB cover abundance ranking included:

1 = < 5% (rare number of individuals);

2 = < 5% (species common at the site);

3 = 5 – 25%

4 = 26 – 50%;

5 = 51 – 75%; and

6 = 76 – 100%.

Table 14 lists the target weed species to be controlled, their declaration class under the *Biosecurity Act 2015* or nomination as a Weed of National Significance (WON), control methods, timing and intensity required to manage these weeds, based on the *NSW Department of Primary Industries Noxious and Environmental Weed Control Handbook* (NSW DPI 2014). The photos have been sourced from http://weeds.dpi.nsw.gov.au/ . Should a control event not be required or conditions are unsuitable (due to dry plants under stress) then evidence this will be provided in the Annual Report.

The use of chemicals in the BAs will be undertaken by suitably qualified, accredited and experienced personnel (bush regenerators) with specific experience in native plant and weed identification and management. All chemical weed control will be in accordance with the registered label or current minor use permit, Safety Data Sheets and appropriate safety standards. Chemical use in the vicinity of waterways will be restricted to herbicides and adjuvants registered for use in or near aquatic environments.

Chemical weed control operations pose a substantial risk to successful natural regeneration processes unless carefully planned, implemented and monitored. Planning considerations relevant to weed control operations in natural or assisted revegetation areas include:

- Selection of personnel based on demonstrated experience and skill in selective weed control methods in regeneration areas; and
- Timing of proposed application in relation to recent or planned revegetation works.

Weed control areas at the Northern Biodiversity Area

Management Plan 2022

Figure 6

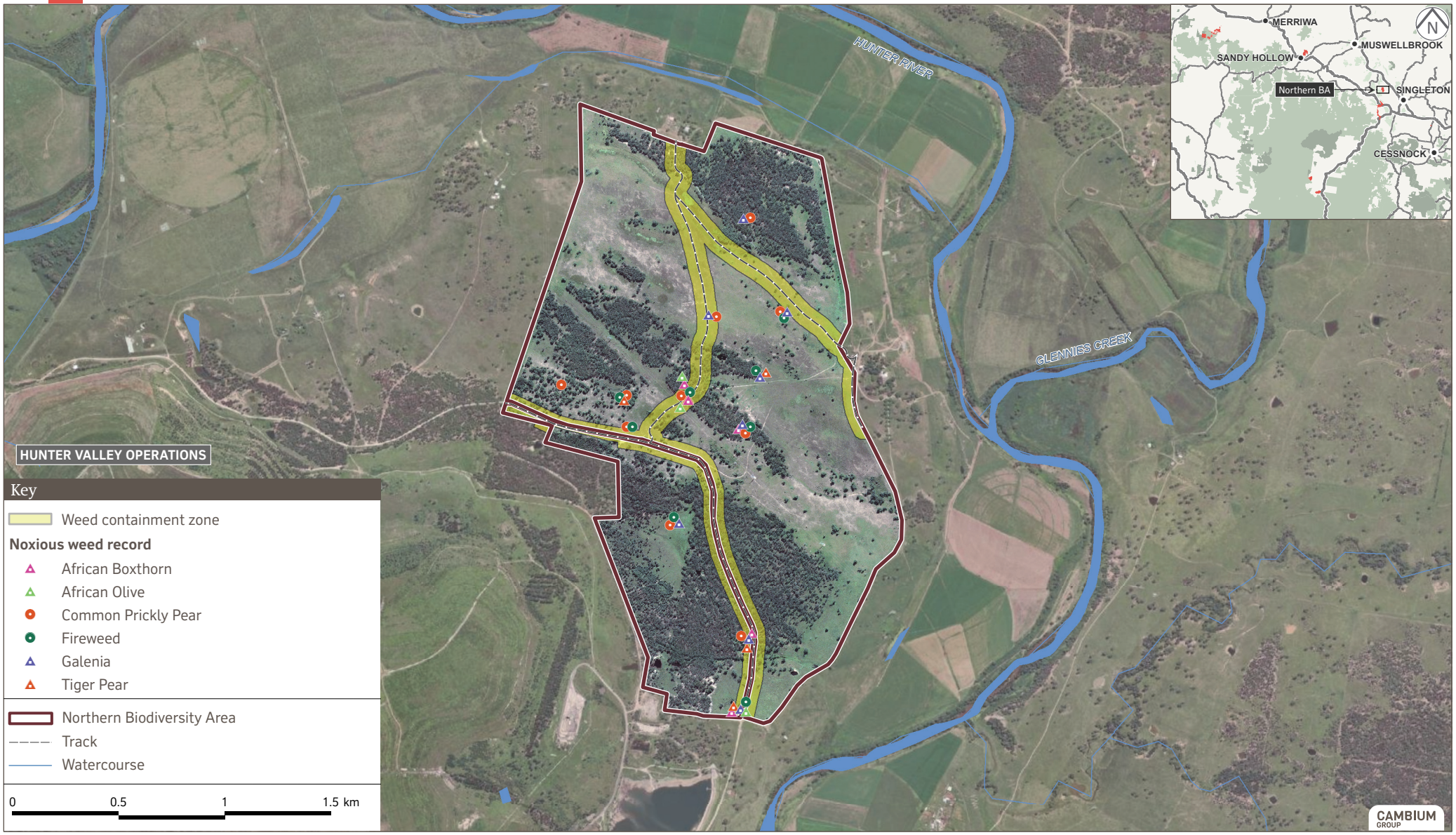

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Table 13 Weed Control Methods

Control Method	Potential use in control regime
Chemical Control – is the application of chemicals to kill the weed by interfering in the plants growth processes.	Spot application of herbicide is the preferred method of application. Boom spray application is permissible as part of ground preparation for re-establishment activities. Areas that cannot be accessed safely by ground based methods the use of Unmanned Aerial Vehicles (UAV) can be used. **Herbicides:** Only registered herbicides will be used for the control of the weed species and used in accordance with the directions on the label. Users have a legal obligation to read and follow the instructions on the label. Where appropriate, selective herbicides will be used to minimise impacts on native vegetation. **Handling and application:** Herbicide is to be applied to actively growing plants. Herbicides must be handled and applied with consideration of their toxic nature and potentially harmful effects on human health, livestock and the environment. Only accredited and trained in the identification of native plant operators are permitted to apply herbicides. During application weather condition, nozzles, equipment and operator are to be closely monitored throughout application to reduce the risk of drift and subsequent off- target damage. Coarse to very coarse nozzles will be used to increase droplets size. Suitable weather conditions for spraying are extremely important. Weather guidelines • Read the product label and follow all label instructions. • Spray when wind is steady and ideally 3–15 km/h. • Avoid variable or gusty wind conditions. • Avoid calm conditions - small droplets remain suspended for long periods. • Spray when wind blows away from sensitive areas. • Avoid spraying in temperatures above 28 °C. • Aim to spray when Delta T is between 2 and 8 and not greater than 10. • Do not spray when inversion conditions exist. • Aim to spray when the atmosphere is neutrally stable. • Most chemicals require a rain free period – check the label. • Be aware of local topographic and convective influences on wind speed and direction. • Record on-site weather conditions at spray time. For more detail please refer to www.bom.gov.au/info/leaflets/Pesticide-Spraying.pdf. **Reporting:** All commercial pesticide users (that includes farmers, leaseholders and spray contractors) must keep records on their pesticide application.
Land Management – good land management practices can reduce the incidence and impact of weeds.	**Weed hygiene:** All machinery will be cleaned and washed down to reduce the spread of weed seed. Livestock being introduced to a BA will be quarantined for several days, so any potential weed seeds can pass through their system in a known area and be treated later. **Weed Identification:** Yancoal staff and other key stakeholders visiting the BA will be required to report any new infestation of weeds.
Grazing management	Grazing may be used to control weeds subject to not meeting or exceeding ground cover trigger values (section 4.2) and there is evidence the weed species are preferentially grazed by stock. Spray graze - applying a hormone herbicide and grazing 7-10 days later. Other grazing management practices that are recommended by the Biodiversity Auditor or the Hunter Local Land Services (HLLS).
Biological Control – is a long term control technique.	This is a complementary strategy and alone it may not eradicate the weed. Any use of biological controls will be undertaken in conjunction with advice from DPE-EES and the HLLS.
Slashing – mechanical cutting of weeds to prevent seed production	Areas heavily infested with exotic grasses can be treated with slashing equipment mounted on a tractor prior to flowering (likely to be late spring/ early summer).
Manual removal – removal of the weed plant and roots from the site.	Physical removal of new weeds, unearthing of root systems and containment and removal of seed.

Table 14 Target weed species, treatment method, control period and intensity

Species	Photo	Class *	WON	Distribution	Control method/s	Control period and intensity
WOODY WEEDS						
African Boxthorn (*Lycium ferocissimum*)		3	✓	Average BB cover abundance score 1 (<5% - rare to common)	Spot spray, basal bark or cut stump application with registered herbicide Mechanically remove mature bushes/thickets when soil is wet (winter) and spray regrowth	Late winter to early summer From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Cotoneaster (*Cotoneaster pannosus)*				Average BB cover abundance score 1 (<5% - rare to common).	Basal bark or cut stump application with registered herbicide Manual removal by–hand pulling individual plants	Actively growing From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Green Cestrum (*Cestrum parqui*)		3			Spot spray, basal bark or cut stump application with registered herbicide.	Late spring to early autumn From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
PRICKLY PEARS						
Common Pear (*Opuntia stricta*) Creeping Pear (*Opuntia humifusa*) Tree pear (*Opuntia tomentosa)* Tiger pear (*Opuntia aurantiaca*)	 *	4	✓	Average BB cover abundance score 2 (>5% - common)	Spot spray with registered herbicide. Biological control (Cactoblastis (*Cactoblastis cactorum*) and Cochineal (*Dactylopius spp.*) – better suited to large infestations or inaccessible areas.	All year – control period. From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.

Species	Photo	Class *	WON	Distribution	Control method/s	Control period and intensity
						
PASTURE / ANNUALS						
Fireweed (*Senecio madagascariensis*)		4	✓	Average BB cover abundance score 2 (>5% - common).	Spot spray with registered herbicide whilst the plant is actively growing and not under stress. Manual removal by–hand pulling individual plants	Autumn to Spring - control period. From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Galenia (*Galenia pubescens)*		4		Average BB cover abundance score 2 (>5% - common)	Spot spray with registered herbicide. Manual removal by– digging or chipping out main root tuber.	Spring/ Summer From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Red Natal Grass (*Melinis repens*)				Average BB cover abundance score 1 (<5% - rare to common)	Spot spray or boom wick-wiper with registered herbicide. Slashing.	Spring/ Summer - Actively growing From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.

*Control Class	Weed type	Example control requirements
Class 1	Plants that pose a potentially serious threat to primary production or the environment and are not present in the state or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also 'notifiable' and a range of restrictions on their sale and movement exist.
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also 'notifiable' and a range of restrictions on their sale and movement exist.
Class 3	Plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.*

Class 4	Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.*
Class 5	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.	There are no requirements to control existing plants of Class 5 weeds. However, the weeds are 'notifiable' and a range of restrictions on their sale and movement exist.

The impact of weeds will be assessed through the ecological monitoring programme. This information will be used to monitor the success of the weed control methods.

4.3.3 Performance Criteria

	Year 1 to Year 4	Year 5 to Year 10	Completion Criteria
Weed control	At least two weed control events each year for species listed in Table 14, and any other weeds recorded from monitoring activities. All actions recorded in the Annual Report.	At least one weed control event each year for species listed in Table 14, and any other weeds recorded from monitoring activities. All actions recorded in the Annual Report.	Ecological monitoring data indicates a trajectory for reduction in exotic plant cover over three consecutive assessments.
Monitoring	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4).	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	

4.3.4 Trigger, Response and Action plan

Trigger	Response and Action
Weeds having detrimental impact - Ecological Monitoring results indicate low native plant recruitment and regeneration and / or no trajectory to benchmark values and increase in exotic plant cover.	Increase the number of weed control events. Suitably qualified and experienced person to review weed control action. Revise the Plan.
New noxious and/or environmental weed is identified within BA.	Notify Government Agency and neighbours of new noxious and/or environmental weed outbreak. Implement new hygiene controls. Review Plan. Follow all directions given by relevant government agency to assist in control.

4.4 Management of fire for conservation

Bushfire prevention is required under the *Rural Fires Act 1997* and a fire regime is required to maintain ecological condition and reduce the risk of damage from wildfire. The absence of fire and the reduction of livestock grazing may lead to a build-up of fire fuel and risk of high intensity bushfire. The land manager is required to take practicable steps to prevent the occurrence of bush fires on the land and minimise the spread of bushfire.

Yancoal, with assistance from the Hunter and Liverpool Range Rural Fire Services, has prepared the Mount Thorley Warkworth Bushfire Management Plan, that covers the Northern BA given its close proximity to Warkworth Mine, it identifies fire risks, control measures and communication procedures. A copy of this plan is available on the Biodiversity Offsets Portal.

The quick identification of a threatening bushfire, notification of the Rural Fire Service and suppression is the primary goal.

Key control measures include:

- documentation of access and water supply points for suppression activities;
- maintain safe and clear access tracks that also form fire breaks;
- use of grazing to reduce fuel build-up along potential ignition sources, such as public roads, prior to the fire season;
- use of ecological burns (with any required approvals and/or permits from Rural Fire Service) to reduce fuel build-up to protect the conservation values;
- establishment of asset protection zones around priority infrastructure;
- investment in water and other fire suppression assets; and
- communication of the Bushfire Management Plan and response procedures with key stakeholders, including Leaseholders, neighbours, consultants, contractors and employees.

Key management and safety restrictions for total fire ban and very high fire danger rating days include:

- no working alone;
- travel plans on these days are to be communicated to staff or family member, so you can be located in the case of an emergency; and
- no contractor, consultant or visitor access or undertaking 'hot works', unless these activities are required for firefighting purposes.

Any fuel hazard reduction burns will be planned in accordance with the Bush Fire Environmental Assessment Code for New South Wales (Rural Fire Service, February 2006) and the guidelines contained in the Threatened Species Hazard Reduction Lists for the Bush Fire Environmental Assessment Code.

Recommendations under the Code are:

- in woodland vegetation, fire should not occur within 5 years of a previous fire and consideration should be given to burning within 40 years of any previous fire; and
- in grassland vegetation derived from the woodland vegetation, the recommended fire intervals are the same as woodland vegetation.

There is no reported history of wild fire at Northern BA. Based on the Code recommendations an ecological burn will be completed across MZ1 and MZ3 within the next 10 to 40 years, unless otherwise specified by the Biodiversity Auditor. Generally fire will be excluded from this offset area in the long term, due to large proportion of grassland and proposed planting.

All ecological burns are dependent upon suitable climatic conditions and appropriate level of risk. The advice of a suitably qualified person experienced in ecological fire management will be required to plan and implement the ecological fire management plan, including a post fire monitoring programme to specifically assess the impact of the ecological burn. Any burns are to be scheduled to occur when conditions are suitable for a low intensity burn. Typically this is winter or early spring. Burning will also be scheduled prior to a significant rain event to assist in the extinguishing the fire.

Data is to be recorded for all ecological burns including the date and intensity of the fire, the area burnt (shown on a map) during fire, any canopy scorch and percentage of leaf litter remaining. Any additional damage, including fire breaks or new tracks, must also be recorded.

No burning is recommended for MZ2 and MZ4 (post planting). Records will be made if any of these areas are burnt during an ecological burn.

4.4.1 Performance Criteria

	Year 1 to Year 4	Year 5 to Year 10	Completion Criteria
Bushfire Management Plan (BFMP)	Actions implemented Review and revise if required.	Actions implemented Review and revise if required.	All required actions of BFMP have been implemented BFMP has been reviewed annually and revised if required.
Monitoring	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	

4.4.2 Trigger, Response and Action plan

Trigger	Response and Action
BA impacted by wildfire.	Map fire damaged area. Prepare fire restoration plan to reinstate infrastructure and monitor post fire to evaluate regenerative capacity and regeneration. Suitably qualified and experienced person to review BFMP. Revise the Plan to include actions from the fire restoration plan.
Post fire monitoring results indicate a reduction in native plant cover and increase in exotic cover.	Evaluate active regeneration, increase in weed control and implement supplementary planting. Revise Plan.

4.5 Infrastructure improvement

Construction of new or maintenance of existing infrastructure (such as access tracks/ fire breaks, fences, off-stream watering points or pipes and removal of dam structures) will be required to maintain safe access to complete weed and feral animal control, fire management, and monitoring activities.

Infrastructure improvement action may cause localised site disturbance.

During the construction or maintenance of infrastructure the following guidelines apply:

- Vegetation clearing is only permissible for actions that are required to achieve the objectives of the Plan:
  - (a) permanent boundary fence - three metres either side;
  - (b) permanent internal fence - six metres total width of clearing;
  - (c) temporary fence - six metres total width of clearing; or
  - (d) road or track - six metres total width of clearing.
- constructed fences will be stockproof;
- standing timber that poses an unacceptable safety risk can be felled and retained on ground as habitat;
- standing timber that poses an unacceptable safety risk can be felled;
- all works will be undertaken in a manner that minimises disturbance to soil and hydrological characteristics, and avoids erosion, as per OEH guidelines Erosion and Sediment Control on unsealed roads (OEH 2012);
- old fences will be removed and unwanted tracks closed and rehabilitated within the offset area; and
- site disturbance will be required to facilitate certain revegetation activities, such as soil cultivation and slashing.

4.5.1 Performance Criteria

	Annual Criteria from Year 1 to Year 10
Infrastructure improvements	Completed GDP for all infrastructure improvement actions. Maintenance of tracks and fences completed at least every 3 years.
Monitoring	Property Inspections (Section 5.4)

4.5.2 Trigger, Response and Action plan

Trigger	Response and Action
Unauthorised clearing of vegetation	Report and review incident within 30 days. Complete significant residual impact assessment of the incident. For incidents with a significant residual impact a rehabilitation plan is to be prepared and implemented. Review the Plan.
Fencing continually damaged by flood waters.	Replace fence with floating fences or re align fence. Update the Plan.

4.6 Maintenance or reintroduction of natural flow regimes

Artificial structures on waterways or waterbodies restrict natural flows, however dams and habitat ponds support strategic grazing and other management actions. All dams were excluded from the mapping of the offset area as specified by BioBanking assessment guidelines.

There are 2 dams located within the Northern BA these will be retained to provide habitat for native fauna.

4.7 Retention of regrowth and remnant native vegetation

Remnant native vegetation and regrowth is important as it is the key component of the BA. The retention of this native vegetation and its regrowth is important to maintain and enhance the conservation value of the offset area.

Natural regrowth of remnant vegetation will be preferentially retained to promote recovery of native vegetation. Dense patches of native regrowth will be allowed to self-thin unless new plantings require regulated control.

Exceptions to this rule include maintenance of fence lines and management tracks associated with the BA (Section 4.5).

4.7.1 Encourage natural regeneration

The woodlands across the BA have been impacted by agriculture and the native plant diversity, community structure and habitat values have been degraded. Consequently, re-instating/restoring these components will aim to:

- increase native mid-storey cover,
- increase native ground cover (herbs, ferns, lilies, rushes, sedges), and
- maintain woodland canopy cover.

The regenerative potential is substantial and natural regeneration is already evident in many areas, particularly where grazing pressure has been removed/substantially reduced. In the absence of disturbance, these areas are likely to regenerate with minimal assistance. Low to moderate management intervention is required in this region and will be implemented in accordance with the management actions outlined in this Section.

4.7.2 Performance Criteria

	Year 1 to Year 10	Completion Criteria
Natural regeneration	Annual weed control, vertebrate pest and fire management actions implemented as per management plans	Ecological monitoring demonstrates a trajectory to benchmark values for all attributes measured over three consecutive assessments (the average of all plots).
Monitoring	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4).	

4.7.3 Trigger, Response and Action

Trigger	Response
No active regeneration and native plant recruitment within 5 years in MZ1 and MZ3 recorded through the ecological monitoring, indicated by no trajectory towards benchmark ranges.	Consider planting actions and revise the Plan. Planting actions to be considered include direct seeding, tube stock planting of species selected from the description of the plant community type, details of the methodology and maintenance to be included in the revised Plan.
Single species and age class domination constraining species diversity observed by Ecological Monitoring (Section 5.3)	Prepare ecological thinning plan to increase species and age class diversity. Implement ecological thinning plan and revise this Plan.

4.8 Supplementary planting

To increase the extent and condition of woodland, active restoration through planting is to be undertaken in the following grassland areas:

- MZ4: Warkworth Sands Woodland (WSW) (H872 Low); and
- MZ2: Central Hunter Grey Box Ironbark Woodland (CHGBIW) (HU817 Low).

The re-establishment process will adopt where possible a shelter belt approach, with planting confined to strips that run perpendicular to the prevailing wind direction or patches close to remnant woodland. This approach aims to create micro climates that will encourage and support natural regeneration between the strips / patches. It minimises site disturbance to avoid damage to existing regeneration and enables natural and sustainable regeneration to increase connectivity.

Figure 7 indicates the location of planting areas. All planting is to occur when suitable climatic conditions prevail. The proposed planting schedule is shown in Table 15..

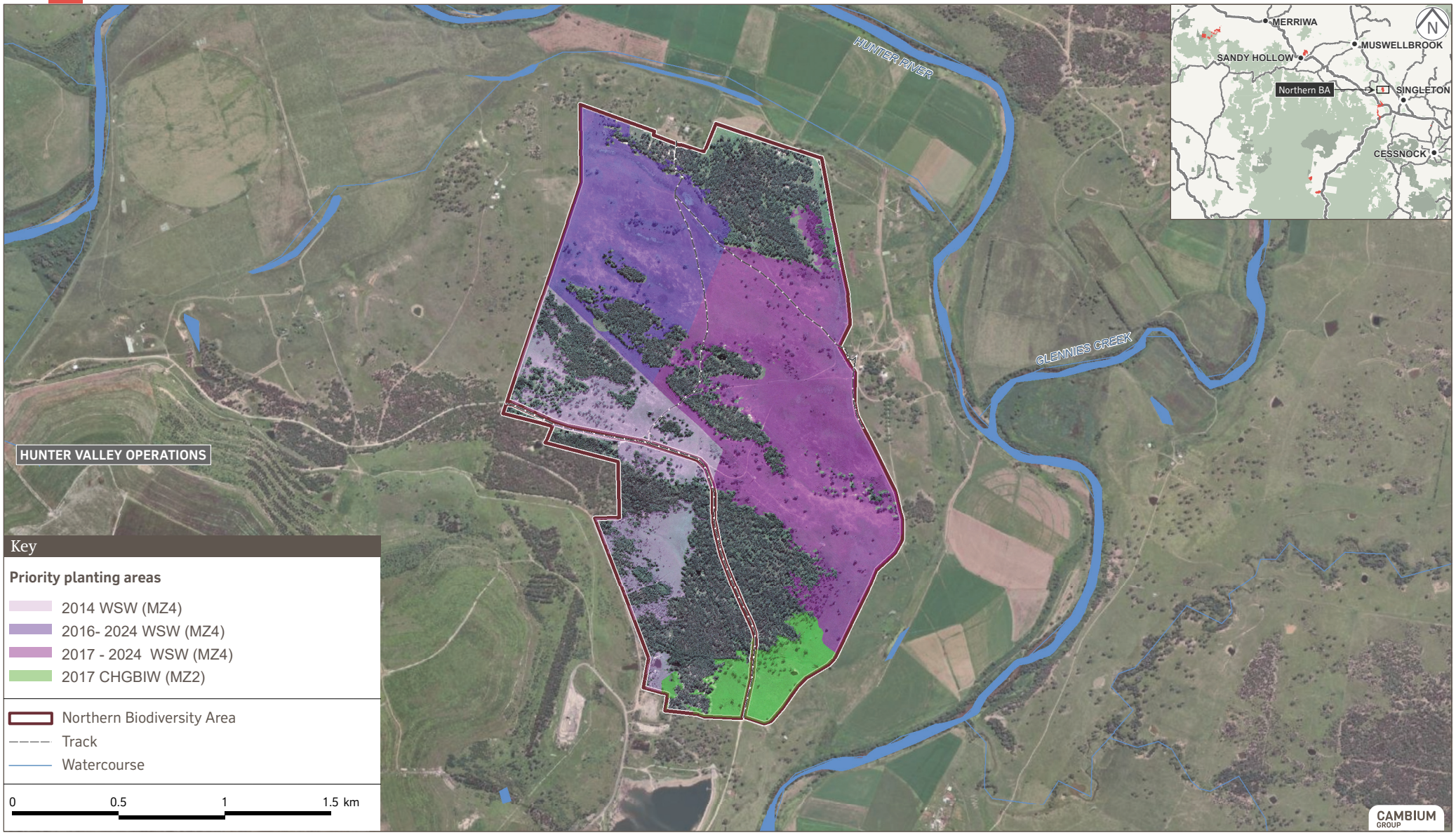
Table 15 Planting schedule

Id	Year	Timing	Area (ha)	Community	Comments
2014WSW	2014	Spring	14	WSW (MZ4)	Maintenance only
2016WSW	2016	Autumn	14	WSW (MZ4)	Maintenance only
2017WSW	2017	Autumn	7	WSW (MZ4)	
2017CHBGIW	2017	Autumn	23	CHGBIW (MZ2)	
2020WSW	2020	Autumn	15	WSW (MZ4)	
2021WSW	2021	Autumn	20	WSW (MZ4)	
2022WSW	2022	Autumn	29	WSW (MZ4)	
2023WSW	2023	Autumn	30	WSW (MZ4)	
2024WSW	2024	Autumn	27	WSW (MZ4)	

Planting areas at the Northern Biodiversity Area

Management Plan 2022

Figure 7



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4.8.1 Translocation of salvaged resources and composted mulch

Two key observations were made following the application of topsoil and composted mulch in the 2014 planting operations. The first was that the application of composted mulch visibly increased the growth of annual weeds, impacting short term survival but possibly providing longer term growth benefits. The application of topsoil initially indicated in 2015 no benefits through natural recruitment in the topsoil seed bank, however in 2016 natural recruitment of *Pimelea linifolia* was visibly evident within the strips as shown in the following photo. It has been concluded that the application of topsoil is beneficial to re-establishment actions.

To reflect these findings the guidelines from the Local OMP have been amended to include selection criteria for topsoil and the omission of composted mulch.

Photo: Strip application of topsoil in Northern Biodiversity area in spring 2016 after planting in spring 2014.

Resources salvaged from areas to be cleared for mining activity, such as topsoil (includes green mulch from site), timber and plant material, are considered valuable resources for the re-establishment of a similar vegetation community in a different location. It provides an opportunity to transfer ecological characteristics to the re-establishment site to support natural regeneration, such as seed sources and microbial soil organisms. The use of these materials is dependent upon their availability and will be used when safe and practical.

The following outlines critical factors in the use and management of these resources:

- Topsoil management:
  - Stockpiling of material is to be avoided where possible.
  - To translocate the majority of seed it is recommended that the top ten centimetres is scalped.
  - Complete assessment of the in situ vegetation community in the area where the topsoil is to be sourced. The following performance measures and criteria are to be used as a minimum standard to assess the potential value of the topsoil to be targeted as a resource salvageable as a potential seed source.

Measure	Criteria
Weed species	Absence of noxious weeds
Ground cover	<10% weed species
Suitable growing media	Presence of A horizon in soil profile
Native species are producing seed	Evidence of recruitment of native flora; presence of fruit/ seed

- Timber:

- Large trees, with their branches intact and roots removed, are to be relocated to provide seed sources, habitat augmentation and protect the soil to create an improved micro climate for restoration.

- Plant material:

- Seeds, cuttings and plants will be salvaged from the disturbance area to further assist in the establishment of ecological characteristics in the re-establishment areas. Species that are known to be difficult to grow from seed will be targeted for cuttings and transplanting from the disturbance areas.

- Seed for planting and seeding activities in the BAs and rehabilitation areas is from local or endemic provenances, however provenance seed from other areas can be used to increase genetic diversity to increase resilience to climate change. To support the BA re-establishment programme, viable seed will be collected prior to clearing vegetation, when it is safe and practical.

4.8.2 Seed collection

It will be permissible to collect seed from remnant patches of ecological communities across the BA. However seed collection must be for non-commercial purposes and meet the standards of the "Guidelines and Codes of Practice" developed by Florabank (www.florabank.org.au), or subsequent equivalent, and the following limitations and permissions apply:

- Collect seed in the BA only if seed of the particular species and genotype is not available elsewhere or if the seed collected is intended for seedlings that will be planted within the BA;
- Seeds may be collected from within endangered ecological communities;
- Seeds may not be collected from species individually listed on schedules 1, 1A or 2 of the TSC Act without prior written approval from the Director General, or under a licence granted under S132c of the Act or S91 of the TSC Act;
- Seeds may be collected from any protected species listed under Section 131 (Schedule 13) of the TSC Act; and
- Seeds may be collected from any other native species.

Species for seed collection will be based on the description provided in Section 2 and the following species list.

4.8.3 Species list

These species lists include species collected locally from BA and species that are listed in the relevant vegetation community species assemblage.

Table 16 lists the WSW species for planting in 2017, 2020, 2021, 2022, 2023 and 2024. Selection of these species was based on results of planting trials on Warkworth sands. The distribution of the planting will include 60% canopy, 20% mid canopy, 10% shrubs and 10% ground cover species.

Table 16 Warkworth Sands Woodland species planting list

Scientific Name	Common Name	Estimated tubestock 2017	Estimated tubestock 2020	Estimated tubestock 2021	Estimated tubestock 2022	Estimated tubestock 2023	Estimated tubestock 2024
Canopy		**9,000**	**3,600**	**6,600**	**10,260**	**12,330**	**12,630**
Angophora floribunda	Rough-barked Apple						
Banksia integrefolia Subsp. integrefolia	Coast Banksia						
Eucalyptus blakelyi/tereticornis	Forest Red Gum						

Scientific Name	Common Name	Estimated tubestock 2017	Estimated tubestock 2020	Estimated tubestock 2021	Estimated tubestock 2022	Estimated tubestock 2023	Estimated tubestock 2024
Eucalyptus crebra	Narrow-leaved Ironbark						
Mid canopy		**3,000**	**1,200**	**2,200**	**3,420**	**4,110**	**4,215**
Acacia filicifolia	Fern-leaved wattle						
Allocasuarina littoralis	Black She-oak						
Allocasuarina luehmannii	Bulloak						
Brachychiton populneus	Kurrajong						
Shrubs		**1,500**	**600**	**1,100**	**1,810**	**1,025**	**1,592**
Breynia oblongifolia	Coffee Bush						
Bursaria spinosa subsp. spinosa	Blackthorn						
Grevillea montana							
Hibbertia linearis	Guinea Flower						
Melaleuca thymifolia							
Ground cover		**1,500**	**600**	**1,100**	**1,810**	**1,025**	**1,592**
Calotis cuneifolia	Purple Burr-daisy						
Dianella revoluta	Blueberry Lilly						
Einadia nutans	Climbing Saltbush						
Lomandra confertifolia	Mat rush						
Vittadinia cuneata	Fuzzweed						

Table 17 lists the CHGBIW species for planting in 2017 and 2018. The distribution of the planting will include 60% canopy, 20% mid canopy, 10% shrubs and 10% ground cover species.

Table 17 Central Hunter Grey – Box Ironbark Woodland species planting list

Scientific Name	Common Name	Estimated tubestock 2017
Canopy		**6,930**
Angophora floribunda	Rough-barked Apple	
Eucalyptus blakelyi/tereticornis	Forest Red Gum	
Eucalyptus crebra	Narrow-leaved Ironbark	
Eucalyptus moluccana	Grey Box	
Mid canopy		**2,310**
Acacia Implexa	Lightwood	
Allocasuarina luehmannii	Bulloak	
Brachychiton populneus	Kurrajong	
Melaleuca decora		
Shrubs		**1,155**
Acacia amblygona	Fan wattle	
Acacia falcata	Sickle wattle	

Acacia salicina	Cooba
Breynia oblongifolia	Coffee Bush
Bursaria spinosa subsp. spinosa	Blackthorn
Cassinia quinquefaria	Cough Bush
Dodonaea viscosa	Hop Bush
Ground cover	**1,155**
Calotis cuneifolia	Purple Burr-daisy
Dianella revoluta	Blueberry Lilly
Einadia nutans	Climbing Saltbush
Lomandra multiflora	Many-flowered Mat-rush
Vittadinia cuneata	Fuzzweed

4.8.4 Planting method

Table 18 lists the key planting criteria to increase the likelihood of planting success.

Table 18 Key planting criteria

Activity	Minimum requirement
Soil test	Complete soil test across planting site to identify soil deficiencies or impediments for plant growth
Species selection	Species selected are species listed on the description of the vegetation communities issued by the NSW Scientific Committee or NSW government description. Seed can be collected from site or regionally from equivalent vegetation communities.
Cultivation	Cultivation for tube stock planting will be to a depth of 500-600mm at least 6 months prior to planting and when soil moisture is low to improve sub surface soil shatter, this is not required on sand sites. Cultivation for direct seeding may include light soil scarification.
Preplant weed control	Chemical control of weeds at least 1 week prior to planting or seeding. An area of at least 1m diameter around each tree or seeding patch is to be sprayed to remove all competition for site resources.
Tube stock planting	Planting will only occur when there is suitable soil moisture, typically 1 -2 days after 25mm of rainfall, in spring or autumn. Tube stock is to be at least 25mm in height, with a well-established root system and in good condition. The tube stock root plug is to be saturated at the time of planting. Soil conditioner is to be applied into the planting hole and all plants will be planted deep, with their root plug at least 50mm below ground and gently firmed in to remove any air pockets in the soil. The spacing of tube stock planting will occur in rows or clusters to create appropriate shelter effects at approximately 400 stems per hectare.
Direct seeding	Seed is to be free of weed seed. Seeding must only occur when there is suitable soil moisture, typically 1 -2 days after 25mm of rainfall, in spring or autumn. Control of ants prior to seeding to reduce the impact of seed removal.
Watering	Watering is to occur at the time of planting or seeding, and if required for 6 months post planting.
Maintenance	Maintenance period will apply for at least 18months, including post plant weed control.
Replanting	Where the survival of tubestock is less than 70% the area will be replanted.

All planting activities are dependent upon suitable climatic condition and may be postponed. If this occurs, weather records will be reported to support any delay in activities.

4.8.5 Survival assessments

Survival assessments are to be completed at 3 and 6 month post planting to assess the success of tubestock planting. Details of the monitoring programme are provided in Section 5.

4.8.6 Performance criteria

	Year 1 to Year 5	Year 6 to Year 10	Completion Criteria
WSW planting (195ha)	Collection of seed. Plant propagation. Tubestock planted. Completed survival assessment	Collection of seed. Plant propagation. Tubestock planted. Completed survival assessment Ecological monitoring completed.	Ecological monitoring demonstrates a trajectory toward the reference site or the benchmark values for HU872 for all attributes measured over three consecutive assessments (the average of all plots).
CHGBIW planting (23ha)	Collection of seed. Plant propagation. Tubestock planted. Completed survival assessment	Ecological monitoring completed.	Ecological monitoring demonstrates a trajectory toward the reference site or the NSW Biometric HU817 for all attributes measured over three consecutive assessments (the average of all plots).

4.8.7 Trigger, Response and Action plan

Trigger	Response and Actions
Average survival assessment less than 70%	Review planting activities, including soil test result, determine if poor survival due to climatic conditions or operational matters. Complete further site assessment if cause cannot be identified. Review Plan in light of finding and replant the area.
Ecological monitoring does not show trajectory toward reference site or the NSW Biometric benchmark.	Review adequacy of management actions, assess if performance can be attributed to factors that cannot be controlled. Consider review of completion criteria. Revise Plan to include suggested remediation actions.

4.9 Erosion control

Soil erosion occurs when vegetation has been removed exposing bare soils, making them susceptible to erosion where water flow is able to mechanically remove or disperse the soil. This often occurs along creek lines but can occur in bare paddocks where vegetation clearing or over grazing exposes bare soils. Bare soils in locations where high volumes of water occur can lead to severe soil erosion.

There is moderate potential for erosion to occur within the BA. Management options for erosion control include excluding grazing, controlling vehicle access, maintenance of tracks and rehabilitation of drainage lines, watercourses and riparian areas where erosion impacts are identified.

Erosion within the BA will be monitored through biannual inspections by Yancoal, as well as other observations recorded during the ecological monitoring programme. Appropriate erosion remediation measures will be undertaken in consultation with the HLLS and NSW DPE-EES.

4.9.1 Performance Criteria

	Year 1 to Year 10	Completion Criteria
Monitoring inspections and reports	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	

4.9.2 Trigger, Response and Action plan

Trigger	Response and Action
Active erosion observed through monitoring.	Install erosion control measures, within 30 days of detection of active erosion, undertake monitoring of the area over 12 months post event to ensure the site is stabilised. Repeat area inspections annually to monitor stability. Report and review incident, within 30 days. Review the Plan.

4.9.3 Salinity Control

Dryland salinity occurs where salt in the landscape is mobilised and redistributed closer to the soil surface or into waterways. This often occurs along creek lines and in bare paddocks where vegetation clearing or over grazing exposes bare soils. There is potential for dryland salinity to occur within the BA. Management options for salinity control include excluding grazing and active re-establishment of trees and shrubs where salinity impacts are identified. Visual assessments of land provides an indication of the severity of salinity.

Salinity within the BA will be monitored through biannual inspections by Yancoal, as well as other observations recorded during the ecological monitoring programme. Appropriate salinity remediation measures will be undertaken in consultation with the HLSS and DPE-EES.

4.9.4 Performance Criteria

	Year 1 to Year 10	Completion Criteria
Monitoring inspections and reports	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	

	Monitor for visual signs of salinity in the landscape and test salinity levels in soil samples where salinity is suspected

4.9.5 Trigger, Response and Action Plan

Trigger	Response and Actions
Active salinity observed through visual inspections and monitoring.	Soil samples indicate the salinity class is moderate to high. Revegetate saline areas and undertake monitoring to ensure the site is stabilized. Report and review incident, within 30 days. Review the Plan.

4.10 Vertebrate Pest and Overabundant Native Animal Control

Vertebrate pest species and overabundant native herbivores can pose a threat to native flora and fauna through degradation of habitat, competition for habitat resources, and direct predation.

The recovery plans for Swift Parrot and Regent Honeyeater list the following key threatening processes, which are relevant to the pest animal control across the BA:

- competition and grazing by the feral European rabbit;
- competition and habitat degradation by feral goats;
- competition from feral honey bees;
- environmental degradation caused by feral deer;
- predation by feral dogs;
- predation by the European red fox;
- predation by the feral cat; and
- competition from Noisy Miners / starlings.

This Plan will target the control of declared vertebrate pests and those causing environmental degradation at a regional and local level, and the opportunistic control of the species listed in Table 19. Other vertebrate pests, overabundant native herbivores, or noisy miners will be managed as required under a specific management plan prepared prior to their control. If the control event is not required or conditions are unsuitable then evidence will be presented in the Annual Report.

Under the *Local Land Services Act 2013* (LLS Act), species that are currently declared pests in NSW include rabbits, feral pigs and wild dogs. Pest Control Orders can be issued by the regulator to legally enforce land managers to control the species on their land. Land managers are defined as either owners or occupiers of the land. Occupiers of land in NSW are not obliged to control other vertebrate pest animals. However, these species may have significant negative impacts on the environment and agricultural production in many areas.

The *Game and Feral Animal Control Act 2002* requires the control of feral deer.

This Plan acknowledges that populations of vertebrate pests are determined by several factors such as topography, shelter, territorial behaviour and food availability. Property fences do not restrict pests, and control actions will not therefore be limited to artificial boundaries. Most vertebrate pests are highly mobile and can readily replace those that are killed on individual properties. A variety of control methods can be utilised provided they are:

- species specific (wherever possible);
- cause no or little damage to the natural environment;
- are humane;
- meet relevant Work, Health, Safety and Environment regulatory requirements; and
- are regularly monitored.

Control programmes are likely to be far more effective when coordinated with multiple landholdings. Yancoal will endeavour to work with the HLLS on regional control programmes and supported by local on ground control actions. Neighbours are to be

notified on local on ground actions to facilitate coordination of efforts and deliver more effective control.

Design and implementation of local controls will be guided by the National Codes of Practice (COPs) and Standard Operating Procedures (SOPs) produced by the Commonwealth Department of the Environment (available at www.feral.org.au). The COPs for each of the key pest animal species provides general information on best practice management, control strategies, species biology and impact, and the humaneness of current control methods. The SOPs describe management techniques and their application for these pest animal species, including a discussion of animal welfare impacts for target and non-target species. They also cover the health and safety aspects of management techniques.

Table 19 Identified Vertebrate Pests control methods, timing and intensity

Pest	Declared	Control methods	Control timing and intensity
European rabbit (*Oryctolagus cuniculus*)	Yes	Baiting: 1080 / Pindone Trapping: cage trap Shooting: ground based Biological: Myxomatosis and / or Rabbit Haemorrhagic Disease(RHD) Other: Exclusion fencing / Warren fumigation / Warren ripping	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Feral Deer (Cervus timorensis) (Dama dama) (Cervus elaphus)	Yes	Shooting: ground based	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Feral cat (*Felis catus*)		Trapping: Wire mesh cage trap / Soft net trap/ Padded-jaw trap Shooting – ground based	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Feral cattle (*Bos taurus*)		Other - Exclusion fencing / Mustering	As required.
Feral Goat (*Capra hircus*)		Shooting – ground / aerial based Other - Exclusion fencing / Mustering	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Feral pig (*Sus scrofa*)	Yes	Baiting – 1080 Trapping - Silo, panel or box traps Shooting – ground / aerial based Other - Exclusion fencing	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Hares (*Lepus europaeus*)		Trapping – cage trap Shooting – ground based Other - Exclusion fencing / Habitat modification / Repellents	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Red fox (*Vulpes vulpes*)		Baiting – 1080 Trapping - Wire mesh cage trap / Soft jaw leg hold trap Shooting – ground based Other - Den fumigation / Exclusion fencing / Ejectors	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.
Wild dog (*Canis lupus spp.*)	Yes	Baiting – 1080 / PAPP Trapping - Soft jaw leg hold trap Shooting – ground based Other - Exclusion fencing/ Ejectors	Control event in Autumn and /or Spring From Year 1 to Year 4, at least two control events per year. Ongoing maintenance, minimum of one control event per year.

Local control

Local on ground control measures including trapping, baiting and shooting (as appropriate) are to occur across the BA in Autumn and Spring, to coincide with breeding seasons of many of the vertebrate pest species. Reactive control may be undertaken at other times in response to reports of threatened species and/or livestock predation.

All control actions will be undertaken by appropriately qualified personnel and are required to complete a comprehensive job safety assessment prior to commencement of actions. Control actions must follow the Model Codes of Practice (COPs) and Standard Operating procedures (SOPs) for the humane control of pest animal (available online http://www.pestsmart.org.au/animal-welfare/humane-codes/).

Regional control

Yancoal will continue to participate in regional aerial and ground control programmes for feral pigs and wild dogs, managed and coordinated by the HLLS and/or National Parks and Wildlife Service (NPWS). It will apply across all MZs in the BA.

Regional control programmes are managed and co-ordinated by the HLLS. The HLLS will be responsible for advising the community of the control action, while Yancoal will notify Leaseholders. The HLLS will provide a report detailing the timing, number of animal culled and the GPS output from the aircraft to Yancoal.

4.10.1 Performance Criteria

	Year 1 to Year 4	Year 5 to Year 10	Completion Criteria
Vertebrate pest local control	At least two control events each year for species listed in Table 19, and any other species recorded from monitoring activities. All actions recorded in the Annual Report.	At least one control events each year for species listed in Table 19, and any other species recorded from monitoring activities. All actions recorded in the Annual Report.	No observed vertebrate pest or damage. Ecological monitoring demonstrates a trajectory to benchmark values for all attributes measured over three consecutive assessments (the average of all plots).
Vertebrate pest regional control	Active participation in programme coordinated by HLLS, this may include local control actions.	Active participation in programme coordinated by HLLS, this may include local control actions.	
Monitoring	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	Complete Ecological Monitoring Section 5.3), (Rapid Condition Assessment and Property Inspections (Section 5.4)	

4.10.2 Trigger, Response and Action plan

Trigger	Response
Vertebrate pest having detrimental impact - Ecological Monitoring results indicate no trajectory towards benchmark and management monitoring observes evidence of vertebrate pests. .	Increase the number of control events. Suitably qualified and experienced person to review control action. Revise the Plan.
New vertebrate pest is identified within BA.	Targeted vertebrate pest control Notify Government Agency and neighbours, if required. Revise the Plan. Follow all directions given by relevant government agency to assist in control.

5 Monitoring

This Section outlines the monitoring programme designed to assess changes in the habitats of the offset areas at three different scales:

- landscape monitoring: to assess vegetation changes and habitat connectivity at the landscape scale in the long-term (10 - 15 years);
- ecological monitoring: to assess habitat restoration and bird assemblages by quantifying changes in vegetation structure, key fauna habitat features and bird assemblages in the short to medium-term (2 years); and
- management monitoring: to assess woodland condition and identify emerging threats in the short-term (biannually/annually).

5.1 Monitoring objectives

The objectives of this monitoring programme are to detect whether the conservation objectives of the Plan are being achieved, and that the Plan is being effectively implemented.

The variables to be monitored are therefore comprised of:

- the key performance and completion criteria, as listed in Table 12;
- the performance criteria and the trigger events, as specified in Section 4; and
- scenarios that represent risk to the attainment of the plans objectives, as assessed in Table 21, Section 6.

It is anticipated that effective monitoring of ecological condition, and management will demonstrate that implementation of the Plan is achieving the conservation objectives. The monitoring is designed to measure the key performance indicators/completion criteria, and identify where corrective actions are required. In this way it is intended that monitoring activities will have a clear relationship to operational decision-making such that:

- if the landscape (Section 5.2), ecological (Section 5.3), and the management (Section 5.4) monitoring demonstrate an increase in woodland extent and enhanced habitat condition then the Plan is achieving the desired outcomes and will proceed without modification;
- if the monitoring indicates no increase in extent of woodland and enhancement of ecological condition then the corrective actions listed in risk assessment at Table 21 will be implemented; and
- if the monitoring indicates that the performance criteria for the conservation management actions are not achieved, then the Trigger, Response and Action plan will be enacted.

The Annual Reports will provide ongoing review of the monitoring results; this includes the annual management monitoring and the biennial ecological monitoring reports. These reports may include recommendations to amend the monitoring programme and any recommendations will be considered and incorporated as part of the review of the Plan or immediately provided it does not diminish the monitoring effort.

The frequency of monitoring activities will vary according to the monitoring schedule provided in Table 20. To enhance understanding and knowledge of all key stakeholders in the management of the BA, Yancoal representatives, where feasible, will accompany the Biodiversity Auditors during the field based components of this monitoring programme.

Table 20 Monitoring Schedule

	2020	2021	2022	2023	2024	2025	2026
Landscape							
Aerial photo interpretation							X
Ecological							
Habitat Restoration	Sept - Nov		Sept - Nov		Sept - Nov		Sept - Nov
Bird Assemblage	July-Aug		July-Aug		Sept - Nov		Sept - Nov
Management							
Rapid Condition Assessment	Sept - Nov	Sept - Nov	Sept - Nov	Sept - Nov	Sept - Nov	Sept - Nov	Sept - Nov
Property inspection	April / Nov	April / Nov	April / Nov	April / Nov	April / Nov	April / Nov	April / Nov

5.2 Landscape Monitoring

Aerial photographic imagery baseline photography captured 2013 will be updated in up to 15 years. This imagery will be analysed and the findings ground-truthed to assess the extent of canopy regeneration within the BA.

The analysis of tree canopy cover will be used to map changes in the distribution and condition of woodland habitats and the connectivity of vegetation remnants. An increase in the extent and condition of woodland habitats will be indicative of successful management of the offset areas towards the Key Performance Indicators.

5.3 Ecological Monitoring

Habitat restoration and bird assemblage monitoring aims to assess changes in the condition and extent of the woodland habitats within the BAs and the ongoing usage of these habitats by woodland birds.

5.3.1 Habitat Restoration Monitoring

The objectives of the habitat restoration monitoring are to demonstrate:

- changes in vegetation community composition, structure and habitat features in the Transition sites towards the Reference sites;
- changes in vegetation composition, structure and habitat features towards the BioMetric Vegetation Types benchmarks;
- recruitment of canopy species through transition up age classes (measured as Diameter at Breast Height);

Eleven permanent monitoring plots across the Northern BA to monitor the condition of woodland reference sites and grassland transition sites, located within MZ1, MZ2, MZ3 and MZ4.

The location of the Habitat Restoration Monitoring Plots is shown in Figure 3. All monitoring results will be stored on the Biodiversity Offsets Portal.

The monitoring programme will assess changes in key attributes within the BA through time as grassland communities are restored to woodland. Monitoring data will also be assessed relative to the benchmark values presented in the BioMetrics Vegetation Types Database (OEH, 2013). These benchmark values relate to species richness and percent cover of native plants in the various vegetation layers as well as counts of tree hollows and the length of fallen timber. Additional habitat features are also be included in this monitoring programme to track canopy regeneration and health, and soil characteristics.

The first survey of all plots was completed in 2014 and subsequent surveys will be biennial (every two years) during late spring/early summer. A summary of results was provided in Section 2.

Field Methods

The field methods follow the ‘Field methodology for measuring condition variables for Site Value and at Reference Sites’ according to the BioMetric 3.1 methods (Department of Environment, Climate Change and Water, 2011). In addition, more detailed data are

collected on species composition and cover abundance, canopy regeneration and health, and habitat features as outlined below.

The plots are 50m x 20m and are established such that the plot runs downslope. A 20m x 20m quadrat is positioned within this larger plot and three 50m transects run its length (Figure 8). Marker pegs are positioned at the top-middle of the plot to establish a permanent plot position. GPS coordinates have been taken to ensure monitoring plots can be relocated over time.

The 50m x 20m plot is used to record details of the over-storey (canopy) layer including species richness, canopy regeneration and canopy health. Specific habitat features, such as the abundance of tree hollows, flowers/fruit, mistletoe and fallen logs are also recorded at this scale

The 20m x 20m quadrat is used to record details of the mid-storey and ground stratum structure including details of the composition and % cover of native/exotic species for various plant groups (e.g. grasses, shrubs, other herbaceous plants). Additional habitat features such as rocks, litter and bare ground are also recorded at this scale.

Three 50m transects are used to assess the % foliage cover of the over-storey. This data is collected at 10 points (i.e. at every 5m) along the length of the transects.

Further details of the field sampling methods, including a table summarising the variables (measurements) that are recorded, their unit of measurement and the sampling unit are provided in **Appendix C**.

Figure 8 Monitoring plot for habitat restoration monitoring

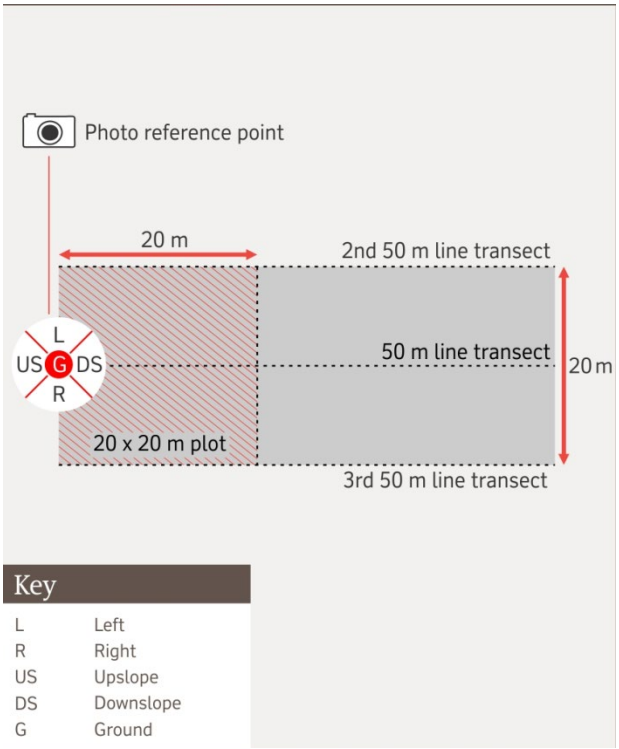

Photo Reference Points

Photo reference points are also established and permanently marked within each habitat monitoring plot. Photo reference points are established at the top of the middle 50m transect at each monitoring site. During each monitoring event, a series of photos are taken from this point to provide a visual record of any changes in vegetation and habitat condition. Depending on the location of the monitoring plot, this might include:

- changes in vegetation structure (e.g. presence/ absence of canopy species, shrubs, tussock grasses);
- the presence/condition of special habitat features (e.g. rock outcrops, flowering/fruiting species); and
- changes in identified threatening processes (e.g. weed infestations, erosion).

- At each photo reference point, a minimum of five photos are taken, in the following directions:
    - downslope;
    - upslope;
    - across the slope – left (when facing downslope);
    - across the slope – right (when facing downslope); and
    - directly down.

The photo records are displayed on the Biodiversity Offsets Portal such that monitoring photos can be viewed against the baseline photo. This will provide an ongoing and gradual visual record of changes in habitats as the management strategies are implemented as well as changes in existing threats and early warning of emerging threats at monitoring sites.

5.3.2 Bird Assemblage Monitoring

The objectives of the bird assemblage monitoring are to:

- demonstrate ongoing habitat usage by woodland birds and a decrease in the relative abundance of bird species typical of forest margins and grasslands; and
- assess the presence of Swift Parrot and Regent Honeyeater within the offset areas and collect information regarding their movements and habitat usage.

Birds are typically abundant and widespread taxa whose populations are easily surveyed. Although they are relatively mobile, many species can show specialisation in their habitat requirements. Patterns in the distribution and abundance of bird assemblages can be indicative of biodiversity as a whole and of environmental change. Accordingly, bird assemblages are being monitored as indicators of general ecosystem condition.

A desktop study has been undertaken to predict the timing and distribution of the Swift Parrot and Regent Honeyeater in the region so that habitat and bird assemblage surveys are designed to maximise the likelihood of detecting these species. Swift Parrots are likely to occur in the region occasionally and in very low numbers between July and October to feed on winter-flowering eucalypts (Swift Parrot Recovery Team 2000; Saunders and Tzaros 2011; OEH 2012). The Regent Honeyeater is known to breed around the Upper Hunter Valley and Mudgee regions. The species has regular movements with seasonal patterns of abundance and breeding related to regional patterns in flowering of key forage species (Franklin, Menkhorst et al. 1989; Menkhorst, Schedvin et al. 1999; OEH 2012; SEWPaC 2012).

Accordingly, bird assemblage monitoring started in winter/spring 2014 to collect baseline data and subsequent monitoring will occur in 2018 and 2020 (Table 20). Birds Australia will be consulted prior to the commencement of these surveys to coordinate survey effort and increase the likelihood of observations, therefore the timing of survey may be adjusted.

Field Methods

Habitat area searches are conducted in accordance with Birds Australia Atlas search methodology and EPBC Act bird survey guidelines (DEWHA 2010). This method involves searching a set area and recording data only from within the pre-defined search zone. A two ha area is surveyed for 20 minutes by two observers. Broadcast surveys are to be included in the methodology in 2018 at the same location as the monitoring plots.

At the Northern BA, five bird monitoring plots are established according to the following distribution and their locations are shown on Figure 3:

- 2 plots in woodland (MZ1 and MZ3); and
- 3 plots in grassland (MZ4).

Incidental and opportunistic surveys are also conducted where suitable habitat areas for the Swift Parrot or Regent Honeyeater are observed when travelling to and between monitoring sites. All opportunistic sightings of these species and their locations are recorded. General notes and important habitat resources such as tree hollows, flowering

trees and nests are recorded incidentally and photographed, as well as any notable bird activities such as specific forage behaviour or signs of breeding activity.

5.3.3 Data Analysis and Interpretation

To assess the success of the management actions in meeting the Key Performance Indicators, data on vegetation, fauna habitats and bird assemblages is analysed against the predicted changes in these groups associated with implementation of the actions.

Univariate and multivariate techniques will be used to analyse and visualise patterns in the data and will include one or more of the following techniques:

- Analysis of Variance (ANOVA): to test for changes in univariate data including species richness, abundance of specific habitat features, % cover vegetation structural layers;
- distance-based permutational Analysis of Variance based on Bray-Curtis dissimilarities: to test for changes in multivariate data including fauna and plant community composition;
- graphs and charts: to summarise patterns in univariate data and visualise changes in variables relative to the reference condition (medium-high quality woodland); and
- non-metric Multidimensional scaling and SIMPER analyses: to summarise patterns in multivariate data, visualize changes in the data relative to the reference condition and assist in ecological interpretation of the results.

Analysis of the baseline data will assess the difference in fauna assemblages and habitat condition between grasslands and woodlands across the BA. It is expected that in subsequent years, with the progressive improvement in habitat condition, the ecological data analysis will eventually show a convergence of ecological variables to that of the reference woodland. This is expected to be a medium to long-term upward trend that will reflect the regeneration of grassland areas to woodland and the development and availability of critical fauna habitat features such as hollows, ground debris and forage resources. By demonstrating this convergence through time, it will be inferred that the proposed conservation management actions have been successful in enhancing the extent and condition of the vegetation communities and restoring the lower quality vegetation and fauna habitats (in particular for Regent Honeyeater and Swift Parrot) towards the reference condition.

5.4 Management Monitoring

5.4.1 Rapid Condition Assessment

The RCA technique is used as a preliminary assessment of woodland condition within the BA. **Appendix A** provides details on the RCA methodology, the location of the plots is shown in Figure 3.

Each year, RCA sites in mature and regrowth vegetation are revisited to record the presence or absence of key habitat components and threatening processes.

The results of the RCA, together with property inspections and photo reference points will be used to monitor woodland condition and identify emerging threats.

5.4.2 Property inspections

Regular property inspections are undertaken to ensure that there is a systematic monitoring of the offset area, to ensure its protection and to ensure early detection of potential threats or failures. A Yancoal representative will undertake biannual inspections, to ensure regular visual inspections of the offset area to detect:

- physical condition of fencing and gates;
- disturbance factors including fire and unauthorised access e.g. hunting, fire wood collection;
- condition of erosion;
- evidence of waste dumping;

- presence/activity of feral pest species;
- grazing pressure from over-abundant native herbivores;
- presence of exotic weed species; and
- assessment of fire fuel loads in winter.

5.4.3 Survival Assessment

To assess the survival of planted tubestock and observe regeneration a 50m line transect will be used and 2m x 2m quadrats will be placed every 10m along the transect. One transect will be established to assess every 10ha of re-establishment.

Along the 50m transect, the number of dead and living tubestock will be recorded. Within the 2m x 2m quadrats at every 10m the following is to be recorded:

- number of native plants regenerating;
- number of weed species; and
- record any erosion.

The starting point and end point of each transect is to be recorded by GPS.

5.5 Complaints Management

Community Complaints are lodged via the Community Complaints line, 1800 656 892. The hotline number prominently displayed on the MTW website. The Complaints Hotline operates 24 hours per day, seven days a week. Complaints will be recorded and investigated by MTW staff. Complaints lodged via other means (letter, in person, fax etc) will also be recorded and investigated by the Environmental Advisor.

Where the investigation identifies potential non-compliance with a consent or licence condition, action to mitigate the cause of the complaint will be taken.

The details of all offset area complaints, and any mitigating actions taken, will be circulated to senior management and other key personnel. Where requested, follow-up correspondence with the complainant will be provided.

6 Risk assessment

Table 21 identifies the key risks to this Plan.

The risk assessment is undertaken in accordance with the following risk framework, having regard for the likelihood and consequence definitions used below.

		Consequence				
		Minor	Moderate	High	Major	Critical
Likelihood	Highly Likely	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances
Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing low cost, well characterised corrective actions.
Moderate	Moderate risk of failure to achieve the plan's objectives. Results in short term delays to achieving plan objectives, implementing well characterised, high cost/effort corrective actions.
High	High risk of failure to achieve the plan's objectives. Results in medium-long term delays to achieving plan objectives, implementing uncertain, high cost/effort corrective actions.
Major	The plan's objectives are unable to be achieved, with significant legislative, technical, ecological and/or administrative barriers to attainment that have no evidenced mitigation strategies.
Critical	The plan's objectives are unable to be achieved, may include widespread and severe environmental harm, with no evidenced mitigation strategies.

Table 21 Risk and Contingency Assessment Matrix

Objective	Scenario[1]	Likelihood	Consequence	Risk level	Trigger	Corrective Action
To protect the conservation values of the offset area within 10 years at the BA.	Delay in securing the offset area under a legally binding mechanism	Likely	Minor	Low	NSW biodiversity reforms not providing a fit for purpose mechanism to legally secure offset area.	Additional consultation with DAWE and DPE.
	Unable to attach the Plan to the land title.	Likely	Minor	Low	NSW government requires different plan to be attached to the land title.	Ensure that a new plan is equivalent to this Plan.
	Illegal access to offset area causing significant residual impact.	Unlikely	Moderate	Low	Failure in access control (Section 4.1.3) captured in management monitoring (Section 5.4.2) and reported in the Annual Report.	Review access control and improve security measures. Consider relocation of offset area.
	Uncontrolled bushfire impact offset area.	Possible	High	Medium	Bushfire on extreme or catastrophic fire danger day impacts offset area.	Implement Post Fire Event recovery with NSW Rural Fire Service. Complete post fire survey, map fire damaged areas, and revise the Plan.
To enhance the condition of conservation values of the offset area within 10 years at the BA.	No enhancement of condition in the conservation values measured by the Habitat Restoration Monitoring (Section 5.3.1) and Rapid Condition Assessment (Section 5.4.1).	Possible	Moderate	Medium	Review of Annual Reports and Monitoring data.	Review external factors (climate) and monitoring effort. Revise Plan and consider new Conservation Management Action. Assess influence on success from other factors such as extreme climatic conditions. Consider relocation of offset area.
	No increase in extent of woodland from the active restoration of grassland as measured by the Landscape (Section 5.2) and Habitat Restoration Monitoring (Section 5.3.1).	Possible	Moderate	Medium	Review of Annual Reports and Monitoring data.	Review external factors (climate) and monitoring effort. Revise Plan and consider new Conservation Management Action. Assess influence on success from other factors such as extreme climatic conditions. Consider relocation of offset area.
To enhance and maintain the habitat values of the offset areas within 10 years at the BA	Observed decrease in species richness and usage of the offset area as measured by the Bird Assemblage Monitoring (Section 5.3.2)	Possible	Moderate	Medium	Review of Annual Reports and Monitoring data.	Review external factors (climate / disease) and monitoring effort. Revise Plan and consider new Conservation Management Action.

Note 1 Assumes effective implementation of management actions as described in the Plan

7 Compliance table

Table 22 Compliance with relevant conditions of EPBC2009/5081

Approval Condition	EPBC 2009/5081	Reference
2	To offset the impacts on the foraging habitat of the regent honeyeater and swift parrot, the person taking the action must submit to the **Minister** for approval an Offset Management Plan (OMP) for the **Phase 1 Offset** identified in Attachment A by no later than 13 April2014.	
	The OMP must include, but not be limited to the following:	
	a) a textual description and map to clearly define the location and boundaries of all of the offset areas. This must be accompanied with the **offset attributes** and a **shapefile**	Section 2.1 Location and description
	b) details of management actions to protect and enhance the extent and condition of habitat values of the offset areas including but not limited to rehabilitation, weed control, fire management, erosion and sediment control, management of livestock and restrictions on access to habitat for the regent honeyeater and swift parrot	Section 3 Objectives, Key Performance Indicators and Completion Criteria Section 4 Conservation Management Actions
	c) the timing, responsibilities and performance criteria for management actions	Section 4 Conservation Management Actions
	d) a monitoring plan including the undertaking of ecological surveys by a qualified ecologist to assess the success of the management actions against identified milestones and objectives	Section 5 Monitoring
	e) a process to report, to the department, the management actions undertaken in the offset areas and the outcome of those actions, including identifying any need for improved management	Section 1.3 Function of the Management Plan
	f) description of the potential risks to successful management and rehabilitation in the offset areas, and a description of the contingency measures that would be implemented to mitigate these risks	Section 4 Conservation Management Actions Section 6 Risk assessment
	g) details of parties responsible for management, monitoring and implementing the plan, including their position or status as a separate contractor.	Section 1.3.2 Key Stakeholders and Roles
	The approved OMP must be implemented.	
	Note: Offset areas can accommodate offset requirements for more than one species habitat within the one area, if a qualified ecologist verifies that suitable habitat is present and includes specific habitat requirements for the relevant species.	
5	The approved OMP, as described in condition 2, must be revised by the person taking the action to include, but not be limited to, those activities as described in condition 2a-g for the **Phase 2 Offset**. The revised OMP must be submitted for approval by the **Minister** within 12 months of the approval of the **Phase 2 Offset.** The revised approved OMP must be implemented.	Refer to condition 2 above.
Re-establishment of Woodland in Biodiversity Management and Offset Areas		
6	Within 12 months of the Commencement of Construction of Phase 1, the person taking the action must submit to the Minister for approval a Re-establishment Plan (REP) for the Phase 1 Offset area. The REP must include, but not be limited to the following:	This Plan
	a) details of the areas to be re-established (re-establishment areas) including location and maps;	Section 4 Conservation Management Actions
	b) documentation including mapping of current environmental values relevant to MNES of the re-establishment areas;	Section 2 Biodiversity Area
	c) where revegetation through planting seedlings and/or seeds is intended, details of appropriate species and ratios of species relevant to historically occurring listed migratory and listed threatened species' habitat;	Section 4 Conservation Management Actions
	d) the source and provenance of the seeds and/or seedlings which will be used;	Section 4 Conservation Management Actions
	e) measures to address threats to MNES including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds;	Section 4 Conservation Management Actions
	f) measures to provide fire management regimes appropriate for the MNES;	Section 4 Conservation Management Actions
	g) measures to manage the MNES in accordance with the recommendations of the approved recovery plan for the migratory and threatened species;	Section 4 Conservation Management Actions

	h) monitoring measures including ecological surveys to measure the establishment and ongoing success of the revegetation based on a comparison with high quality habitat for the MNES;	Section 5 Monitoring
	i) performance measures and reporting requirements against identified objectives, including trigger levels for contingency measures to be taken to ensure performance measures and objectives are met	Section 4 Conservation Management Actions Section 6 Risk assessment
	j) identify persons responsible and arrangements for implementing the REP and for reporting on performance.	Section 1.3.2 Key Stakeholders and Roles
	The approved REP must be implemented.	
7	The approved REP, as described in condition 6, must be revised by the person taking the action to include at least those activities as described in conditions 6a-j for the Phase 2 Offset. The revised REP must be submitted for approval by the Minister within 12 months of the Commencement of Construction of Phase 2 of the action. The approved revised REP must be implemented.	This Plan

Table 23 Compliance with relevant conditions of NSW SSD-6464

Approval Condition	Development Consent SSD-6464	Reference
Sch. 3 Cond. 28	Retirement of Offsets	
	Within 3 years of the date of commencement of development under this consent, the Applicant shall retire biodiversity credits of a number and class specified in Tables 9 and 10 below to the satisfaction of OEH. The retirement of these credits must be carried out in accordance with the NSW Biodiversity Offsets Policy for Major Projects and can be achieved by : (a) acquiring or retiring credits under the Biobanking Scheme in the TSC Act; (b) making payments into an offset fund that has been developed by the NSW Government; or (c) providing supplementary measures.	The credits reported in this document and the BioBanking Assessment Report will be retired to meet this condition.

Table 9: Ecosystem credit requirements

Vegetation Community	*Code (BVT)*	*Biometric Vegetation Type*	*Area (ha)*	*Endangered Ecological Community (EEC)*	*[a]Credits required*
Warkworth Sands Woodland	HU872	Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	72.12	Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	3,043
Warkworth Sands Grassland	HU872	Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	0.67	N/A	16
Central Hunter Grey Box - Ironbark Woodland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	614.64	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	[b] 12,180
Regenerating Central Hunter Grey Box - Ironbark Woodland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	6.43	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	108
Central Hunter Grey Box - Ironbark Derived Grassland	HU817	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	378.6	N/A	4,516
Central Hunter Ironbark - Spotted Gum - Grey Box Forest	HU818	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	16.61	Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions EEC	633

Notes:
- *[a] Or as otherwise determined by OEH as part of its detailed consideration of credits retirement.*
- *[b] This must be read in conjunction with the similar figure in Table 11. It reflects the fact that some of these credits may be retired through mine rehabilitation.*

Table 10: Species credit requirements

Species	*[a]Credits Required*
Regent Honeyeater	18,929
Southern Myotis	18,222
Large-eared Pied Bat	139

Note:
- *[a] Or as otherwise determined by OEH as part of its detailed consideration of credits retirement.*

Approval Condition	Development Consent SSD-6464	Reference
Sch. 3 Cond. 30	Direct Land-Based Offsets	
	Within 3 years of the date of commencement of the development under this consent, the Applicant shall secure offset areas listed in Table 12 under an in perpetuity conservation mechanism such as entering into a biobank agreement, in accordance with the relevant provisions of the TSC Act. The direct land-based offsets may be used as offsets for any approval required under the EPBC Act for this development.	This Plan will form part of the conservation agreement.

Table 12: Direct Land-based Offsets

Offset Area	*Minimum Size (hectares)*
Northern Biodiversity Area	303
Southern Biodiversity Area	705
Goulburn River Biodiversity Area	1,063
Bowditch Biodiversity Area	520
Putty Road Biodiversity Area	94
2003 Warkworth Sands Woodland Area	155.8
North Rothbury Biodiversity Area (Hanwood Estate)	40

Note: To identify the areas referred to in Table 12 see the applicable figures in Appendix 4.

Sch. 3 Cond. 36	Biodiversity Management Plan	
	The Applicant shall prepare a Biodiversity Management Plan for the development to the satisfaction of the Secretary, and carry out the development in accordance with this plan. This Plan must: (a) be prepared in consultation with OEH and submitted to the Secretary for approval prior to the commencement of any development under this consent; (b) describe the short, medium, and long term measures that would be implemented to: • manage the remnant vegetation and fauna habitat on the site; • implement the biodiversity offset strategy described in the EIS; • regenerate and conserve Warkworth Sands Woodland EEC in the biodiversity areas; • integrate the implementation of the biodiversity offset strategy to the greatest extent practicable with the rehabilitation of the site; (c) include detailed performance and completion criteria for evaluating the performance of the biodiversity offset strategy (including the regeneration of Warkworth Sands Woodland). and triggering remedial action (if necessary); (d) include a detailed description of the measures that would be implemented over the next 3 years for: • regenerating Warkworth Sands Woodland in the biodiversity offset areas; • protecting vegetation and fauna habitat outside the approved disturbance area on-site; • enhancing the quality of existing vegetation and fauna habitat on the site and in the biodiversity offset areas; • minimising clearing and avoid unnecessary disturbance; • maximising the salvage of resources within the approved disturbance area - including vegetative and soil resources - for beneficial reuse in the enhancement of any land-based offsets or the rehabilitation of the site; • collecting and propagate seed; • minimising the impacts on fauna on site, including undertaking pre-clearance surveys; • managing salinity using best practice dryland salinity management revegetation measures; • controlling weeds and feral pests; • controlling erosion; • managing grazing and agriculture on site; • controlling access; and • bushfire management; (e) include a seasonally-based program to monitor and report on the effectiveness of these measures, and progress against the detailed performance and completion criteria; (f) identify the potential risks to the successful implementation of the biodiversity offset strategy (including the regeneration of Warkworth Sands Woodland) and include a description of the contingency measures that would be implemented to mitigate against these risks; and (g) include details of who would be responsible for monitoring, reviewing, and implementing the plan. Note: Management measures relating to the biodiversity offset strategy may be addressed via equivalent measures required by OEH as part of a BioBanking Agreement or similar conservation agreement.	Completed – this Plan satisfies the requirements of the Biodiversity Management Plan approved in January 2016. Conditions (c) and (d) see Section 3 and Section 4. Condition (e) see Section 5 Condition(f) see Section 6 Condition (g) see Section1.3.2.
Sch. 5 Cond. 3	Management Plan Requirements	
	The Applicant shall ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) detailed baseline data; b) a description of • the relevant statutory requirements (including any relevant consent, licence or lease conditions); • any relevant limits or performance measures / criteria;	Section 2.6, Table 11, Appendix A Table 1, Section 1.2 Environmental Approvals

Approval Condition	Development Consent SSD-6464	Reference
	• the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development of any management measures; c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures / criteria; d) a program to monitor and report on the: • impacts and environmental performance of the development; • effectiveness of any management measures (see c above) e) a contingency plan to manage any unpredicted impacts and their consequences; f) a program to investigate and implement ways to improve the environmental performance of the development over time; g) a protocol for managing any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; and h) a protocol for periodic review of the plan. Note: The Secretary may waive some of these requirements if they are unnecessary for particular management plans.	Table 12, Appendix B, Section 4 Performance Criteria Section 4 Performance Criteria, Section 6 Risk Assessment Section 1.3.3 Review and reporting, Section 5 Monitoring Sections 4 Performance Criteria, Section 5 Monitoring Section 4 Trigger, Response and Action plan, Section 5.5 Complaints Management, Section 1.3.3 Review and reporting Section 1.3.3 Review and reporting

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Appendix A – Rapid Condition Assessment

The Rapid Condition Assessment (RCA) is derived from the 'Save the Bush Toolkit' technique (Wakefield and Goldney, 1997), which identifies the presence or absence of key habitat components and threatening processes. This technique is not applicable to all types of native vegetation (e.g. native grasslands, wetlands or pastures) but is a quick and reliable way to assess the condition of woodland communities.

The RCA requires answering true or false to a series of questions, with a tally of the "True" scores indicating woodland health. Where answers are false, improved management in these areas may be required. Sites scoring 16 - 20 "trues" are generally considered to be areas of healthy vegetation that are sustainable under current management. Sites scoring 10 - 15 "trues" are generally considered to be areas of moderately disturbed bushland that have key elements missing and need improved management. Scores lower than 10 are highly disturbed and have many key elements missing. They are generally unsustainable under the current management and require improved management. These RCA attributes are listed in Table A1 with an example score for relatively undisturbed woodland.

Table A1 Rapid Condition Assessment attributes

Remnant attribute	Site
Low grazing intensity - never farmed	True
Tree and shrub regeneration present (<2m)	True
Infrequent fire regime (<5year intervals)	True
Healthy mature trees (no dieback)	False
Little to no evidence of rabbits	True
Little to no evidence of foxes/cats	True
Low abundance of weeds (most remnants contain some weeds)	True
No evidence of firewood collection	False
No obvious signs of erosion or salinity	True
Not susceptible to fertiliser application, herbicide or pesticide drift	True
Less than 20% trees with Mistletoe (NB some mistletoe is healthy)	True
Few tracks, trails or fence lines	True
Presence of native shrubs	True
Presence of large, old growth trees with hollows	True
Dead timber is left standing	True
Fallen timber and logs are left on the ground	True
Abundance of native ground flora	True
Presence of litter, cryptogams, cracks and rocks	True
Remnant is large (> 5ha is optimum)	True
Connected to or in close proximity to other remnant vegetation	True
Total No. True answers (x/20)	**18/20**

Appendix B – WSW Performance Criteria

YANCOAL
兖煤澳大利亚有限公司

WARKWORTH MINE

Warkworth Sands Woodland Performance Criteria

Yancoal Warkworth Mine, New South Wales | December 2017

These performance criteria aim to determine successful regeneration of Warkworth Sands Woodlands in the Northern Biodiversity Area within 15 years (2030), a compliance requirement of Condition 32 of the NSW Project Approval (SSD-6464) granted under the Environmental Planning & Assessment Act 1979 to Warkworth Mining Limited.

Contents page

1 Introduction

This document has been prepared to satisfy the conditions of New South Wales (NSW) environmental approvals held by Warkworth Mining Limited for the Warkworth Coal Mine located in the Hunter Valley NSW. The Warkworth Mine forms part of the Mt Thorley Warkworth complex managed by Yancoal Australia Limited (Yancoal).

1.1 Compliance

Condition 32 of WML's NSW Project Approval (SSD-6464) for the Warkworth Continuation Project requires the development of suitable performance criteria for determining the successful regeneration of Warkworth Sands Woodland (WSW) Endangered Ecological Community (EEC). The full consent condition is shown below:

Condition 32. Within 6 months of the commencement of development [15 February 2016] under this consent, the Applicant shall:

(a) develop suitable performance criteria to the satisfaction of OEH for determining the successful regeneration of the Warkworth Sands Woodland EEC in the Northern Biodiversity Area within 15 years from the commencement; and

(b) lodge a bond (in the form of a bank guarantee) of $1 million (indexed to CPI) with OEH.

Note: The Applicant's biodiversity offset strategy involves the regeneration of 159 hectares of Warkworth Sands Woodlands in the Northern Biodiversity Area, and the protection of an additional 19.5 hectares of existing Warkworth Sands Woodland in the Northern Biodiversity Area and 56 hectares of existing Warkworth Sands Woodland in the Southern Biodiversity Area.

Please note the consent has incorrectly referenced the Applicant's biodiversity offset strategy for the Warkworth Continuation Project. The strategy listed the area of Warkworth Sands Woodland to be regenerated in the Northern Biodiversity Area (BA) as 156 hectares (ha), not 159ha.

The mapping of the WSW vegetation in this paper is consistent with the estimated WSW extent determined by the chief judge of the NSW Land and Environment Court in the case of *Bulga Milbrodale Progress Association Inc v The Minister for Planning and Infrastructure and Warkworth Mining Limited*.

The areas mapped as Warkworth Sands Grassland (WSG) are grassland communities occurring on the Warkworth Aeolian sand sheet. These grasslands have some of the understorey components of the WSW community represented, but due to past clearing activities they have an absence of WSW canopy and mid-storey species. The distribution of WSW and WSG are shown in Figure 1.

Within the Northern BA there are two offset areas reflecting the requirements of the 2003 and 2005 (SSD-6464) consent conditions. Table 1 indicates these areas.

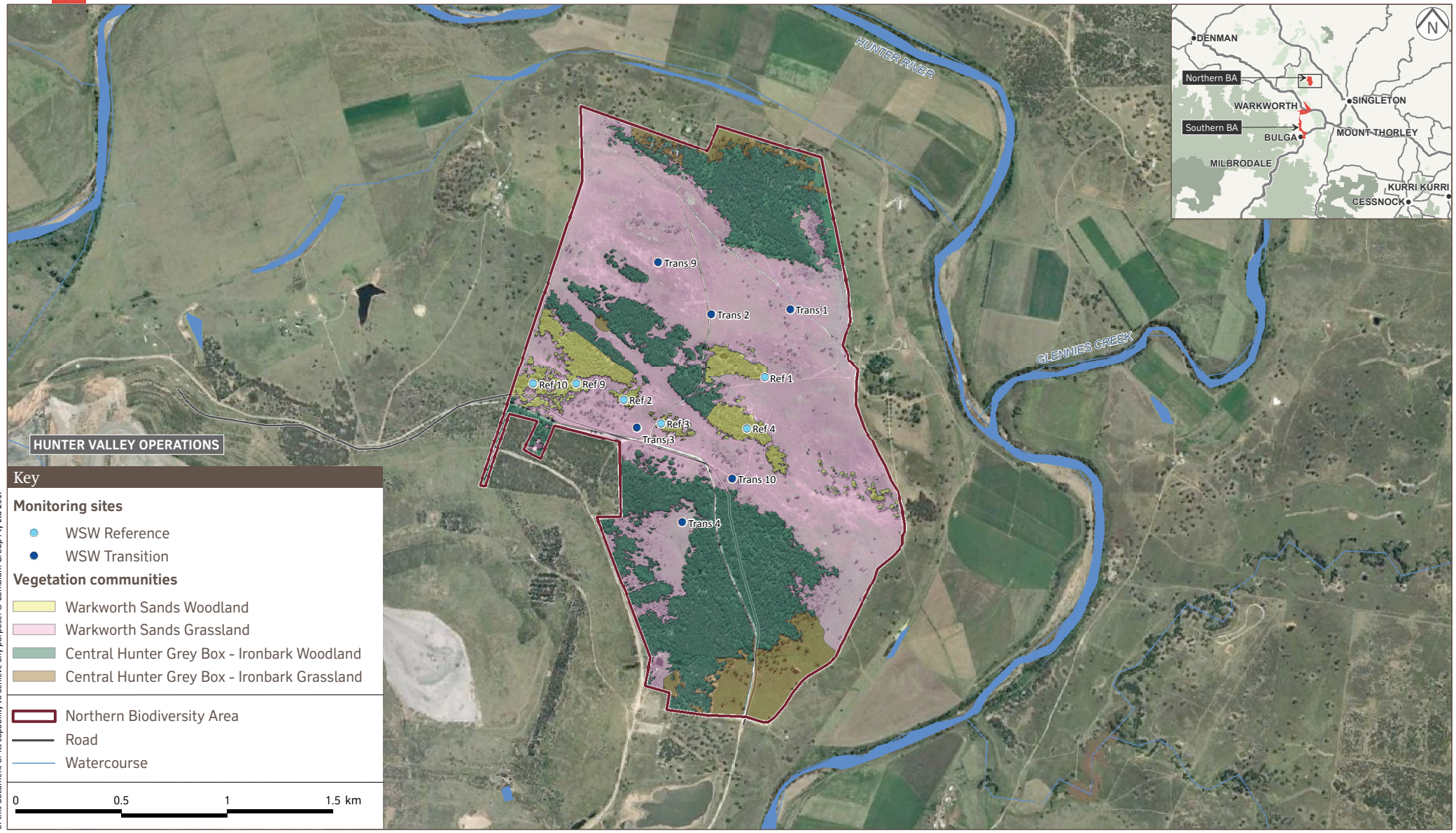
Table 1 Offset Areas containing Warkworth Sands Woodlands in Northern Biodiversity Area

Northern Biodiversity Area	Warkworth Sands Woodland (ha)	Warkworth Sands Grassland (ha)	Total (ha)
Offset Area for 2003 consent		39	39
Offset Area for 2015 consent	20	156	176
Total	20	195	215

Distribution of Warkworth Sands Woodland, Warkworth Sands Grassland and Monitoring Sites at the Northern Biodiversity Area

Warkworth Sands Woodland Performance Criteria

Figure 1



031102_WSW PCs_171204_v02

There are also offsets areas within the Southern BA that contain WSW. The areas are indicated in Table 2.

Table 2 Offset Areas containing Warkworth Sands Woodlands in Southern Biodiversity Area

Southern Biodiversity Area	Warkworth Sands Woodland (ha)	Warkworth Sands Grassland (ha)	Total (ha)
Offset Area for 2003 consent	78	39	117
Offset Area for 2015 consent	59	1	60
Total	137	40	177

Table 3 shows a summary of the offset areas containing WSW across the Northern and Southern BAs.

Table 3 Total Offset Areas containing Warkworth Sands Woodlands

Biodiversity Area	Warkworth Sands Woodland (ha)	Warkworth Sands Grassland (ha)	Total (ha)	Clear Area (Quarry) (ha)	Total (ha)
Northern	20	195	215		215
Southern	137	40	177	3	180
Total	157	235	392	3	395

These performance criteria apply to the regeneration of WSG within the Northern BA only.

They will be used to assess the effectiveness of Yancoal's management actions over 15 years, and the release of the $1 million WSW Regeneration Bond held by the Office of Environment and Heritage (OEH).

1.2 Objective

The performance criteria will determine the successful regeneration of 195ha of WSG in the Northern BA within the specific timeframe of 15 years.

These grasslands are to be regenerated to a WSW community, through the implementation of conservation management strategies such as planting of seedlings, introduction of habitat features salvaged from areas cleared for mining, and the control of weeds and pest animal impacts.

The Management Plan (MP) for the Northern BA has been prepared, which details the conservation management strategies and monitoring program, and incorporates the requirements of the 2015 consent (SSD-6464).

1.3 Approach to setting Performance Criteria

The task of setting performance criteria is complicated by the intrinsically variable nature of vegetation communities, both spatially and temporally. It is therefore difficult to assign specific and meaningful targets for the regeneration of the WSG within the Northern BA in the medium-term (15 Years). Accordingly, a two-tiered approach has been used to measure performance:

- both on-site Reference site data and Benchmark data provided by the WSW Biometric Vegetation Type will be used as targets against which regeneration success will be measured (Section 2.1); and
- specific planting rates, survival rates and representation of native species listed as characteristic species of WSW in the Final Determination will also be used to set targets (Section 2.2).

It should be noted that the impact of external factors such as climatic conditions, bushfire, disease or other catastrophic events may need to be considered in the assessment of the achievement of these performance criteria. Also there may be short term fluctuations in performance due to the implementation of conservation management strategies. These impacts will need to recorded and reported to OEH through the MP annual report.

1.4 Timing

The restoration activities to be implemented are described within the MP. It is expected that there will be three phases of active restoration. Phase 1 commenced in 2014 with the planting of the 2003 consent offset areas (39ha), followed by planting in May 2016 (56ha), and planting scheduled for 2017 (100ha). This first phase has focused on planting canopy species in strips or patches at close spacing in order to create shelter to promote natural regeneration in surrounding areas. The Vegetation and Habitat Monitoring Program data, as described in the MP, is to be analysed and assessed to inform Phases 2 and 3 activities. However, it is expected these later phases will focus on restoration of the shrub and ground cover stratum.

1.5 Review

The performance criteria will be reviewed following the monitoring events scheduled for Year 7 and Year 11. These reviews will consider the outcomes of prior monitoring events, and update any external data sources if required (such as Benchmark values). A detailed analysis of the trajectory of change in site attributes towards Reference sites and Benchmark values will be undertaken as part of this review.

At Year 7, when 5 sets of monitoring data will be available, a review of the statistical methods will be undertaken to optimise the analyses and adjust sample sizes if required. This will include consideration of the statistical power for detecting a meaningful effect size (difference between Reference (WSW) and Transition (WSG) sites) with the current monitoring design.

Table 4 provides a timeline for the restoration works, review of performance criteria and monitoring schedule.

Table 4 Timeline for the restoration works, review of performance criteria and monitoring

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
RESTORATION	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Passive Restoration																	
Active Restoration - Phase 1																	
Active Restoration - Phase 2																	
Active Restoration - Phase 3																	
Review of performance criteria																	
Monitoring of indicator attributes	0		1		2		3		4		5		6		7		8

1.6 Definitions of terms

Active restoration: involves direct land management interventions such as augmenting a site with soil and plant material. Active restoration is usually required where there is significant anthropogenic impact to a plant community's regenerative capacity.

Passive restoration: promotes the assisted natural regeneration of a plant community using minimal intervention land management practices. These practices assume that the current plant community retains moderate to high levels of regenerative capacity (resilience).

Re-establishment: the act of partially or, more rarely, fully replacing structural or functional characteristics of an ecosystem that have been diminished or lost, or the substitution of alternative qualities or characteristics than those originally present with the proviso that they have more social, economic or ecological value than existed in the disturbed or degraded state. This typically involves the planting of seedlings or direct seeding a disturbed or degraded site.

Regeneration: is the process of restoration and growth that makes an ecosystem resilient to natural fluctuations or events that cause disturbance or damage. It can be demonstrated by the new growth of seedlings, community assembly and absence of weeds.

Trajectory: A consistent trend of improved condition in key vegetation and habitat attributes within an ecological community demonstrating a pathway to recovery after disturbance.

2 Performance Criteria

The objective for regeneration of the WSG at the Northern BA is that the WSG becomes similar to the WSW community at the Northern BA, with the minimum target that site attributes are within or approaching benchmark values. Specific targets are also prescribed for management activities relating to planting rates, survival rates and species composition.

The site attribute data collected during the biennial Vegetation and Habitat Monitoring Program, in accordance with the methods described in the MP, will be used to assess the success of the conservation management strategies in achieving the performance criteria. The Vegetation and Habitat Monitoring Program has been completed in Spring 2014 and 2016 and is due to be undertaken again in Spring 2018.

Appendix A provides a summary of the site attribute data and methods used to collect the vegetation and habitat data. Figure 1 shows the location of the monitoring plot measured in 2016.

2.1 Convergence of Transition (WSG) to Reference (WSW) Sites and to Benchmark values

A combination of on-site Reference site data and broader Benchmark values will be used to determine the successful regeneration of the WSG to WSW at the Northern BA as detailed below in Sections 2.1.1 and 2.1.2 respectively.

2.1.1 Comparison of Transition (WSG) and Reference (WSW) sites

The Vegetation and Habitat Monitoring Program involves collection of vegetation and habitat data from Transition (WSG) and Reference (WSW) sites within the Northern BA. Details of the field methods and indicator attributes measured are provided in Appendix A. The vegetation and habitat attributes that are likely to change in response to the restoration activities over the next 15 years are shown in Table 5.

The Reference sites have been included in the monitoring program as they best represent a realistic target for assessing the regeneration of WSG. The Reference sites provide a site-specific representation of vegetation community composition and structure, taking into account local environmental conditions and possible local constraints to regeneration success (such as historical site disturbance).

At the Northern BA, it is acknowledged that the WSW is not pristine, but is a mixture of remnant and regenerating woodland of various ages following prior clearing for agriculture. Accordingly, the existing WSW at the Northern BA might best represent a pragmatic target condition for the WSG in the medium-term (15 years) because i) the WSW at the Northern BA is, and is likely to remain, fragmented and isolated from other remnant vegetation and therefore, will remain vulnerable to the associated pressures, and ii) the regenerating WSW at the Northern BA reflects the outcome of natural regeneration in the medium-term, and therefore is a plausible outcome for WSG regeneration in the medium-term.

Reference sites will be monitored concurrently with Transition sites in the WSG to take into account temporal variation due to external factors such as rainfall and bushfire. Each round of monitoring will include direct comparisons between Reference and Transition sites.

The data collected during the monitoring events will be analysed to determine if the Transition sites have become statistically similar to the Reference sites by Year 15. This will be based on a combination univariate and multivariate statistical analyses including, where relevant, Analysis of Variance, time segment analyses and graphs for univariate data and multivariate permutational Analysis of Variance and non-metric Multidimensional Scaling for multivariate data (for details, see the Northern MP and the associated Vegetation and Habitat Monitoring Reports).

Performance criteria 1a

At Year 15, successful regeneration of the WSG community will be determined if the following targets are met:

- ***native species richness in Transition sites is statistically similar to or greater than Reference sites;***
- ***exotic species richness and exotic % cover at Transition sites is statistically similar to or less than Reference sites; or***
- ***% cover of structural layers at Transition sites is statistically similar to Reference sites.***

These targets are summarised in Table 5 (but see Section 2.1.2 for interaction with assessment against Benchmark values)

Table 5 Targets for WSG (Transition sites) relative to WSW (Reference sites) at Year 15

Attributes	Targets for Transition sites relative to Reference sites at Year 15
Species Richness (No. of species)	
Native over-storey	Similar to or greater than
Native mid-storey	Similar to or greater than
Native ground stratum (grasses)	Similar to or greater than
Native ground stratum (shrubs)	Similar to or greater than
Native ground stratum (other)	Similar to or greater than
Exotic ground stratum	Similar to or less than
*Total Native	Similar to or greater than
Total Exotic	Similar to or less than
Community Structure (% cover)	
*Native over-storey	Similar
*Native mid-storey	Similar
*Native ground stratum (grasses)	Similar
*Native ground stratum (shrubs)	Similar
*Native ground stratum (other)	Similar
*Exotic	Similar to or less than
Additional Habitat Features	
*Log (total length (m))	Similar

* Assessment against Benchmark values applies for these measures

2.1.2 NSW BioMetric Benchmark Values

The NSW OEH maintains the Vegetation Benchmarks Database via the VIS Classification database. Benchmark values use the best available data to define the variability in site attributes for a given Biometric Vegetation Type (BVT) throughout its distribution. The WSW and WSG at the Northern BA are classified as BVT HU872 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth Area.

As stated on the OEH website:

'*Vegetation condition benchmarks are quantitative measures of the variability in condition of vegetation with relatively little evidence of human alteration, disturbance or modification since European settlement*'

The Benchmark values for eight site attributes for this BVT are provided in Table 6. These eight site attributes are expected to change for WSG during the 15 year regeneration period for the WSG.

At the Northern BA, these benchmarks are not intended to represent a definitive target for measuring restoration success as they are not site-specific, are dependent on the data available on the BVT and are based on near-pristine vegetation. However, comparison of site values with benchmark values is intended to provide a broader context for interpreting the restoration pathway and the trajectory of change as management measures are implemented. They provide a secondary check that WSG regeneration is occurring towards this broader reference condition.

It is also anticipated that the proposed management interventions will result in the regeneration of structural and habitat features that are currently not approaching benchmark values in the naturally regenerating WSW Reference sites (e.g. % cover of the mid-storey and the presence of logs). In these cases, priority will be given to attainment of benchmark or near-benchmark values (see Section 2.1.3)

Performance criteria 1b

At Year 15, successful regeneration of the WSG community will be determined if Transition sites are within or approaching (within 50-100% of) the benchmark values (target range).

Table 6 Benchmark values and near benchmark values for Warkworth Sands Woodland (BVT HU872)

	NPSR	NOS	NMS	NGCG	NGCS	NGCO	EPC	Logs (m)
min target range	13	6.5	5	2	2.5	2.5	0	10
benchmark min	26	13	10	4	5	5	0	20
max		40	50	15	30	25	5	
max target range		60	75	22.5	45	37.5	7.5	

	50-100% of benchmark
	within benchmark

NPSR	Native plant species richness	NGCO	Native ground cover (other) % cover
NOS	Native over-storey % cover	EPC	Exotic plant cover % cover
NMS	Native mid-storey % cover	Logs (m)	Length of logs (m)
NGCG	Native ground cover (grass) % cover		
NGCS	Native ground cover (shrubs) % cover		

2.1.3 Assessment Pathway

It will be determined that the performance criteria at Year 15 have been achieved if:

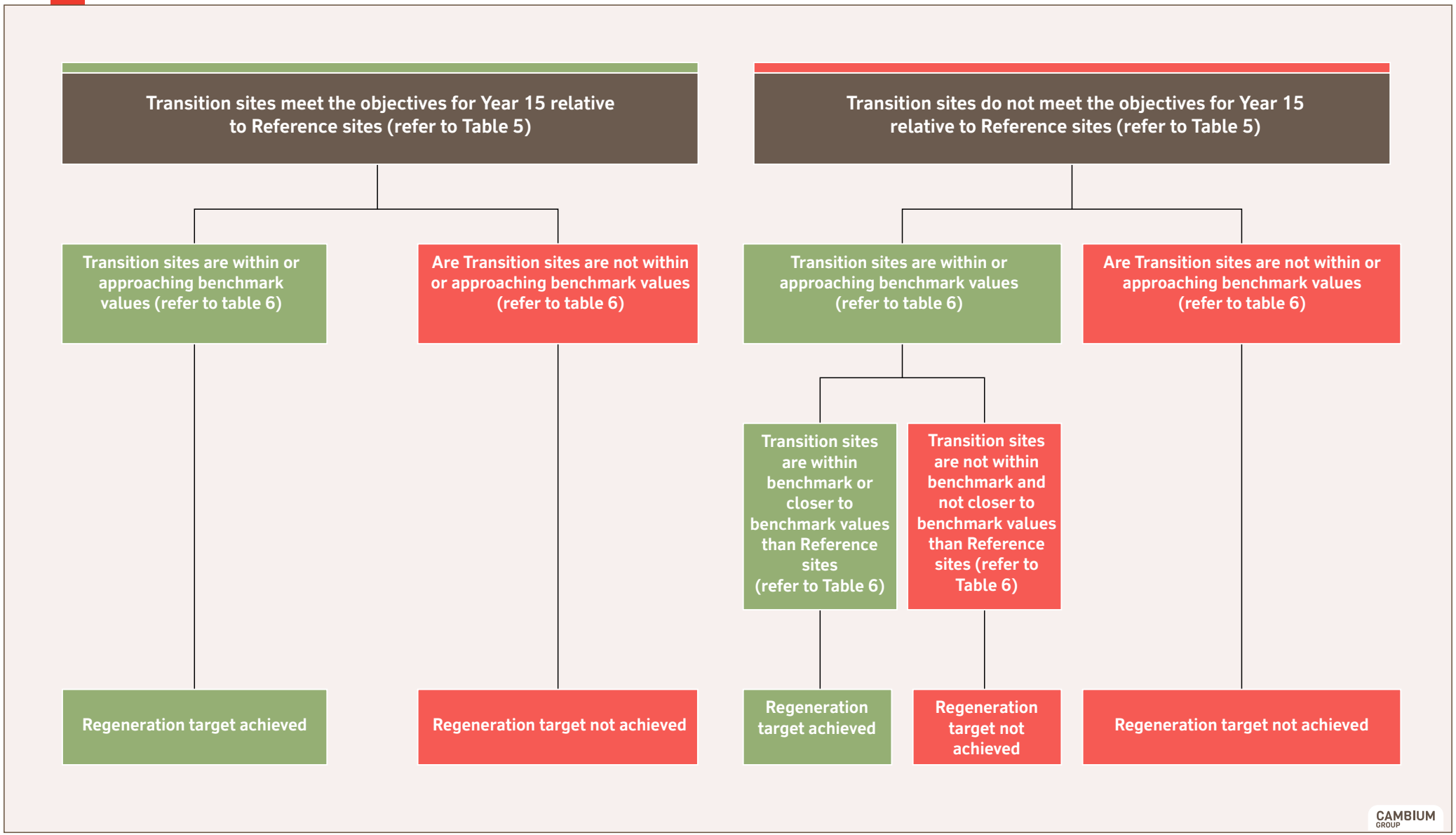
- the site attribute data for the Transition sites relative to the Reference sites meet the objectives outlined in Table 5; and
- the site attribute data for the Transition sites are within or approaching (within 50-100% of) the benchmark values (Table 6).

The decision pathways are outlined in Figure 2.

Assessment pathway to determine if WSG becomes similar to the WSW community at the Northern BA, with the minimum requirement that site attributes are within or approaching benchmark values

Warkworth Sands Woodland - Performance Criteria

Figure 2



2.2 Re-establishment Planting

Specific performance criteria targets have been applied to the planting and survival of native species, including those listed as characteristic species of the Warkworth Sands Woodland community in the Final Determination. The Northern MP describes the methodology used to plant these seedlings.

Performance criteria 2

At Year 15, successful regeneration of the WSG community will be determined if the minimum number of seedlings planted, their minimal survival rate and the minimum average number of characteristic WSW species, as shown in Table 7, is attained.

Table 7 Minimum number of seedlings planted, their minimal survival rate and the minimum average number of characteristic WSW species in Transitional sites

	Planted	Survival	Average No. characteristic WSW species per Transitional site
Canopy/mid-storey	9,000	>75%	2 or more
Shrubs	4,500	>75%	3 or more
Ground cover	1,500	>75%	6 or more

The characteristic WSW species listed in the Final Determination for this community are provided in Table 8.

Table 8 Species assemblage listed in the NSW Scientific Committee final determination (2002) for Warkworth Sands Woodland

Scientific Name	Common Name	Strata
Acacia falcate	Hickory Wattle	Shrub
Acacia filicifolia	Fern-leaved wattle	Canopy / Mid storey
Ajuga australis	Austral Bugle	Ground cover
Allocasuarina littoralis	Black She-oak	Canopy / Mid storey
Allocasuarina luehmannii	Bulloak	Canopy / Mid storey
Amyema pendulum	Mistletoe	Shrub
Angophora floribunda	Rough-barked Apple	Canopy / Mid storey
Aristida calycina		Ground cover
Aristida ramose	Purple Wiregrass	Ground cover
Aristida vagans	Threeawn Speargrass	Ground cover
Aristida warburgii		Ground cover
Banksia integrifolia	Coast Banksia	Canopy / Mid storey
Brachyloma daphnoides	Daphne Heath	Shrub
Breynia oblongifolia	Coffee Bush	Shrub
Callitris endlicheri	Black Cypress Pine	Canopy / Mid storey
Calotis cuneifolia	Purple Burr-daisy	Ground cover
Cheilanthes sieberi	Poison Rock Fern	Ground cover
Chrysocephalum apiculatum	Common Everlasting	Ground cover
Desmodium varians		Ground cover
Dianella revolute	Blue Flax Lily	Ground cover
Dichondra species A	Kidney Grass	Ground cover
Echinopogon caespitosus	Bushy Hedgehog-grass	Ground cover
Echinopogon intermedius	Erect Hedgehog Grass	Ground cover
Einadia trigonos	Fishweed	Ground cover
Entolasia stricta	Wiry Panic	Ground cover
Eucalyptus blakelyi/tereticornis	Forest Red Gum	Canopy / Mid storey
Eucalyptus crebra	Narrow-leaved Ironbark	Canopy / Mid storey
Eucalyptus glaucina	Slaty Red Gum	Canopy / Mid storey
Exocarpos cupressiformis	Cherry Ballart / Native Cherry	Canopy / Mid storey
Exocarpos strictus	Pale-fruit Ballart / Dwarf Cherry	Canopy / Mid storey
Hardenbergia violacea	Purple Coral Pea	Ground cover
Hibbertia linearis	Showy Guinea-flower	Shrub
Hovea linearis	-	Shrub
Hypoxis hygrometrica	Golden Weather-grass	Ground cover
Imperata cylindrical	Blady grass	Ground cover
Indigofera australis	Australian Indigo	Shrub
Jacksonia scoparia	Winged Broom-pea	Shrub
Lomandra glauca	Pale Mat-rush	Ground cover
Lomandra leucocephala	Woolly Mat-rush	Ground cover
Lomandra muticus		Ground cover
Melaleuca decora	White Feather Honeymyrtle	Shrub
Melaleuca thymifolia	Thyme Honey-myrtle	Shrub
Persoonia linearis	Narrow-leaved Geebung	Shrub
Pimelea linifolia	Wedding Bush / Slender Rice-	Shrub

Scientific Name	Common Name	Strata
	flower	
Pomax umbellate		Ground cover
Pteridium esculentum	Common Bracken	Ground cover
Solanum prinophyllum	Forest Nightshade	Ground cover
Vittadina sulcata		Ground cover

Appendix A - Vegetation Monitoring – Field Methods

Field Methods

The field methods are derived from the 'Field methodology for measuring condition variables for Site Value and at Reference Sites' according to the BioMetric 3.1 methods (Department of Environment, Climate Change and Water, 2011).

The plots are 50m x 20m and are established such that the plot runs downslope. A 20m x 20m quadrat is positioned within this larger plot and three 50m transects run its length. Marker pegs are used to establish a permanent plot position. GPS coordinates have been taken to ensure monitoring plots can be relocated over time.

The 50m x 20m plot are used to record details of the over-storey (canopy) layer including species composition, species richness, canopy regeneration and canopy health. The % foliage cover directly overhead for canopy species and presence of specific habitat features, such as the abundance of tree hollows, flowers/fruit, mistletoe and fallen logs is also recorded at this scale

The 20m x 20m quadrat is used to record details of the mid-storey and ground stratum composition and structure. All plant species are identified and a cover abundance ranking assigned to each species using a modified Braun- Blanquet cover abundance ranking (Braun Blanquet 1928). The % cover of native/exotic species for various structural layers/plant groups is estimated and additional habitat features such as rocks, litter and bare ground are also recorded at this scale.

Three 50m transects is used to assess the total % foliage cover of the over-storey. These data are collected at 10 points (i.e. at every 5m) along the length of the transects.

Details of the field methods for Vegetation Monitoring are provided below and a summary of the key variables that will be extracted from this data for analysis is provided in Table 1.

- **50x20m plot**

Over-storey composition and species richness: Systematically cover the entire 50x20m plot identifying all over-storey species (tallest woody stratum >1m).

Over-storey regeneration: When identifying over-storey species, also record stem diameter class (0-10cm, 10-20cm or >20cm) for each tree.

Additional habitat features: When identifying over-storey species, note the presence of tree hollows (minimum entrance width of 5cm), mistletoe or flowers/fruit on each tree and any dead trees. Also record the length of fallen logs (minimum diameter 10cm and minimum length 0.5m) within the plot.

- **20x20m quadrat**

Community species richness: Systematically cover the entire 20x20m quadrat identifying and recording all native species in the mid-storey (all vegetation between the over-storey and >1m including tall shrubs, under-storey trees and tree regeneration) and all native species in the ground stratum noting native grasses (plants belonging to the Family Poaceae), native shrubs (woody vegetation <1m), other native species (other native non-woody vegetation in ground stratum e.g. forbs, herbs, lilies, rushes, sedges) and exotic species. Assign a cover abundance ranking to each species, using a modified Braun- Blanquet cover abundance ranking (Braun Blanquet 1928). Rankings will follow: 1 = few individuals (< 1% cover); 2 = many individuals (< 5% cover); 3 = 5 – 25% cover; 4 = 26 – 50% cover; 5 = 51 – 75% cover; 6 = 76 – 100% cover.

Community structure: Divide the 20x20m quadrat into four 10x10m quarters and estimate the % cover of native species in each stratum (mid-storey, ground stratum (grasses), ground-stratum (shrubs), ground stratum (other) and exotics) within each quarter. Average the four estimates to obtain an average % cover for each stratum in the 20x20m quadrat.

Additional habitat features: Within each quarter of the quadrat, also estimate % cover of litter, rock and bare ground. Average the four estimates to obtain an average % cover for each habitat feature in the 20x20m quadrat.

- **50m transect**

Community structure: At 10 points along each of the three 50m transects (every 5m) estimate % foliage cover directly overhead (over-storey) using reference images provided in the BioMetric 3.1 Operational Manual (Department of Environment, Climate Change and Water, NSW, 2011). Average the estimates to obtain an average % foliage cover for the plot.

Table 1 Key attributes used to monitor changes in the vegetation/habitat condition

Attributes	Measurement units	Sampling units
SPECIES RICHNESS		
Native over-storey	Species ID and No. species/sampling unit	50x20m plot
Native mid-storey	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (grasses)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (shrubs)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (other)	Species ID and No. species/sampling unit	20x20m quadrat
Exotic ground stratum	Species ID and No. species/sampling unit	20x20m quadrat
Total	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Native	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Exotic	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
COMMUNITY STRUCTURE		
Native over-storey	% cover of species and vegetation layer	3x50m transects
Native mid-storey	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (grasses)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (shrubs)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (other)	% cover of species and vegetation layer	20x20m quadrat
Exotic	% cover of species and vegetation layer	20x20m quadrat
OVERSTOREY REGENERATION & HEALTH		
Over-storey species regeneration	No. species	50x20m plot
Over-storey species stem diameter class (0-10cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (10-20cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (>20)	No./sampling unit	50x20m plot
ADDITIONAL HABITAT FEATURES		
Litter	% cover	20x20m quadrat
Rock	% cover	20x20m quadrat
Bare ground	% cover	20x20m quadrat
Log	Length	50x20m plot
Tree hollows	Number	50x20m plot
Dead trees	(% tree population)	50x20m plot
Mistletoe	(% tree population)	50x20m plot
Flower/fruit	(% tree population)	50x20m plot

Appendix C - Habitat Restoration Monitoring

Details of the field methods for Vegetation Monitoring are provided below and a summary of the key variables that will be extracted from this data for analysis is provided in Table C1.

- **50x20m plot**

Over-storey composition and species richness: Systematically cover the entire 50x20m plot identifying all over-storey species (tallest woody stratum >1m).

Over-storey regeneration: When identifying over-storey species, also record stem diameter class (0-10cm, 10-20cm or >20cm) for each tree.

Additional habitat features: When identifying over-storey species, note the presence of tree hollows (minimum entrance width of 5cm), mistletoe or flowers/fruit on each tree and any dead trees. Also record the length of fallen logs (minimum diameter 10cm and minimum length 0.5m) within the plot.

- **20x20m quadrat**

Community species richness: Systematically cover the entire 20x20m quadrat identifying and recording all native species in the mid-storey (all vegetation between the over-storey and >1m including tall shrubs, under-storey trees and tree regeneration) and all native species in the ground stratum noting native grasses (plants belonging to the Family Poaceae), native shrubs (woody vegetation <1m), other native species (other native non-woody vegetation in ground stratum e.g. forbs, herbs, lilies, rushes, sedges) and exotic species. Assign a cover abundance ranking to each species, using a modified Braun- Blanquet cover abundance ranking (Braun Blanquet 1928). Rankings will follow: 1 = few individuals (< 1% cover); 2 = many individuals (< 5% cover); 3 = 5 – 25% cover; 4 = 26 – 50% cover; 5 = 51 – 75% cover; 6 = 76 – 100% cover.

Community structure: Divide the 20x20m quadrat into four 10x10m quarters and estimate the % cover of native species in each stratum (mid-storey, ground stratum (grasses), ground-stratum (shrubs), ground stratum (other) and exotics) within each quarter. Average the four estimates to obtain an average % cover for each stratum in the 20x20m quadrat.

Additional habitat features: Within each quarter of the quadrat, also estimate % cover of litter, rock and bare ground. Average the four estimates to obtain an average % cover for each habitat feature in the 20x20m quadrat.

- **50m transect**

Community structure: At 10 points along each of the three 50m transects (every 5m) estimate % foliage cover directly overhead (over-storey) using reference images provided in the BioMetric 3.1 Operational Manual (Department of Environment, Climate Change and Water, NSW, 2011). Average the estimates to obtain an average % foliage cover for the plot.

Table C1 Key attributes used to monitor changes in the vegetation/habitat condition

Attributes	Measurement units	Sampling units
SPECIES RICHNESS		
Native over-storey	Species ID and No. species/sampling unit	50x20m plot
Native mid-storey	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (grasses)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (shrubs)	Species ID and No. species/sampling unit	20x20m quadrat
Native ground stratum (other)	Species ID and No. species/sampling unit	20x20m quadrat
Exotic ground stratum	Species ID and No. species/sampling unit	20x20m quadrat
Total	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Native	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
Total Exotic	Species ID and No. species/sampling unit	20x20m quadrat for mid-storey and ground strata, 50x20m plot for over-storey
COMMUNITY STRUCTURE		
Native over-storey	% cover of species and vegetation layer	3x50m transects
Native mid-storey	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (grasses)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (shrubs)	% cover of species and vegetation layer	20x20m quadrat
Native ground stratum (other)	% cover of species and vegetation layer	20x20m quadrat
Exotic	% cover of species and vegetation layer	20x20m quadrat
OVERSTOREY REGENERATION & HEALTH		
Over-storey species regeneration	No. species	50x20m plot
Over-storey species stem diameter class (0-10cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (10-20cm)	No./sampling unit	50x20m plot
Over-storey species stem diameter class (>20)	No./sampling unit	50x20m plot
ADDITIONAL HABITAT FEATURES		
Litter	% cover	20x20m quadrat
Rock	% cover	20x20m quadrat
Bare ground	% cover	20x20m quadrat
Log	Length	50x20m plot
Tree hollows	Number	50x20m plot
Dead trees	(% tree population)	50x20m plot
Mistletoe	(% tree population)	50x20m plot
Flower/fruit	(% tree population)	50x20m plot

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