

Tony Dwyer Group Manager – Approvals and Biodiversity Vickery Coal Pty Ltd By email: <u>tdwyer@whitehavencoal.com.au</u>

13/03/2024

### Subject: Revised Biodiversity Offset Strategy

Dear Mr Dwyer

Thank you for submitting the Revised Biodiversity Offset Strategy in accordance with condition B56 of the development consent for the Vickery Coal Mine Extension Project (SSD 7480). I also acknowledge your response to the Department's requests for additional information.

I note the strategy has been prepared in consultation with the Biodiversity Conservation and Science Directorate of the NSW Department of Climate Change, Energy, the Environment and Water, and contains the information required by the conditions of consent. Accordingly, as nominee of the Planning Secretary, I approve the Revised Biodiversity Offset Strategy (Rev 5, dated 12 March 2024).

You are reminded that the Biodiversity Management Plan, required by condition B63 of SSD 7480 must be reviewed and revised to include any relevant changes. Please ensure that all relevant management plans and strategies are reviewed and updated to reflect the changes in the strategy.

You are reminded that if there are any inconsistencies between the strategy and the conditions of approval, the conditions prevail. Please ensure you make the document publicly available on the project website at the earliest convenience.

If you wish to discuss the matter further, please contact Philip Nevill on (02) 8275 1036.

Yours sincerely

Stephen O'Donoghue Director Resource Assessments As nominee of the Planning Secretary





Our ref: DOC24/188450 Your ref: SSD 7480

Philip Nevill Senior Environmental Assessment Officer Energy and Resource Assessment Department of Planning, Housing & Infrastructure philip.neville@planning.nsw.gov.au

### Dear Philip,

### Vickery Coal 2 – Revised biodiversity offset strategy (SSD 7480)

Thank you for your e-mails dated 23 and 27 February, and request via the Major Project Portal on 7 March 2024, to the Biodiversity, Conservation and Science Directorate (BCS) of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) providing additional information on the progress of biodiversity credit retirement and an updated version of the revised biodiversity offset strategy (BOS) for Vickery Coal 2.

We appreciate the inclusion of additional information in the BOS to address the recommendations in our letter dated 2 February 2024. As recommended, the BOS now includes additional information for:

- the criteria used to select the substitute offset sites,
- justification for replacing offset Areas 2 to 5,
- land management history for the original and the substitute offset sites,
- data enabling a comparison of current vegetation condition and species habitat between the original and substitute offset sites,
- details of the restoration program for the substitute offset sites.

We are of the view that the substitute offset sites as described in the revised BOS are capable of meeting the condition under Condition B56 of the project consent. Evidence that long term security of the offset sites has been established should be provided prior to discharging the requirements of this condition.

Specific comments on the revised information in the BOS is provided below.

#### Advantages of the substitute offset sites

The Vickery substitute offsets will be consolidated with other Whitehaven offset areas. We concur with the revised BOS findings that, with management for restoration and conservation, the substitute offset areas will:

- Provide landscape connectivity between Boonalla Community Conservation Area and Vickery State Forest
- Experience lower edge effects than the original offset areas 2 to 5
- Be less vulnerable to stochastic events than offset areas 2 to 5
- Be more efficient to manage for conservation, especially when combined with the other Whitehaven offset areas.

### Comparative condition of original and substitute offset sites

The additional information provides a comparison for plant community type (PCT) 101 Poplar Box -Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion. This comparison indicates that the vegetation in the substitute offset sites is in lower condition than original offset sites 2 to 5, as follows:

- The substitute offset sites have had a history of more intense agricultural disturbance than the original offset sites 2 to 5. Agricultural activities on the original offset sites ceased in mid-2017. The substitute offset sites have been largely cleared since before 1966. The BOS does not state when agricultural activities ceased on the substitute offset sites.
- The vegetation condition of PCT 101 woodland areas in the substitute offset areas is similar to that in the original offset areas 2 to 5. The substitute offset areas have a vegetation integrity (VI) score of 73.5 compared with 74.1 in the original offset areas.
- The vegetation condition of PCT 101 derived native grassland (DNG) is lower in the substitute offset areas (VI score of 36.1) compared with the original offset areas (VI score of 48).
- The area of PCT 101 woodland in the original offsets is significantly higher (122.02 ha) than the substitute offset areas (18.7 ha).
- The area of PCT 101 DNG in the original offset areas 2 to 5 is substantially lower (6.04 ha) than in the substitute offset areas (432.16).

Please note that PCT 101 is incorrectly named as *Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion* in sections 5.1.2 to 5.1.4 of the revised BOS.

### Comment on future vegetation integrity scores

Table 5.7 provides a comparative assessment of vegetation integrity between original and substituted offset areas using data generated by the Biodiversity Assessment Method Calculator (BAM-C). This includes the future VI scores after 20 years of conservation management.

Section 4.2.4 provides the method for calculating the future gain in vegetation integrity, stating that:

Data collected from BAM plots across all offset areas were analysed to provide an overall current Vegetation Integrity Score (VI) and an overall VI Score with Management, including Active Restoration Management Actions (ARMA) restoration in DNGs on the substitute offset areas, at year 20.

The revised BOS does not state whether the BAM-C VI scores for year 20 assume the same management actions (eg ARMA restoration in DNGs) for both the original offset areas 2 to 5 and the substitute offset sites.

It is therefore unclear whether the total gains in VI score are directly comparable, especially for DNG. The higher gain in VI score for the substituted offset areas (VI score gain of 9) compared with the original offset sites (VI score gain of 3.7) may be due to:

- Different management actions being entered into the BAM-C
- The substituted offset sites having a lower current VI score. This means that, as they are currently further below the benchmark for PCT 101, they have more scope for VI gain.

Table 5.2 also provides a total indicative credit generation for the original offset areas and substituted offset areas. The credit generation of the substitute offset areas is likely to be greater due to their larger size (450.86 ha compared with 128.06 ha for the original offsets) and the greater VI gain in PCT 101 DNG.

### Security of offsets

Condition B57 of the Vickery Extension Project (SSD 7480) requires the Applicant to make suitable arrangements to provide long term security for offset areas 2 to 5 within 2 years of commencement of development unless otherwise agreed by the Planning Secretary.

The BOS does not outline whether long term security has been provided for offset areas 2 to 5.

The email provided to BCS on 23 February included an update on progress towards satisfying the biodiversity offset requirements of SSD 7480. This states that Whitehaven Coal has submitted applications to the Biodiversity Conservation Trust (BCT) on 31 March 2023 for conservation agreements over the substitute offset areas. Whitehaven Coal is working with the BCT to secure the substitute offsets on title by 28 April 2024.

#### Conclusion

In the development consent for the Vickery Extension Project (SSD 7480), a note under Condition B56 states that any area of the offset strategy in Table 9 of the consent may be substituted with an alternative offset site subject to demonstration of equivalent biodiversity outcomes and to the satisfaction of the Secretary.

We are satisfied that the BOS now contains adequate information to allow the consent authority to decide whether the biodiversity outcomes of the substitute offset sites are equivalent to those of offset areas 2 to 5.

If you have any questions about this advice, please do not hesitate to contact Liz Mazzer, Senior Conservation Planning Officer, via <u>liz.mazzer@environment.nsw.gov.au</u> or (02) 6883 5325.

Yours sincerely

Calvin Houlison Senior Team Leader Planning North West Biodiversity, Conservation and Science

8 March 2024

Cc: Andrew Wright, Group Superintendent – Biodiversity, Whitehaven Coal Limited <u>AWright@whitehavencoal.com.au</u>

Belinda Pellow, Specialist Advisor / Senior Botanist, AMBS Ecology & Heritage belindap@ambs.com.au



# Revision of the Vickery Biodiversity Offset Strategy

Prepared by AMBS Ecology & Heritage Pty Ltd for Whitehaven Coal Limited

Submission Report

March 2024

# **Document Information**

Citation:	AMBS Ecology & Heritage (2024), <i>Revision of the Vickery Biodiversity Offset Strategy</i> . Consultancy report to Andrew Wright, Whitehaven Coal Limited.
AMBS Ref:	19777
Versions:	Version 1: Draft Report issued 14/07/2023 Version 2: Draft Report issued 14/08/2023 Version 3: Report for Submission issued 01/09/2023 Version 4: Report for Submission issued 27/02/2024 Version 5: Final Report for Submission issued 12/03/2024
Recipient:	Andrew Wright
Authors	Elsa Lillford, Chris Jackson, Belinda Pellow, Corey O'Brien
Approved by:	Belinda Pellow

# **Executive Summary**

AMBS Ecology & Heritage Pty Ltd (AMBS) were commissioned by Whitehaven Coal Limited (WHC) to prepare a revision to the Biodiversity Offset Strategy (RBOS) for the Vickery Coal Mine (the Mine). The Mine was initially approved in 2014 under development consent SSD-5000 which outlined a biodiversity offset strategy to offset impacts to biodiversity. This offset obligation was subsequently transferred to the Vickery Coal Mine Extension Project (SSD-7480) approved in 2020.

Since the preparation of the original BOS in 2014 the process to establish in perpetuity, the security of offset areas by Conservation Agreements (CA), has changed due to the implementation of the NSW Biodiversity Conservation Act 2016 (BC Act) and the subsequent establishment of the Biodiversity Conservation Trust (BCT). To prepare and registration on title in June 2021 the Willeroi Conservation Agreement (CA0060), the BCT required WHC to undertake detailed cadastral surveys and utilise contemporary vegetation mapping for the Willeroi CA0060.

This RBOS also outlines the substitution of the original offset areas 2 to 5 by establishing three new, substituted offset areas which, in combination with the secured Willeroi East offset area, will have equivalent biodiversity outcomes as required in SSD-7480, as well as providing an opportunity to improve landscape connectivity between the Vickery State Forest and Nandewar Range Biodiversity Corridor by strategically aligning the offset area locations compared to the original 2014 BOS (SSD-5000).

The Vickery Coal Mine Extension is also subject to an approval granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Condition 21 of the EPBC Act Approval 2016/7649 requires specified areas of potential habitat for the Regent Honeyeater (*Anthochaera phrygia*) and Koala (*Phascolarctos cinereus*) to be set aside as offsets.

This RBOS outlines how Willeroi East and substituted offset areas provide improved biodiversity outcomes to the original BOS requirements from NSW approval SSD-5000 (subsequently transferred to SSD-7480) and greater areas of habitat for the Regent Honeyeater and Koala to meet Commonwealth requirements in EPBC Act approval 2016/7649 (Condition 21).

A comparison between the BOS and the RBOS shows variation between the vegetation classes mapped (Table 6.2). While there is variation; overall the RBOS meets the biodiversity value requirements as per the Vickery Coal Mine Extension Project Approvals (SSD-7480 & EPBC 2016/7649) relating to TECs, Koala and Regent Honeyeater habitat, and the extent of offset area and area required for "enhanced with the restoration" (i.e. revegetation and habitat augmentation).

The RBOS will result in an increase in the area of TECs secured in perpetuity (Table 6.1) by 134.76 ha due to the revisions made as a result of the higher accuracy of spatial data delineating the cadastral boundaries of properties surveyed, and the application of contemporary vegetation community mapping standards.

There will be no change to the status of the threatened plants recorded on the Willeroi East offset area as a result of the Vickery RBOS.

The habitat area identified in Table 6.1 contains 1,358.11 ha of potential Regent Honeyeater (*Anthochaera phrygia*) habitat (greater than the minimum 293.9 ha which is the equivalent of 2,087 species credits) and 1,377.98 ha of potential Koala (*Phascolarctos cinereus*) habitat

(greater than the minimum 112 ha which is the equivalent of 795 species credits) as required under Condition 21 of the EPBC Act Approval 2016/7649.

The offset areas of Willeroi East, and those substituted, Wean North, Costavale and Glenroc, as proposed in this RBOS, collectively fulfill, and exceed, the requirements of SSD 7480 and/or EPBC 2016/7649 (Table 7.1).

Biodiversity Offset Strategy Criteria (SSD 7480 and/or EPBC 2016/7649)	Required Quantum for Biodiversity Offset Strategy (ha)	Quantum in Revised Biodiversity Offset Strategy (ha)	Difference (Revised BOS - Required BOS)
Minimum Area	2,075.5 (1,671 + 404.5)	2,111.77	+ 36.27
Box Gum Woodland CEEC	201 (156 + 45)	285.97	+ 84.97
Poplar Box Woodland	127	449.98	+ 322.98
Potential Regent Honeyeater Habitat	293.9	1,358.11	+ 1,064.21
Potential Koala Habitat	112	1,377.98	+ 1,265.98

Summary of requirements of SSD 7480 and/or EPBC 2016/7649 and how they have been met.

Incorporating the substitute offset areas, will serve as an important linkage between the Boonalla Conservation Area, Vickery State Forest and other WHC offset areas enhancing connectivity within the broader environment. This connectivity facilitates the movement of species, allowing for gene flow, dispersal, and ecological resilience overtime. The integration of these offset areas into the RBOS demonstrates a meaningful approach towards preserving and enhancing the ecological integrity of the region, ensuring the long-term viability of its biodiversity and supporting the overall objectives of conservation.

Despite variation in time since cessation of agricultural practices and varying agricultural history, the assessment of data using the BAMC shows only small differences in Vegetation Integrity Current and Future between woodland areas of original and substitute offset areas. The Vegetation Integrity Scores in the DNG area of original offset areas is higher than in the substitute offset areas however, when broken into the data components, structural and compositional condition is similar.

Restoration planting was commenced on Glenroc in 2022 and will be implemented in Costavale and Glenroc in 2024.

While this is a legacy offset requirement grandfathered to an offsetting scheme prior to the 2016 NSW Biodiversity Offset Scheme; the contemporary assessment of the substitute offset areas using this scheme, being larger in area, would hypothetically, contribute a greater number of biodiversity credits at commencement of management than could the original offset areas and this value will increase with restoration.

Long-term limitations due to the isolation of offset areas 2 to 5 could be overcome more easily at the substitute offset areas through restorative canopy revegetation and active management.

This RBOS does not alter or vary the existing commitment from the original Vickery BOS (SSD-5000) for a Rehabilitation Area of 1,360 ha as part of the Offset package that has been transferred through to SSD-7480 Condition B56. This RBOS only addresses the external land based components of the Vickery BOS; and as such the description and implementation of the Rehabilitation Area offset will be documented in future Vickery Coal Mines' Rehabilitation Management Plan and Rehabilitation Strategy revisions to be updated prior to major construction works and full scale mining.

It was determined that, considering these conclusions collectively, the key objectives of the original BOS could be achieved using the substitute offset areas and that additional gains to biodiversity, in the long term, would be facilitated by the adoption of the substitute offset areas as proposed in this RBOS.

# Contents

E	kecutiv	ve Summary	III
1	Intr	oduction	9
	1.1	Background	9
	1.2	Relevant Approval Conditions Relating to this Revised BOS	10
	1.2.1	1 Vickery Coal Mine (SSD-7480 transferred from SSD-5000)	10
	1.2.2	2 Commonwealth approval for the Vickery Coal Mine Extension (EPBC Act Ap	oproval
	2016	5/7649, Clause 21)	10
	1.3	Scope and Objectives	10
	1.4	Location of the Study Area	11
2	Ove	erview of Original Offset Areas	13
	2.1	Willeroi East	13
	2.1.1	1 Flora	13
	2.1.2	2 Threatened Ecological Communities	18
	2.1.3	3 Threatened Plants	
	2.1.4	4 Fauna	
	2.2	Uffset areas 2, 3, 4, & 5	
	2.2.2	L Flord	21
	2.2.1	1 Threatened Plants	22
	2.2.2	2 Fauna	22
	2.2.	4 Historic Aaricultural Landuse	27 28
	2.2	Rehabilitation Area as Part of the Approved BOS	
2	Dro	norod Substitute Officet Areas	20
3	2 1	Justification for Substitution	<b>20</b>
	3.1	Criteria used to Select Substitute Offset Area	29
	5.2		
4	IVIE	[NOGS	33
	4.1	Flora – Willeroi East	33
	4.1.	Desktop and Literature Review	
	4.1.2 1 1 1	2 FIEld Sulveys	55 2/1
	4.1.	Flora - Wean North Glenroc and Costavale	
	4.2.1	1 Desktop and Literature Review	
	4.2.2	2 Field Surveys	
	4.2.3	3 PCT Determination and Mapping	
	4.2.4	4 Determining Vegetation Condition for Comparative Assessment	38
	4.3	Fauna	39
	4.3.2	1 Desktop and Literature Review	39
	4.3.2	2 Categorising Habitat Value for Koala and Regent Honeyeater	39
5	Res	ults	40
	5.1	Description of Revised BOS Values – Flora	40
	5.1.2	1 Willeroi East	40
	5.1.2	2 Wean North	61
	5.1.3	3 Glenroc	67
	5.1.4	4 Costavale	75
	5.2	Description of Revised BOS Values - Fauna	78
	5.2.2	1 Revised BOS Habitat Values	78
	5.2.2	2 Willeroi East	82
	5.2.3	Gienroc	82
	5.2.4	4 COSTAVAIP	دة
	5.2.3	Comparative Assessment of Vegetation Condition	دة م
	J.J	comparative Assessment of vegetation condition	

	5.4	Comparative Assessment of Fauna values	86
	5.5	Landscape Connectivity	87
6	Sun	nmary of Findings	91
	6.1	Plant Community Types	91
	6.2	Threatened Ecological Communities	91
	6.3	Threatened Plants	91
	6.4	Fauna	94
	6.5	Vegetation Condition	94
	6.6	Rehabilitation Area as part of the approved BOS	95
	6.7	Restoration of Substitute Offsets	95
7	Cor	clusions	99
8	Ref	erences1	01
A	opend	lix A: Historic Imagery and Land Use Mapping Original Offset Area 21	04
A	opend	lix B: Historic Imagery and Land Use Mapping Original Offset Area 31	08
A	opend	lix C: Historic Imagery and Land Use Mapping Original Offset Areas 4 & 5 $\dots$ 1	12
A	opend	lix D: Historic Imagery and Land Use Mapping Wean North1	16
A	opend	lix E: Historic Imagery and Land Use Mapping Glenroc and Costavale1	20

# Tables

Table 1.1 Summary of the biodiversity offset strategy (DPE 2020a SSD-7480)	10
Table 2.1 Vegetation Community Alignment and Area for Willeroi East (Niche 2012)	15
Table 2.2 Threatened Ecological Communities recorded in the Willeroi East offset area (Niche 20	)12)
	18
Table 2.3 Plant Community Types listed for offset areas 2 – 5 (Whitehaven 2018)	21
Table 3.1 Justification for substituting the original offset areas (2 to 5) with Wean North, Costa	vale
and Glenroc offset areas	31
Table 4.1 Qualifications of ecologists undertaking fieldwork for the Willeroi property	33
Table 4.2 Survey Effort on Willeroi property (East and West offset areas)	36
Table 4.3 Qualifications of ecologists undertaking fieldwork on Wean North, Costavale and Gler	۱roc
	37
Table 5.1 PCTs mapped within the Willeroi East offset area and condition states	40
Table 5.2 Threatened Ecological Communities listed for Willeroi East	60
Table 5.3 Plant Community Types for Wean North	61
Table 5.4 Plant Community Types for Glenroc	67
Table 5.5 Plant Community Types for Costavale	75
Table 5.6: Fauna habitat values for the Revised Vickery BOS	79
Table 5.7 Comparative Assessment of Vegetation Integrity between original and substituted of	fset
areas using data generated by the BAMC	85
Table 5.8 Bird and microbat species richness comparison	86
Table 6.1 Summary Table Willeroi east previous and revised TEC areas	91
Table 6.2 Vegetation Classes recorded in the original BOS and RBOS and the area of each	92
Table 6.3 PCTs providing potential existing habitat for the Regent Honeyeater and Koala in Will	eroi
East	94
Table 6.4 Example of a planting regime	96
Table 7.1 Summary of requirements of SSD 7480 and/or EPBC 2016/7649 and how they have b	een
met	99

# **Figures**

Figure 1.1 Location of the study area	
Figure 2.1 Extent of the Willeroi East offset area as shown in the SS	5D-7480 approval (Whitehaven
2018)	
Figure 2.1 Extent of the Willeroi East offset area as shown in the SS 2018)	5D-7480 approval (Whitehaver 14

Figure 2.2 Vegetation Mapping of the Willeroi East offset area (Niche 2012) using PCTs assigned t RBVTs as per DPIE (2017)	0
Figure 2.3 Extent of offset areas, 2 3, 4, and 5 as shown in the SSD-7480 approval (Whitehaven 2018	;) 1
Figure 2.4 Plant Community Types for Area 2 (Whitehaven 2018)2	3
Figure 2.5 Plant Community Types for Area 3 (Whitehaven 2018)	4
Figure 2.6 Plant Community Types for Area 4 (Whitehaven 2018)2	5
Figure 2.7 Plant Community Types for Area 5 (Whitehaven 2018)2	6
Figure 3.1 Location of substituted offset areas adjoining other WHC Biodiversity Management Area	S
(existing Offset Areas/Conservation Agreements and Biodiversity Stewardship Sites)	2
Figure 5.1 Plant community types in the Willeroi East offset area4	2
Figure 5.2 Plant community types for Wean North6	2
Figure 5.3 Plant Community Types for Glenroc6	8
Figure 5.4 Plant Community Types and TECS for Costavale7	6
Figure 5.5: Koala Existing Potential Habitat and Future Potential Habitat – Willeroi East	0
Figure 5.6: Regent Honeyeater Existing Potential Habitat and Future Potential Habitat – Willeroi East	st
	1
Figure 5.7: Location of revegetation to provide connectivity between offset areas, Vickery Stat	e
Forest and the Boonalla Conservation Area8	9
Figure 5.8 Improving connectivity across the Region9	0

# 1 Introduction

### 1.1 Background

AMBS Ecology & Heritage Pty Ltd (AMBS) were commissioned by Whitehaven Coal Limited (WHC) to prepare a revision to the Biodiversity Offset Strategy (RBOS) for the Vickery Coal Mine (the Mine). The Mine was initially approved in 2014 under development consent SSD-5000 which outlined a biodiversity offset strategy to offset impacts to biodiversity. This offset obligation was subsequently transferred to the Vickery Coal Mine Extension Project (SSD-7480) approved in 2020.

The 2014 BOS was established across 5 offset areas, Willeroi East, the largest, and offset areas 2 to 5 (henceforth referred to as the original offset areas) in the vicinity of the Mine site.

Since the preparation of the BOS in 2014 the process to establish in perpetuity, the security of offset areas by Conservation Agreements (CA), has changed due to the implementation of the NSW Biodiversity Conservation Act 2016 (BC Act) and the subsequent establishment of the Biodiversity Conservation Trust (BCT). The BCT now oversees the preparation of CAs for the securing of offset areas.

To prepare for and achieve registration on title in June 2021 the Willeroi Conservation Agreement (CA0060), the BCT required WHC to undertake detailed cadastral surveys and utilise contemporary vegetation mapping for the Willeroi CA0060. The Willeroi CA includes the Willeroi East offset area for the Vickery Coal Mine (VCM) and the Willeroi West offset area for Tarrawonga Coal Mine (TCM).

The cadastral survey was undertaken by registered surveyors and involved redefining the cadastral boundary to a very high accuracy, resulting in variations to the previous extent of the offset area when compared to the lower accuracy, digital cadastre spatial data, that was used when mapping the original offset areas. In addition, the BCT required the use of the NSW Plant Community Type (PCT) vegetation mapping classification system and therefore the original VCM BOS vegetation mapping (undertaken by Niche [2012] using an older classification system) needing to be revised utilising quantitative biometrics to define vegetation assemblages for the application of the required PCT mapping.

This RBOS also outlines the substitution of the original offset areas 2 to 5 by establishing three new, substituted offset areas which, in combination with the secured Willeroi offset area, will have equivalent biodiversity outcomes as required in SSD-7480, as well as providing an opportunity to improve landscape connectivity between the Vickery State Forest and Nandewar Range Biodiversity Corridor by strategically aligning the offset area locations compared to the original 2014 BOS (SSD-5000).

The Vickery Coal Mine Extension is also subject to Approval 2016/7649 granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Condition 21 of this approval requires specified areas of potential habitat for the Regent Honeyeater (*Anthochaera phrygia*) and Koala (*Phascolarctos cinereus*) to be set aside as offsets. This requirement to set aside habitat will be met within the Willeroi East offset area and is addressed in this RBOS.

This RBOS outlines how Willeroi East and substituted offset areas provide improved biodiversity outcomes to the original BOS requirements from NSW approval SSD-5000 (subsequently transferred to SSD-7480) and greater areas of habitat for the Regent Honeyeater and Koala to meet Commonwealth requirement s in EPBC Act approval 2016/7649 (Condition 21).

# **1.2** Relevant Approval Conditions Relating to this Revised BOS

### 1.2.1 Vickery Coal Mine (SSD-7480 transferred from SSD-5000)

Vickery Coal Mine was approved in 2014 (DPE 2014a) and the Vickery Mine Extension was approved in 2020 (DPE 2020a). The BOS was transferred from SSD-5000 to SSD-7480 Condition B56 requiring the implementation of the BOS shown in Table 1.1 with an additional note (as per excerpt with Table 1.1):

"Any area of the offset strategy in Table 9 (of the 2020 approval) may be substituted with an alternative offset area subject to demonstration of equivalent biodiversity outcomes and to the satisfaction of the Secretary"

Area	Offset Type	Minimum Size (hectares)
Willeroi East Offset	Existing vegetation to be enhanced, and additional vegetation to be established with the restoration of at least 156 ha of Box Gum Woodland EEC, as listed under the TSC Act	1,671
Areas 2, 3, 4 & 5	Existing vegetation to be enhanced with the restoration of at least 127 ha of Poplar Box Woodland and 45 ha of Box Gum Woodland EEC, as listed under the TSC Act	404.5
Rehabilitation Area	Re-establishment of native vegetation communities for a biodiversity conservation land use objective	1,360

Table 1.1 Summa	arv of the biodiversit	v offset strategy	(DPE 2020a SSD-748	30)
		1	1	/

#### Note:

- For the purposes of this consent Box Gum Woodland refers to the EEC listed as White Box Yellow Box Blakely's Red Gum Woodland under the TSC Act, or similar EEC as may be updated from time to time.
- Any area of the offset strategy in Table 9 (of the 2020 approval) may be substituted with an alternative offset area subject to demonstration of equivalent biodiversity outcomes and to the satisfaction of the Secretary
  - 1.2.2 Commonwealth approval for the Vickery Coal Mine Extension (EPBC Act Approval 2016/7649, Clause 21)

The Vickery Coal Mine Extension is subject to an approval granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DAWE 2021) Condition 21 specifies that at least 293.9 ha of potential Regent Honeyeater (*Anthochaera phrygia*) habitat (the equivalent of 2,087 species credits) and 112 ha of potential Koala (*Phascolarctos cinereus*) habitat (the equivalent of 795 species credits) must be offset. In a statement (AMBS, 2022) submitted to the Commonwealth demonstrating that the required minimum extent of potential habitat was being met within the Willeroi East offset area.

### **1.3** Scope and Objectives

The scope of this project is to prepare a revised BOS that updates the original BOS and its required biodiversity values, first described in SSD-5000 and then transferred to SSD-7480, and to address threatened fauna habitat requirements under Commonwealth approval 2016/7649 for the Vickery Coal Mine and the proposed Extension.

The objectives are to:

• describe the NSW BOS requirements and associated offset areas;

- describe the proposed revisions to the NSW BOS and associated and substituted offset areas;
- describe the way in which the Commonwealth offset requirements for threatened fauna will be met; and
- describe how these NSW and Commonwealth offset biodiversity value requirements will be met by the RBOS.

### 1.4 Location of the Study Area

The study area is located on the north western slopes of New South Wales in an area bounded by Gunnedah to the south, Manilla to the east, Boggabri to the West and Narrabri to the north west (Figure 1.1). The study area falls within two Local Government Areas (LGAs), Narrabri Shire to the north and Gunnedah Shire to the south. The original and substituted offset areas are within the Brigalow Belt South IBRA region and Liverpool Plains subregion and the Willeroi East offset area located further to the north in the Nandewar IBRA region and Peel subregion.



Figure 1.1 Location of the study area

# 2 Overview of Original Offset Areas

# 2.1 Willeroi East

The extent of the Willeroi East offset area as described in the SSD-7480 approval is shown in Figure 2.1. An assessment of this property was undertaken in 2012 as part of the EIS for the Vickery Coal Mine (Niche 2012). Willeroi East is located approximately 40 kilometres (km) north-east of Boggabri and 60 km north of Gunnedah, NSW. The property is owned by Whitehaven Coal Mining Limited. Willeroi East is situated in the Gunnedah Basin, within the Maules Creek sub-catchment of the Namoi CMA and within the Nandewar IBRA bioregion, and the Peel-IBRA subregion.

The topography of the study area is generally rugged, with steep terrain and ridgetop environments occupying the eastern portion of the study area, and flatter areas generally towards the west. Altitudes in the study area range from 400 metres (m) Australian Height Datum (AHD) to 1,020 m AHD in the south-eastern portion. The flatter areas of the property are predominantly cleared with mature native trees and shrubs occupying watercourses and steeper slopes.

The study area is part of a large expanse of connected vegetation, extending from approximately 25 km to the south-west, through to Mount Kaputar National Park to the immediate north-west. The main watercourse in the study area is Maules Creek, which occurs along the western border of the study area. Maules Creek is a small tributary of the Namoi River. Throughout the study area a number of drainage lines feed into Maules Creek.

The total extent of Willeroi East was originally described as being 1,671 ha; containing approximately 1,393.11 ha of existing forest/woodland, 245.78 ha of secondary/derived native grasslands and 26.88 ha of eroded/scald land. This includes approximately 155.23 ha Box-Gum Woodland EEC, and 19.33 ha of Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions EEC (Figure 2.2).

### 2.1.1 Flora

Flora surveys were undertaken over seven days between 27 and 28 March 2012 and 1 April and 6 April 2012. Niche completed 83 plots in native vegetation types sampled from across the study area to determine the vegetation types present and a series of rapid data points to assist with the vegetation mapping.

The vegetation communities within the study area were composed of 10 parent vegetation types. Collectively 19 vegetation communities were identified as different condition states across the 10 types (Table 2.1; Figure 2.2). Vegetation was assigned to Regional Biodiversity Vegetation Types (RBVT) that were in use at that time. Equivalent Plant Community Types (PCTs) have been assigned to these RBVTs using the biometric vegetation types archive - 17082017 (DPIE 2017).



APPENDIX 4 BIODIVERSITY OFFSETS

Figure 2.1 Extent of the Willeroi East offset area as shown in the SSD-7480 approval (Whitehaven 2018).

Code	Vegetation Community	TEC status	RBVT Code	RBVT	Keith Class	Keith Formation	Equivalent PCT (DPIE 2017)	Area (ha)
1	Narrow-leaved Ironbark - White Cypress Pine Shrubby Open Forest	Not a TEC	NA228	White Cypress Pine Narrow-leaved Ironbark shrub/grass open forest of the western Nandewar Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby subformation)	1313	418
2	White Box - White Cypress Pine Shrubby Woodland	Not a TEC	NA225	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	North-west Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrub/grass subformation)	1308	50
2a	White Box - White Cypress Pine Cypress Regeneration	Not a TEC	NA225	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	North-west Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrub/grass subformation)	1308	121
2b	White Box - White Cypress Pine Semi cleared	Not a TEC	NA225	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	North-west Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrub/grass subformation)	1308	567
2c	White Box - White Cypress Pine Derived Native Pasture	Not a TEC	NA225	White Box - White Cypress Pine shrubby open forest of the Nandewar and Brigalow Belt South Bioregions	North-west Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrub/grass subformation)	1308	72
2e	White Box - White Cypress Pine Derived Shrubland	Not a TEC	NA225	White Box - White Cypress Pine shrubby open forest of the Nandewar	North-west Slopes Dry Sclerophyll Woodlands	Dry Sclerophyll Forests (Shrub/grass subformation)	1308	22

 Table 2.1 Vegetation Community Alignment and Area for Willeroi East (Niche 2012)

Code	Vegetation Community	TEC status	RBVT Code	RBVT	Keith Class	Keith Formation	Equivalent PCT (DPIE 2017)	Area (ha)
				and Brigalow Belt South Bioregions				
Зс	White Box Grassy Woodland Derived Native Pasture	Yellow Box Blakely's Red Gum Woodland	NA226	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	Western Slopes Grassy Woodlands	Grassy Woodlands	1383	136
5	Bracteate Honeymyrtle Low Riparian Forest	Not a TEC	NA191	River Oak riparian woodland of the Brigalow Belt South and Nandewar	Eastern Riverine Forests	Forested Wetlands	84	36
5b	Bracteate Honeymyrtle Low Riparian Forest Semi- cleared Regenerating	Not a TEC	NA191	River Oak riparian woodland of the Brigalow Belt South and Nandewar	Eastern Riverine Forests	Forested Wetlands	84	24
5c	Bracteate Honeymyrtle Low Riparian Forest Derived Native Pasture	Not a TEC	NA191	River Oak riparian woodland of the Brigalow Belt South and Nandewar	Eastern Riverine Forests	Forested Wetlands	84	13
8c	Yellow Box - Blakely's Red Gum Derived Native Pasture	White Box Yellow Box Blakely's Red Gum Woodland	NA191	Yellow Box – Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	84	20
9	River Oak – River Red Gum Riparian Forest	Not a TEC	NA237	River Oak riparian woodland of the Brigalow Belt South and Nandewar	Eastern Riverine Forests	Forested Wetlands	1329	19
9c	River Oak – River Red Gum Derived Native Pasture	Not a TEC	NA191	River Oak riparian woodland of the Brigalow Belt South and Nandewar	Eastern Riverine Forests	Forested Wetlands	84	7
10	Rough-barked Apple Riparian Open Forest	Not a TEC	NA197	Rough-barked Apple riparian forb/grass open forest of the	New England GW	Grassy Woodlands	1118	3

Code	Vegetation Community	TEC status	RBVT Code	RBVT	Keith Class	Keith Formation	Equivalent PCT (DPIE 2017)	Area (ha)
				Nandewar				
				Bioregion				
10a	Rough-barked Apple Riparian Regeneration	Not a TEC	NA197	Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion	New England GW	Grassy Woodlands	1118	10
11	Semi-evergreen Vine Thicket	Semievergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	NA199	Semi-evergreen vine thicket of basalt hills of the NSW north western slopes (Benson 147)	Dry Rainforests	Rainforests	147	19
12	Trachyte Outcrop Shrubland	Not a TEC	NA240	Heathy shrubland on granitic outcrops of the central and western New England Tablelands	Northern Montane Heaths	Heathlands	884	10
24	Red Stringybark Shrubby Open Forest Semi Cleared and Regenerating	Not a TEC	NA112	Blakely's Red Gum - Rough-barked Apple - Red Stringybark grassy open forest of the western New England Tablelands	New England Grassy Woodlands	Grassy Woodlands	1354*	97
Se	Scald Erosion	Not a TEC	-	-	-	-		-
Total Area								1,671

### 2.1.2 Threatened Ecological Communities

The following Threatened Ecological Communities (TECs) as listed under the NSW Biodiversity Conservation Act (BC Act) and/or Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act) were detected within the study area:

- Semi-evergreen Vine Thicket is equivalent to Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions which is listed under the EPBC Act;
- Yellow Box Blakely's Red Gum Derived Native Pasture is equivalent to White Box Yellow Box Blakely's Red Gum Woodland listed as Critically Endangered under the BC and EPBC Acts; and
- White Box Grassy Woodland Derived Native Pasture is equivalent to White Box Yellow Box Blakely's Red Gum Woodland listed as Endangered under the TSC Act BC and EPBC Acts.

The areas of each TEC are given in Table 2.2 and the location is shown on Figure 2.2.

#### Table 2.2 Threatened Ecological Communities recorded in the Willeroi East offset area (Niche 2012)

TEC	Area (Ha)
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions which is listed under the EPBC Act	19
White Box Yellow Box Blakely's Red Gum Woodland listed as Endangered under the TSC Act and Critically Endangered under the EPBC Act.	156

### 2.1.3 Threatened Plants

One threatened plant species listed under the BC Act has been recorded within the Willeroi East offset area: *Swainsona sericea* (Niche 2012).

### 2.1.4 Fauna

Baseline fauna surveys were completed by Niche in 2012. Niche defined seven fauna habitats on the Willeroi East, these being:

- riparian corridors;
- native grassland;
- Cypress regeneration;
- woodland forest;
- vine thicket;
- heathland; and
- dams.

Niche noted that the habitats had good connectivity within the property and to similar habitats adjacent to the property. Previous clearing and grazing had impacted the midstorey structure in some areas.

Niche confirmed the presence of ten species listed under the NSW Threatened Species Conservation Act 1997 (all of which are still listed under the more recent Biodiversity Conservation Act 2016), these being:

- Brown Treecreeper (eastern subspecies) (Climacteris picumnus victoriae);
- Diamond Firetail (Stagonopleura guttata);
- Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Speckled Warbler (Pyrrholaemus saggitatus);
- Turquoise Parrot (*Neophema pulchella*);
- Eastern Bentwing Bat (Miniopterus schreibersii oceanensis);

- Eastern Cave Bat (Vespadelus troughtoni); and,
- Eastern False Pipistrelle (Falsistrellus tasmaniensis).

Niche noted that a further seven threatened species had been detected on Willeroi West, adjacent to the Willeroi East Study Area, these being:

- Border Thick-tailed Gecko (Underwoodisaurus sphyrus);
- Black-chinned Honeyeater (Melithreptus gularis gularis);
- Grey-crowned Babbler (eastern subspecies (Pomatostomus temporalis temporalis);
- Greater Broad-nosed Bat (Scoteanax rueppellii);
- Eastern Free-tail bat (Mormopterus norfolcenssis);
- Squirrel Glider (Petaurus norfolcensis);
- Varied Sittella (Daphoenositta chrysoptera);

Niche determined that there was a "moderate likelihood" that Koala and the Regent Honeyeater could occur on the study area based on the presence of primary feed trees and regional records. They did not quantify the area of suitable habitat for these two species.





the Produced: 12/07/2023 | CRS: GDA 1994 MGA Zone 56 | Imagery: ESRI World Imagery atial Data: Offset Property Boundaries and Vegetation Mapping supplied by client

# Figure 2.2 Vegetation Mapping of the Willeroi East offset area (Niche 2012) using PCTs assigned to RBVTs as per DPIE (2017)

Not Native

bs

### 2.2 Offset areas 2, 3, 4, & 5

The extent of biodiversity offset areas 2, 3, 4, and 5, as described in the SSD-7480 approval is shown in Figure 2.3.



Figure 6: Biodiversity Offset Strategy

#### Figure 2.3 Extent of offset areas, 2 3, 4, and 5 as shown in the SSD-7480 approval (Whitehaven 2018)

2.2.1 Flora

Based on the vegetation mapping provided, offset areas 2 to 5 contain approximately 219.6 ha of existing forest/woodland and approximately 172.3 ha of native grasslands and 22.8 ha of non-native vegetation areas including waterbodies (dams and rivers), infrastructure and cropped areas (Table 2.3).

Figure 2.4 Plant Community Types for Area Figure 2.4 to Figure 2.7 show the vegetation mapped in these properties and Table 2.3 lists them.

PCT ID	PCT Name	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5
78	River Red Gum riparian tall woodland / open forest wetland			55.06	
101	Poplar Box - Yellow Box- Western Grey Box grassy woodland	28.26	25.80	53.66	14.30
101	Poplar Box - Yellow Box- Western Grey Box grassy woodland (DNG)				6.04
102	Liverpool Plains grassland			100.63	4.07

Table 2.3 Plant Community Types listed for offset areas 2 – 5 (Whitehaven 2018)

PCT ID	PCT Name	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5
238	Permanent and semi-permanent freshwater lakes wetland			2.43	
599	Blakely's Red Gum - Yellow Box grassy tall woodland				2.05
710	Bluegrass - Redleg Grass - Common Woodruff clay plain grassland	35.60	1.49		22.04
1329	Yellow Box - Blakely's Red Gum grassy woodland		2.81		20.60
1383	3 White Box grassy woodland 17.03				
Total Native Vegetation		80.90	30.10	211.77	69.11
Excluded from Mapping					0.51
Not Native			20.79	1.17	0.81
Total		80.90	50.89	212.94	70.43

#### 2.2.1 Threatened Ecological Communities

The offset areas were considered to contain approximately 127 ha of Poplar Box Grassy Woodland and approximately 45 ha of Box-Gum Woodland EEC (Whitehaven 2018).

### 2.2.2 Threatened Plants

No documented flora investigations are described for offset areas 2, 3, 4 & 5 following their inclusion into the Vickery BOS (DPE 2014a).



Figure 2.4 Plant Community Types for Area 2 (Whitehaven 2018)



Figure 2.5 Plant Community Types for Area 3 (Whitehaven 2018)



Figure 2.6 Plant Community Types for Area 4 (Whitehaven 2018)



Figure 2.7 Plant Community Types for Area 5 (Whitehaven 2018)

### 2.2.3 Fauna

No documented fauna investigations were undertaken for offset areas 2, 3, 4 & 5 following their inclusion into the Vickery BOS in 2013, most likely because Willeroi East met the primary fauna habitat values required under the SSD-5000 approval.

Three fauna habitat types occur within offset areas 2, 3, 4 & 5: Native Grassland, Grassy Open Woodland and Riparian Woodland.

A review of the BioNet Database (DPE 2023a) indicates that records of 26 threatened species occur within 5 kilometres of the offset areas but none occur on the offset areas. No Regent Honeyeater records occur within 5 kilometres of the offset areas, but several Koala records occur within 5 kilometres of the offset areas, but several Koala records occur within 5 kilometres 4 and 5.

Individually, all four offset areas contain habitats that are suitable for a variety of threatened fauna species including the Koala and Regent Honeyeater. They are comprised of remnant woodland communities which contain large mature trees, many of which have hollows. These habitats would provide seasonal foraging resources for a variety of threatened species and could provide roosting resources for a large number of native species. They are also rare across the local landscape which has been cleared extensively for agricultural purposes, and as such are of high value for a variety of fauna species.

However, the fauna habitat value of all four offset areas is constrained by a history of anthropogenic disturbance. All four offset areas exist in a highly fragmented landscape and have poor landscape connectivity to any larger areas of remnant habitat that occur within the region.

Offset area 2 has no direct vegetation connectivity with other remnant woodland habitat in the region. It is situated 3.5 kilometres south from the boundary of the Leard State Forest, 4.1 kilometres southwest of remnant vegetation which is privately owned and 5.8 kilometres north of the Vickery State Forest. The vegetation between Offset area 2 and these other large patches of remnant vegetation is comprised of agricultural crops with occasional paddock trees, sparsely vegetated drainage lines and roadside verges. Fauna movement between Offset area 2 and the regional remnant habitat features is highly impeded and would likely be limited to highly mobile species, such as some bird and microbat species as well as species able to take advantage of agricultural landscapes.

Offset area 3 has no direct vegetation connectivity with other remnant woodland habitat in the region. It is situated 4.2 kilometres north-west of the Vickery State Forest and 5.2 kilometres south of the Leard State Forest. The vegetation between offset area 3 and these patches of remnant vegetation is comprised of agricultural crops with occasional paddock trees, grazed open woodland, sparsely vegetated drainage lines and roadside verges. Fauna movement between offset area 3 and the regional remnant habitat features is highly impeded and would likely be limited to highly mobile species, such as some bird and microbat species as well as species able to take advantage of agricultural landscapes.

Offset areas 4 and 5 have patchy and highly disturbed landscape connectivity with the Vickery State Forest which is situated 7.7 kilometres to the northeast. The connectivity is maintained by revegetated post-mining landscapes, roadside verges and paddocks grazed by livestock. Connectivity is also maintained along the length of the Namoi River south to Gunnedah and North to Boggabri. However, this connectivity is also highly disturbed, limited to a thin line of trees along the riverbank along large sections of the river. The landscape connectivity of the offsets is highly degraded and likely to be influenced by introduced herbivores and carnivores as well as the presence of over abundant and aggressive honeyeater species. Despite this, threatened species records within 5 kilometres of the offset areas indicate that some connectivity is maintained for some species, evident by historical records of Koala that exist along the riverside vegetation.

Management actions such as pest animal control, weed control, stock exclusion and revegetation would likely improve the fauna habitat value for each offset area. However, there is limited scope to improve landscape connectivity with other large patches of remnant vegetation.

### 2.2.4 Historic Agricultural Landuse

Agricultural activities/management on original offset areas 2 to 5 ceased in mid 2017 when WHC took management control. Up until that time historical imagery (DCCEEW 2024; Google Earth Pro 2024) suggests that various sections of these properties were cultivated and grazed. Areas mapped as PCT 101 do not appear to have been cultivated but grazing was occurring until 2017. The eastern portion of PCT 101 on offset area 2 appears to have been cleared in 1966 with regrowth being cleared again 1988 (Appendix A). PCT 101 on offset area 3 appears to have been left as woodland since 1966 with little change to the woodland boundary up until 2022. However, cropping has occurred to the north and south over that time (Appendix B). PCT 101 on offset area 4 was partially or completely cleared prior to 1966 and has remained partially cleared woodland since that time (Appendix C).

State Land use Mapping (NSW Government 2024) designates all areas mapped as PCT 101 to be either grazing or modified grazing (Appendices A - C).

## 2.3 Rehabilitation Area as Part of the Approved BOS

The existing commitment from the original Vickery BOS (SSD-5000) has been transferred through to SSD-7480 Condition B56 (Table 1.1). This commitment for a Rehabilitation Area of 1,360 ha for the "Re-establishment of native vegetation communities for a biodiversity conservation land use objective" is not addressed in this RBOS. The RBOS only addresses the external land based components of the Vickery BOS; and as such the description and implementation of the Rehabilitation Area offset will be documented in future Vickery Coal Mines' Rehabilitation Management Plan (current version 31 May 2023 only describes the proposed rehabilitation strategy (current version July 2023 only describes the proposed rehabilitation Strategy (current versions to be updated prior to major construction works and full scale mining (i.e. no bulk rehabilitation works at this stage thus no Rehabilitation Management Plan Section 6.2.5 and Rehabilitation Strategy Section 3.3 describe the aim and intent to rehabilitate the final post mining landform to native woodland/forest vegetation type PCT1308.

# **3** Proposed Substitute Offset Areas

Parts of three properties, Glenroc, Costavale and Wean North have been selected to substitute offset areas 2, 3, 4 and 5 (Figure 1.1). These offset areas have been selected as substitutes because they contain biodiversity values required by the original Vickery BOS (SSD-5000); are in closer proximity to not only the Vickery Mine impact area (like for like habitat) but also closer to other offset areas (Figure 3.1); and provide an opportunity to improve landscape connectivity between the Vickery State Forest and Nandewar Range Biodiversity Corridor.

The proposed Vickery substituted offset areas, which are 520.57 ha in total area, will meet the minimum area requirements (404.5ha) of original offset areas 2 to 5 described in SSD-7480, Condition B56 (Table 1.1) and the minimum area requirements for "enhancing and restoration" of Poplar Box Woodland (127 ha) also required by SSD-7480. The minimum area requirement for "enhancing and restoration" of Box Gum Woodland associated with original offset areas 2 to 5 (45

ha) in SSD-7480 has been achieved by the Willeroi East offset area which is secured in perpetuity by the 2021 Conservation Agreement CA0060. The Willeroi East offset area was only required to have 156 ha of the Box Gum Woodland but as result of revisions described in this RBOS now has 285.97 ha of Box Gum Woodland.

### **3.1** Justification for Substitution

Offset areas 2 to 5 were included in the original Biodiversity Offset Strategy (addressing SSD-5000) with the express objective of including a further 127 hectares (ha) of Poplar Box Woodland vegetation to be enhanced with restoration (See section 1.2 of the RBOS). However, these properties exist as isolated patches within areas of intense agricultural land use and future management actions in Poplar Box Woodland within original offset areas 2 to 5 were unlikely to achieve significant biodiversity gains due to ongoing impacts associated with edge effects, fragmentation and isolation. Specifically, given the highly cleared agricultural landscape in which the properties exist, the following impacts were likely to continuously influence the biodiversity outcomes and limit biodiversity gains of the offset areas:

- weed incursion from adjacent agricultural properties
- livestock incursion from adjacent agricultural properties
- pest animal incursion from adjacent agricultural properties
- edge effects and fragmentation resulting in:
  - genetic isolation of flora and fauna species
  - over abundant aggressive honeyeater species
  - o limited natural recruitment of native plant species
  - o limited immigration and emigration of fauna species with low mobility.
- vulnerability to stochastic events including drought, flood and fire with limited opportunity to naturally regenerate after these types of stochastic events.

WHC notes that SDD-7480 consent conditions included B56, which states: "Any area of the offset strategy in Table 9 (of the 2020 approval) may be substituted with an alternative offset area subject to demonstration of equivalent biodiversity outcomes and to the satisfaction of the Secretary".

Given the management challenges to biodiversity outcomes identified on offset areas 2 to 5 and described above, WHC concluded that superior biodiversity outcomes could be generated through the identification of more appropriate offset areas to include in the RBOS. WHC determined that to ensure "equivalent biodiversity outcomes" the key criteria to be met were:

- ensure that any substitute biodiversity offset areas contained at least 127 ha of Poplar Box Woodland vegetation that could be enhanced with restoration;
- locate suitable substitute offset areas that will enhance connectivity and increase total area of land being managed for biodiversity conservation within the region; and
- a reduction in the impacts to biodiversity outcomes, as described above for original offset areas 2 to 5.

After the initial submission of this Vickery RBOS Report, consultation with DCCEEW determined that a contemporary, quantitative vegetation condition assessment (utilising aspects of BAM 2020) was required to justify "equivalent biodiversity outcomes" for substituting of offset areas beyond the previous minimum requirements of SSD-7480 Condition B56 of at least 127ha of Poplar Box Woodland vegetation. Therefore, a fourth key criteria was agreed with DCCEEW using comparative analysis of the substituted offsets area equivalent condition to the original offset areas. This was achieved by using aspects of the BAMC to determine Vegetation Integrity, Vegetation Integrity Gain at year 20 and indicative credit generation to compare between the original and substitute offset areas (see Section 4.2.4).

As the original offset areas were selected based on WHC ownership as well as presence of Poplar Box vegetation; utilising existing regional land ownership by WHC since 2020 was seen as the best

approach to achieve comparable biodiversity outcomes in terms of identifying the required Poplar Box Woodland vegetation suitable for restoration via a revegetation program. Upon further investigation, an opportunity was identified to apply revegetation and land management actions to the substitute offset areas that would develop a vegetated corridor linking the surrounding WHC Biodiversity Management Areas (existing Offset Areas/Conservation Agreements and Biodiversity Stewardship Sites for Vickery, Rocglen/Canyon/Tarrawonga and Maules Creek Coal Mines, thus creating a vegetated corridor between the Vickery State Forest and the Boonalla Aboriginal Area (formerly Kelvin State Forest) (Figure 3.1). Such an approach would address the described limitations associated with fragmentation, connectivity and edge effects present at original offset areas 2 to 5 over time. Management gains would also be generated by the location of the substitute offset areas in conjunction with existing WHC Biodiversity Management which would allow a landscape approach to pest animal, weed and revegetation management via integration into programs already being undertaken on those offset areas.

Flora and fauna surveys between 2020 and 2022 identified suitable biodiversity values on the WHC owned properties adjoining the Vickery State Forest and towards the Boonalla Aboriginal Area. Based on the quantum and range of biodiversity values required to meet the Vickery Extension Project (SSD-7480 Condition B58 Biodiversity Credits); the review of properties available to WHC determined that Wean Amalgamated (parts of former properties known as Wean, Wear/Silkdale, Bull Mountain, Woodlands and Yarrawonga) and Greenwood were most suitable as Biodiversity Stewardship Sites and in the context of the justifications described above, Wean North, Glenroc and Costavale properties were selected as substitute offset areas to be enhanced with the restoration of at least 127ha of Poplar Box Woodland vegetation.

## 3.2 Criteria used to Select Substitute Offset Area

The initial criteria used to determine the suitability of the substitute offset areas are described in Table 3.1. Further actions to support the substitution including field surveys and data analyses are describe below in Sections 4 and 5.

In summary, the substitute offset areas were initially selected because:

- 1. they contained Plant Community Types (PCT) that corresponded to Poplar Box Woodland vegetation equating to an area equal or greater than 127 ha that could be enhanced with restoration;
- 2. they are located directly adjacent to existing Offset Areas/Conservation Agreements already managed for biodiversity by WHC;
- 3. they are located adjacent to properties which are newly established Biodiversity Stewardship Sites to offset the contemporary biodiversity credit liability of the Vickery Extension Project;
- 4. they were already owned by WHC; and
- 5. when added to WHC Biodiversity Management Areas (existing Offset Areas/Conservation Agreements and Biodiversity Stewardship Sites), they formed a corridor between Boonalla Aboriginal Area and Vickery State Forest.

#### Table 3.1 Justification for substituting the original offset areas (2 to 5) with Wean North, Costavale and Glenroc offset areas

	Area of minimum Required (127 ha) Poplar Box Vegetation	Location	Connectivity	Edge Effects	Invasive species	Stochastic events
Original properties 2, 3, 4 & 5	Minimum requirement met (128.08 ha)	Further from the Vickery Mine footprint Isolated from each other and other conservation areas State Forest or reserves by intense agricultural land use	Disconnected from each other and disconnected from surrounding areas of conservation, State Forest or reserves.	Susceptible to edge effect. Ongoing management costs are likely to remain high.	More vulnerable to invasive species due to isolation within a rural landscape. Ongoing management costs are likely to remain high.	Isolated locations make these properties more susceptible to drought, flood and fire events. Recovery is likely to be poor without significant intervention due to distance to natural sources of propagules. Mortality of fauna likely to be high due to lack of vegetated escape routes in the case of fire or refugee in the case of sever heat/drought.
Substitute properties Wean North, Costavale Glenroc	Minimum requirement significantly exceeded (451.12 ha)	Closer to the Vickery Mine Footprint Connected to other conservation areas, the Vickery State Forest and other reserves.	Connected locally to other conservation areas the Vickery State Forest and other reserves.	Edge effects reduced due to location within a corridor of conservation areas being restored and managed for biodiversity. Ongoing management costs are likely to be decrease over time	Less vulnerable to invasive species due to location within a corridor of vegetation being management for biodiversity. Collective management efforts are likely to be decrease invasive species over time.	Properties are in locations that will allow fauna to escape in case of fire and refugee in the case of severe heat/ drought via the extensive corridors provided by surrounding conservation areas and State Forest and reserves.



Figure 3.1 Location of substituted offset areas adjoining other WHC Biodiversity Management Areas (existing Offset Areas/Conservation Agreements and Biodiversity Stewardship Sites)
# 4 Methods

# 4.1 Flora – Willeroi East

## 4.1.1 Desktop and Literature Review

The Border Rivers Gwydir / Namoi Region Version 2.0 VIS ID 4467, State Vegetation Type Map was reviewed to identify broad target areas for field vegetation surveys and potential Plant Communities. Previous mapping undertaken within the property by Niche (2012) and AMBS was also reviewed to inform the selection of survey locations and candidate PCTs.

# 4.1.2 Field Surveys

Preliminary field surveys were undertaken across the offset area by AMBS in 2019. Comprehensive data collection for determining PCTs and Threatened Ecological Communities (TECs) were completed in February and March 2022. Surveys included vegetation mapping and BAM floristic plots and rapid data points (RDPs) for confirmation of PCT selection and boundaries. Vegetation community boundaries were assigned on the basis of data and observations collected in the field and aerial photograph interpretation. RDPs involved collecting waypoints using a combination of the following devices and software: the Handy GPS mobile device application; the Fulcrum mobile device application; and a handheld Garmin GPS unit. Dominant species, soil type, structure and condition were recorded.

Areas with the potential to fit the criteria for the Box-Gum Woodland CEEC were sampled with full floristic plots and rapid data points. These data were used to assess patches against the criteria in the Box-Gum Woodland CEEC Listing Advice (TSSC, 2006).

The experience and qualifications of the ecologists involved in the collection of the flora field data are provided in Table 4.1.

A total of 21 Full Floristic, 51 Rapids, 15 TEC plots and 13 TEC Rapid Plots were undertaken across two adjoining offset areas, Willeroi East and Willeroi West (offset for the Tarrawonga Mine). The location of these plots is shown on Figure 4.2.

For Willeroi East, a total of 11 full floristic, 25 rapid plots, 9 TEC plots and 9 TEC Rapid plots were undertaken over a number of survey periods, starting from 14 December 2020, 8-10 and 22-25 February 2022 as well as 4 and 9-11 March 2022.

Name	Qualifications	Experience		
Belinda Pellow	Diploma in Applied Science (Agriculture)			
	Associate Diploma in Arts (Aboriginal Studies) 40 years'			
	Certified Practicing Ecological Consultant (ECA NSW No:3)			
Tom O'Sullivan	Master of Environmental Mgt (incomplete) - Macquarie University			
	Undergraduate Degree (majors: Zoology / Physical Geography	25 years'		
	Environmental Management Certificate – TAFE			
	Accredited BAM Assessor			
Mark Robinson	Associate Diploma in Horticulture	30 years'		

#### Table 4.1 Qualifications of ecologists undertaking fieldwork for the Willeroi property

Name	Qualifications	Experience		
	Graduate Diploma in Environment Management			
	Master of Environment & Restoration			
	Bachelor of Science (Honours)			
James Schlunke	Doctor of Philosophy BAM accredited Assessor	13 years'		
	Bachelor of Science			
Matt Saunders	Master of Ecosystem Management and Conservation	5 years'		
	Bachelor of Science (Advanced; General Biology)			
Corey O'Brien	Master of Research	4 years'		
	Certificate IV in Spatial Information Service			
Gabriella Hoban Bachelor of Environmental Management (Ecology)		5 years'		
	Bachelor of Science (Ecology)			
Manuel Lequerica Tamara	Master of Agriculture (Environmental Economics)	10 years'		
	Master of Science (Urban Ecology)			
	Doctor of Philosophy			

# 4.1.3 PCT Determination and Mapping

PCT determination and mapping was undertaken across two adjoining offset areas, Willeroi East and Willeroi West (offset for the Tarrawonga Mine) to maximise the effectiveness of the data analyses and interpretation. The methods used for systematic survey, classification and mapping of vegetation in the Willeroi East offset area, conform with NSW standards (see Appendix 5 of the Native Vegetation Interim Type Standards; Sivertsen 2009). Data analyses and interpretation, determination of PCTs and PCT mapping were undertaken by Belinda Pellow and Corey O'Brien. Floristic data from 36 plots was used in quantitative analyses to identify vegetation groups which were subsequently assigned to PCTs (DPIE 2023c). Data collected in areas of native vegetation determined to be of Good or Moderate condition were included in the floristic analysis. Records of percent cover and abundance estimates were transformed to a modified Braun-Blanquet 1-6 cover score (Braun-Blanquet 1932). Floristic data were edited to remove non-native species, native species not recorded to at least the species level, and species recorded in a single plot. Scientific names of all floristic records were updated in accordance with the Bionet Species Names database (NSW DPIE 2022b) and where flora identified to subspecies level, the record was reverted to species level to ensure consistency across plots.

Agglomerative hierarchical clustering using UPGMA (Unweighted Pair-Group Method using Arithmetic averages) was undertaken using the *vegan* R package (Oksaren et al. 2022; R Core Team 2021) based on Bray-Curtis dissimilarity distance measures between sites. Optimum groupings of sites were initially determined by assessing within cluster sums of squares, average silhouette widths and gap statistic methods from the *factoextra* R package (Kassambara & Mundt 2020). The resulting groups were visualised spatially in GIS software alongside topographic data and opportunistic floristic data records to assign groups to PCT based on floristic composition and position in the landscape. Where appropriate, sites were reassigned to different PCTs than what was determined by original grouping with consideration of landscape position, dominant flora species, and the presence of canopy species recorded in surrounding area not captured within the 20 m x 20 m plot.

A Multi-level Pattern Analysis was conducted using the *indicspecies* R package (Caceres & Legendre 2009) on final site groupings to identify indicator species for single groups and combinations of groups. Pairwise comparisons of species contributions to group formation were conducted via SIMPER analysis using the *vegan* R package (Oksaren et al. 2022).

Plant Community Types (PCTs) were assigned using published descriptions, benchmark condition and associated data included in the *BioNet Vegetation Classification Database* (DPIE 2023c). PCTs were primarily compared based on characteristic species in vegetation assemblages in addition to abiotic variables of the associated plot locations including geology, topography and soils if required.

PCT selection in this region is difficult as there can be discrepancy between actual species composition and the species assemblages in the PCT description (DPIE 2023c). Where discrepancies occur a "best fit" approach has been used to assign a PCT. Where zones have been cleared designation of PCT is constrained by the lack of structural features in particular representative canopy trees. In these situations, a number of other features are used to help delineate boundaries this includes observations of the vegetation immediately adjacent to the zone, location in the landscape and contour lines. If appropriate, soils are also considered although this feature is not definitive in relation to the species assemblages present.



Table 4.2 Survey Effort on Willeroi property (East and West offset areas)

# 4.2 Flora - Wean North, Glenroc and Costavale

# 4.2.1 Desktop and Literature Review

The Border Rivers Gwydir / Namoi Region Version 2.0 VIS ID 4467, State Vegetation Type Map was reviewed to identify broad target areas for field vegetation surveys and potential Plant Communities.

# 4.2.2 Field Surveys

A number of field surveys across Wean North, Costavale and Glenroc were undertaken between 2021 and 2023. The determination of PCTs and boundaries within the offset areas were mapped using a combination BAM plots, RDPs and walking transects.

Initial flora surveys were undertaken across Costavale and Glenroc in March 2021 and between October 2021 and November 2021. Additional field assessments, data interpretation, determination of PCTs and PCT mapping were undertaken in June 2022. Follow up surveys were undertaken in March 2023.

Further floristic data were collected across the original offset areas and the substitute offset areas in 2024 to allow the use of the BAMC as a tool for assessing comparative condition.

A total of 25 BAM plots were undertaken across the original and substitute offset areas.

The experience and qualifications of the ecologists collecting the flora field data are provided in Table 4.1.

Name	Qualifications	Experience	
Michael Somerville	Bachelor of Science Graduate Diploma in Natural Resource Management Accredited BAM Assessor	14 years'	
Belinda Pellow	Diploma in Applied Science (Agriculture) Associate Diploma in Arts (Aboriginal Studies) Accredited BAM Assessor Certified Practicing Ecological Consultant (ECA NSW No:3)	40 years'	
Tom O'Sullivan	Masters of Environmental Mgt (incomplete) - Macquarie University Undergraduate Degree (majors: Zoology / Physical Geography Environmental Management Certificate – TAFE Accredited BAM Assessor	25 years'	
Elise Connolly	Advanced Diploma in Environmental Management Diploma Conservation and Land Management Accredited BAM Assessor	10 years'	
Corey O'Brien	Bachelor of Science (Advanced; General Biology) Master of Research Certificate IV in Spatial Information Service	4 years'	
Anne Bauman	Diploma of Arboriculture	8 years'	

#### Table 4.3 Qualifications of ecologists undertaking fieldwork on Wean North, Costavale and Glenroc

Name	Qualifications
	Doctor of Philosophy in Agricultural Science
	Bachelor of Science in Agriculture (Honours II)
	Certificate III in Conservation and Land Management
	Arboriculture Techniques Certificate
	Tree Surgery Certificate
Elsa Lillford	Bachelor of Environmental Science
	Bachelor of Laws

## 4.2.3 PCT Determination and Mapping

Plant Community Types (PCTs) were finalised using published descriptions, benchmark condition and associated data included in the *BioNet Vegetation Classification Database* (DPE 2023c). PCTs were primarily compared based on characteristic species in vegetation assemblages in addition to abiotic variables of the associated plot locations including geology, topography and soils if required.

PCT selection in this region is difficult as there can be discrepancy between actual species composition and the species assemblages in the PCT description (DPE 2023c). Where discrepancies occur a "best fit" approach has been used to assign a PCT. Where zones have been cleared designation of PCT is constrained by the lack of structural features in particular representative canopy trees. In these situations, a number of other features are used to help delineate boundaries this includes observations of the vegetation immediately adjacent to the zone, location in the landscape and contour lines. If appropriate, soils are also considered although this feature is not definitive in relation to the species assemblages present.

# 4.2.4 Determining Vegetation Condition for Comparative Assessment

PCT 101 on the original offset areas 2, 3, 4, & 5, which equate to Poplar Box Woodland as described in the Vickery BOS (SSD-7480 Condition B56), were compared with PCTs in the substituted offset areas, Wean North, Costavale and Glenroc that also equate to Poplar Box Woodland (PCT 101 and PCT 244).

To provide a comparison between current biodiversity values and the potential for the substituted offset areas to achieve equivalent biodiversity outcomes after 20 years of management as the original offset areas, a contemporary assessment commensurate to the process applied for Biodiversity Stewardship Agreements using BAM Calculator (BAMC) was used. Data collected from BAM plots across all offset areas were analysed to provide an overall current Vegetation Integrity Score (VI) and an overall VI Score with Management, including Active Restoration Management Actions (ARMA) restoration in DNGs on the original and substitute offset areas, at year 20. The median value between the upper (Benchmark) and lower (Future Value with Offset) was used in the BAM-C to determine a predicted future value with restoration. From these values a total indicative credit value was generated for each zone to provide a contemporary, overall condition "value" for the original and substitute offset areas.

PCTs 101 and 244 are Poplar Box Woodlands which belong to the same Vegetation Class, Floodplain Transition Woodlands, and therefore the benchmarks used in the BAMC are the same. For this reason, PCT 101 and PCT 244 that occur on the substituted offset areas were combined into the one Zone for determining VI scores.

Please Note: The use of the BAMC for this assessment is purely as an aid to compare condition by generating VI scores and a hypothetic credit value for the purpose of comparison between the original and substitute offset areas. It does not represent a value as per the requirements of an approved BSA subject to the NSW Biodiversity Offsetting Scheme.

# 4.3 Fauna

# 4.3.1 Desktop and Literature Review

A review of available reports and threatened fauna records from databases was used to assess the fauna values of the substituted offset areas proposed in the RBOS.

The following reports and databases were reviewed for the purposes of understanding fauna diversity, abundance and habitat preferences for the offset areas in the revised RBOS:

- Cenwest Environmental Services (2011) Willeroi Fauna Survey Report;
- Niche Environment and Heritage Services (2013) Flora and fauna survey of potential offset site (Willeroi East Offset Area) for the Vickery Coal Project;
- AMBS Ecology and Heritage (2018) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Offset Areas Spring 2017;
- AMBS Ecology and Heritage (2019a) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Biodiversity Offset Areas Spring 2018;
- AMBS Ecology & Heritage (2019b) Bird Surveys in Whitehaven Offset Areas Winter 2018;
- AMBS Ecology and Heritage (2020a) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Biodiversity Offset Areas Spring 2019;
- AMBS Ecology & Heritage (2020b) Bird Surveys in Whitehaven Offset Areas Winter 2019;
- AMBS Ecology & Heritage (2020c) 5 Year Review of the Annual Fauna Monitoring Program Data for the Maules Creek and Tarrawonga Biodiversity Offsets.
- AMBS Ecology & Heritage (2022) Koala Monitoring on the Whitehaven Coal Biodiversity Offset Areas 2020 - 2022
- AMBS Ecology & Heritage (2023a) Koala Monitoring on the Whitehaven Coal Biodiversity Offset Areas 2022 – 2023;
- AMBS Ecology & Heritage (2023b) Fauna Monitoring of the Whitehaven Coal Biodiversity Offset Properties June 2020 to July 2023;
- BioNet Atlas (DPE 2023a);
- Atlas of Living Australia Website (Atlas of Living Australia, 2023); and,
- Birdlife Australia Website (BirdLife Australia, 2023).

The following reports and data sources were reviewed to develop a better understanding of habitat features on and adjacent to the offsets, including the abundance and diversity of Mistletoe species and feed tree species:

- AMBS Ecology & Heritage (2020d) Habitat Needs Assessment for the Whitehaven Offset Properties;
- AMBS Ecology & Heritage (2021) Vickery Coal Mine EPBC Condition 21;
- Wean North vegetation mapping plot data;
- Costavale vegetation mapping plot data; and,
- Glenroc vegetation mapping plot data.

# 4.3.2 Categorising Habitat Value for Koala and Regent Honeyeater

Defining and identifying potential habitat for the Koala and Regent Honeyeater was undertaken in two steps. The first step was to interrogate the Threatened Biodiversity Data Collection (TBDC) (DPE 2023b) to inform baseline PCT mapping for each species. Once this was complete, each

polygon was evaluated to determine if they were an accurate representation of habitat for both species based on the presence or absence of certain habitat features. For the Regent Honeyeater, important habitat features included the presence of key feed tree species (Mugga Ironbark, White Box, Yellow Box) and key mistletoe species (Needle-leaf Mistletoe, Box Mistletoe and Drooping Mistletoe). For the Koala, key habitat features included primary feed tree species and secondary feed trees or shelter trees. The decision to include or exclude each polygon was based on AMBS' six years of field observations on the Willeroi property (East and West offset areas), annual monitoring surveys on the properties (AMBS 2017, 2018, 2019a, 2020c, 2023b), target habitat assessments undertaken in 2019 (AMBS 2020c) and 2021 (AMBS 2021) and the reported ecology of each species.

From that process, a set of maps were produced that reflect the current habitat present for each species. After this process was undertaken, habitats were classified as either Existing Potential Habitat, Future Potential Habitat or not habitat.

Both woodland and derived native grassland forms of the relevant PCTs occur within the proposed offset areas. Areas of woodland considered suitable for each species was defined and mapped as "Existing Potential Habitat".

Areas of derived native grassland within the offset areas were identified as "Future Potential Habitat" because these areas are adjacent to Existing Potential Habitat and will be revegetated. Revegetation for these areas will provide foraging resources for the Koala and Regent Honeyeater as the revegetation develops and will improve landscape connectivity with areas of Existing Potential Habitat. There is no timeline proposed for when these areas of habitat will become suitable for the Koala and Regent Honeyeater and these areas are not included in the assessment of area of habitat value for both species.

Unmapped areas correspond with PCTs that are not considered to be suitable for either species. This mapping is conservative as in many cases, patchy foraging resources for both species are present (i.e. Box Mistletoe and Drooping Mistletoe are present) and the areas are adjacent to PCTs mapped as Existing Potential Habitat.

The area values of Existing Potential Habitat were used to evaluate the habitat value provided by the substituted offset areas against the requirements defined in the original BOS, SSD-7480 and EPBC 2016/7649.

# 5 Results

# 5.1 Description of Revised BOS Values – Flora

# 5.1.1 Willeroi East

Twelve plant community types in a range of condition states were mapped across the Willeroi East offset area. The PCTs are listed in Table 5.1, shown in Figure 5.1 and described below.

Table 5.1 PCTs mapped within the	Willeroi East offset area and	condition states
----------------------------------	-------------------------------	------------------

PCT Label	Condition	Area (ha)
112: Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland	Semi cleared	1.18
112: Derived Native Grassland	Cleared - Derived Native Grassland	2.91
1308: Derived Native Grassland	Cleared - Derived Native Grassland	11.12
	Cleared - Derived Native Grassland	13.04
1308: White Box - White Cypress Pine shrubby open forest	Intact or advanced regeneration	176.35
	Semi cleared	14.24

PCT Label	Condition	Area (ha)
	Semi cleared regenerating	133.69
1202. Device d Native Creation d	Cleared - Derived Native Grassland	145.09
1383: Derived Native Grassland	Erosion	15.88
	Erosion	17.39
	Intact or advanced regeneration	3.34
1383: White Box grassy woodland	Semi cleared	9.15
	Semi cleared regenerating	85.06
147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket	Intact or advanced regeneration	6.78
520: Heathy outcrop shrublands	Semi cleared	11.92
563: Derived Native Grassland	Cleared - Derived Native Grassland	35.83
	Intact or advanced regeneration	535.23
563: White Box - Silvertop Stringybark +/- White	Semi cleared	35.93
cypress rine grass sinds open forest	Semi cleared regenerating	69.98
588: White Box - White Cypress Pine shrubby hills	Intact or advanced regeneration	206.40
open forest	Semi cleared regenerating	5.63
592: Narrow-leaved Ironbark - cypress pine - White Box shrubby open forest	Intact or advanced regeneration	15.09
84: Derived Native Grassland	Cleared - Derived Native Grassland	1.20
	Intact or advanced regeneration	32.78
84: River Oak - Rough-barked Apple - red gum -	Semi cleared	0.42
	Semi cleared regenerating	4.39
Not Native	Dam	1.19
Grand Total	·	1,591.20



Figure 5.1 Plant community types in the Willeroi East offset area

## Plant Community Type descriptions

#### **PCT 84**



PCT 84: River Oak - Rough-barked Apple - red gum - box riparian tall woodland

<u>PCT Name:</u> River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion

Vegetation Class: Eastern Riverine Forests

EPBC Status: not listed

BC Status: not listed

Sites included: WIFF1011, WIFF1013, WIFF1014

#### **Description on the Property**

The canopy layer in this PCT is dominated by *Angophora floribunda* (Rough-barked Apple), *Melaleuca bracteata* (Black Tea-tree), *Pandorea pandorana* (Wonga Birdlife Vine), *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak), *Callitris glaucophylla* (White Cypress Pine).

The mid layer has a tall layer of *Alectryon subdentatus f. subdentatus* and a shrub layer dominated by *Dodonaea viscosa* (Sticky Hop-bush) and *Phyllanthus subcrenulatus* with *Pandorea pandorana* (Wonga Birdlife Vine). Other species in this layer include *Melaleuca bracteata* (Black Tea-tree), *Trema tomentosa* var. *aspera* (Native Peach), *Olearia elliptica* (Sticky Daisy-bush), *Pimelea strigose, Melicytus dentatus* (Tree Violet), *Pimelea neo-anglica* (Poison Pimelea), *Abutilon oxycarpum* (Straggly Lantern-bush).

The ground layer contains grass species such as *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Austrostipa verticillata* (Slender Bamboo Grass), *Oplismenus imbecillis, Austrostipa scabra* (Speargrass). Sedges and rushes include Lomandra longifolia (Spiny-headed Mat-rush) and *Cyperus vaginatus* (Stiff Flat-sedge).

Species such as Nyssanthes diffusa Barbwire Weed, Geranium solanderi (Native Geranium), Nyssanthes diffusa (Barbwire Weed), Einadia trigonos (Fishweed), Sigesbeckia australiensis, Sigesbeckia australiensis, Galium leptogonium, Commelina cyanea (Native Wandering Jew), Urtica incisa (Stinging Nettle), Geranium solanderi (Native Geranium), Vittadinia condyloides, Calotis lappulacea (Yellow Burr-daisy) were also present in the ground layer of the plots.

# **BioNet Description**

PCT 84 is typically a tall woodland or open forest to 30 m high dominated by Casuarina cunninghamiana subsp. cunninghamiana often with Angophora floribunda, Eucalyptus camaldulensis, Eucalyptus melliodora, Eucalyptus blakelyi and occasionally Eucalyptus albens. A sparse shrub layer may occur including Acacia implexa, various Leptospermum spp., Dodonaea spp., Phyllanthus subcrenulatus, Bursaria spinosa, Callistemon spp., Olearia viscidula and the vines such as Pandorea pandorana, Clematis glycinoides, Parsonsia straminea and Stephania japonica. In some places a dry rainforest lower tree/high shrub layer may occur that includes Alphitonia excelsa, Alectryon spp., Ficus rubiginosa and Notelaea microcarpa. The ground cover can be dense or sparse and contains a rich flora of small shrubs, grasses, sedges and forbs. Grasses include Microlaena stipoides var. stipoides, Cynodon dactylon, Chloris virgata, Oplismenus imbecillis, Austrostipa verticillata, Lachnagrostis filiformis, Arundinella nepalensis, Elymus scaber var. scaber and Poa sieberiana. The graminoid Lomandra longifolia is common in some locations. Sedges include Carex appressa, Carex incomitata and Cyperus vaginatus. Ferns include Cheilanthes sieberi, Adiantum aethiopicum, Doodia aspera and Pellaea nana. Forbs include Urtica incisa, Dichondra repens, Ranunculus lappaceus, Einadia hastata and Scutellaria humilis. Weeds may be common in some places. They include Salix babylonica, Ailanthus altissima and forbs such as Conyza bonariensis, Sonchus oleraceus, Bidens pilosa, Fumaria capreolata, Modiola caroliniana and Hypochaeris radicata.

Occurs on clay sand or sandy loam soils on riverine deposits on stream-banks and terrace flats of major rivers and creeks in low hills and hills landforms of Nandewar and Brigalow Belt South Bioregions. This community grades into PCT 78 River Red Gum along sections of the rivers. Varies in floristic composition with altitude and substrate with different species occurring on rocky substrates compared to deeper alluviums.



PCT 112: Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland

<u>PCT Name</u>: Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion

Vegetation Class: Inland Riverine Forests

EPBC Status: not listed

BC Status: not listed

Site included: WIFF1054

## Description on the property

The upper canopy of this PCT is sparse and dominated by *Eucalyptus albens* (White Box).

The mid layer is dense and dominated by *Notelaea microcarpa* (Native Olive), *Callitris glaucophylla* (White Cypress Pine), *Acacia salicina* (Cooba), *Brachychiton populneus* (Kurrajong). Other shrubs include *Melaleuca bracteata* (Black Tea-tree), *Dodonaea viscosa* (Sticky Hop-bush), *Pimelea neo-anglica* (Poison Pimelea) and *Geijera parviflora* (Wilga).

The ground layer contains a cover of grasses such as *Sporobolus creber* (Slender Rat's Tail Grass), *Austrostipa verticillata* (Slender Bamboo Grass) and *Cyperus gracilis* (Slender Flat-sedge).

## **BioNet Description**

PCT 112 is typically low open forest or very tall shrubland dominated by *Melaleuca bracteata*. Other tree species include *Casuarina cunninghamiana*, *Angophora floribunda* and *Eucalyptus camaldulensis*. Shrubs are sparse and include *Geijera parviflora*, *Pimelea neo-anglica*, *Phyllanthus subcrenulatus*, *Breynia cernua*, *Dodonaea viscosa subsp. angustifolia*, *Pimelea curviflora var. curviflora*, *Psydrax oleifolia* and *Abutilon oxycarpum*. Vines include *Pandorea pandorana subsp. pandorana* or *Clematis microphylla var. leptophylla*. The ground cover contains the forbs *Urtica incisa*, *Persicaria decipiens*, *Plantago debilis*, *Wahlenbergia communis*, *Rorippa eustylis*, *Geranium solanderi var. solanderi*, *Hydrocotyle laxiflora*, *Wahlenbergia communis and Daucus glochidiatus*. Grasses include *Austrostipa verticillata*, *Lachnagrostis filiformis*, *Sporobolus creber*, *Ancistrachne uncinulata*, *Bothriochloa macra*, *Oplismenus aemulus*, *Cynodon dactylon and Leptochloa digitata*. Sedges include *Cyperus gracilis*, *Carex incomitata*, *Carex appressa*, *Cyperus gunnii*, *Cyperus vaginatus* and *Cyperus victoriensis*. Species of rush (Juncus) may also occur.

This community is often very weedy with exotic species dominating in many locations Weds include *Lycium ferocissimum, Medicago minima, Sida rhombifolia, Modiola caroliniana, Verbascum virgatum, Galium aparine, Stellaria media, Fumaria muralis, Vicia sativa subsp. sativa and Cirsium vulgare.* 

Occurs on alluvial deep, brown or black loam or clay soils, that are often saline, sometimes derived from a basalt substrate in depressions and lining watercourses in low hill and hill landform patterns extending to rocky creeks in places. Common in the Bellata region south-east of Moree, near Terry Hie Hie and east of Narrabri near Maules Creek and at the base of Mount Kaputar in the Brigalow Belt South Bioregion.



PCT 147: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket

<u>PCT Name:</u> Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion.

Vegetation Class: Western Vine Thickets

<u>EPBC Status</u>: Endangered: Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

<u>BC Status</u>: Endangered: Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions.

Sites included: WIFF1070

## Description on the property

The upper canopy is dominated by *Eucalyptus albens* (White Box). There is also an upper mid layer of *Notelaea microcarpa* (Native Olive) and *Callitris glaucophylla* (White Cypress Pine).

There is a distinct lower mid layer comprising of *Olearia elliptica, Pimelea neo-anglica* (Poison Pimelea), *Cassinia laevis* and *Geijera parviflora* (Wilga).

The canopy is dominated by *Eucalyptus albens* (White Box) *Notelaea microcarpa* (Native Olive) and *Callitris glaucophylla* (White Cypress Pine).

The mid layer contains *Melaleuca bracteata* (Black Tea-tree), *Dodonaea viscosa* (Sticky Hop-bush), *Pimelea neo-anglica* (Poison Pimelea) and *Cassinia laevis* (Cough Bush).

The ground layer contains grasses such as *Paspalidium gracile* (Slender Panic) and *Austrostipa verticillata* (Slender Bamboo Grass), *Cymbopogon refractus Sporobolus creber, Poa sieberiana, Cyperus gracilis* (Slender Flat-sedge). Species such as *Geranium solanderi* (Native Geranium) and *Phyllanthus subcrenulatus* and vines such as *Pandorea pandorana* (Wonga Vine) are also present in these plots.

## **BioNet Description**

PCT 147 is typically a mid-high to low closed or open forest known as semi-evergreen vine thicket dominated by rich diversity of low trees and shrubs to about 6 m high. Low trees include Notelaea microcarpa var. microcarpa, Geijera parviflora, Ehretia membranifolia along with Elaeodendron australe var. integrifolia, Ventilago viminalis, Psydrax oleifolia, Alectryon subdentatus and Alstonia constricta. Some tree species are facultatively deciduous. Emergent trees to 15 m high are often present including Eucalyptus albens, Eucalyptus melanophloia, Callitris glaucophylla and Casuarina cristata. The shrubs layer may be mid-dense or dense and includes Carissa ovata, Beyeria viscosa, Spartothamnella juncea, Solanum parvifolium, Rhagodia parabolica, Olearia elliptica, Senna coronilloides, Indigofera adesmiifolia, Indigofera brevidens, Breynia cernua, Solanum semiarmatum, Cassinia laevis, Myoporum montanum, Capparis lasiantha, Pimelea neo-anglica and Phyllanthus subcrenulatus. Vines are common and include Pandorea pandorana, Parsonsia eucalyptophylla, Clematis microphylla var. microphylla, Cayratia clematidea and Jasminum lineare. Mistletoes include Lysiana exocarpi, Lysiana subfalcata and Amyema miraculosum. The ground cover is mid-dense in open areas or sparse under dense tree or shrub canopies. Common grass species include Austrostipa verticillata, Leptochloa asthenes, Poa sieberiana var. hirtella, Elymus scaber, Panicum queenslandicum var. queenslandicum, Chloris ventricosa, Austrodanthonia bipartita, Paspalidium gracile and Cymbopogon refractus. The sub-shrub Desmodium brachypodum is often abundant. Forbs include Boerhavia dominii and Dichondra sp. A. Sedges such as Carex inversa may be present along with the rock fern Cheilanthes sieberi subsp. sieberi.

Occurs on dark chocolate brown to black loam soils on basalt hills or flats on the North Western Slopes of NSW mainly in the Brigalow Belt South Bioregion. This is a dry rainforest type adapted to low rainfall areas west of the Great Dividing Range.



## PCT 520: Heathy outcrop shrublands

<u>PCT Name</u>: Heathy outcrop shrublands on volcanic sediments of the Nandewar Bioregion and Brigalow Belt South Bioregion

Vegetation Class: Northern Montane Heaths

EPBC Status: not listed

BC Status: not listed

Sites included: WIFF1060

## Description on the property

No upper storey, but there is a sparse layer of *Leptospermum* spp. (Tea-tree) and a mid layer of *Pimelea neo-anglica* (Poison Pimelea).

A ground layer comprised of *Austrostipa scabra* (Speargrass), Cymbopogon refractus (Barbed Wire Grass), *Digitaria brownii* (Cotton Panic Grass), *Lachnagrostis filiformis*. *Cyperus* spp. (Flat-sedge), *Rytidosperma* spp. Also occur in the ground layer. Forbs such as *Vittadinia* spp., *Calotis lappulacea* (Yellow Burr-daisy), *Dichondra* spp., *Cheilanthes sieberi* (Rock Fern).

## **BioNet Description**

PCT 520 is typically a shrubland or low woodland that has affinities with shrublands on trachyte / sandstone outcrops in Mount Kaputar National Park and surrounds to the north. Contains scattered *Callitris glaucophylla* and *Eucalyptus dealbata*. Common shrub species include *Kunzea occidentalis, Calytrix tetragona, Micromyrtus striata* and *Beyeria viscosa*. There is a sparse ground layer of forbs, grasses and ferns, with species such as *Bulbine semibarbata, Sigesbeckia orientalis subsp. orientalis, Aristida jerichoensis var. jerichoensis, Triptilodiscus pygmaeus, Wahlenbergia gracilis, Cheilanthes sieberi subsp. sieberi, Cymbopogon refractus, Aristida ramosa, Agrostis avenacea var. avenacea, Cheilanthes distans, Cyperus fulvus, Dichopogon fimbriatus, Galium gaudichaudii, Lepidosperma laterale, Paspalidium distans, Paspalidium gracile, Schoenus apogon and Wahlenbergia communis*. A distinctive, restricted vegetation type dominated by species with limited distribution in the Nandewar and Brigalow Belt South bioregions.



563: White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest

<u>PCT Name</u>: White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nandewar Bioregion and New England Tableland Bioregion

Vegetation Class: North-west Slopes Dry Sclerophyll Woodlands

<u>EPBC Status</u>: Critically endangered: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, partially subset of TEC.

<u>BC Status</u>: Critically endangered: White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions.

<u>Sites included:</u> WIFF1000, WIFF1001, WIFF1002, WIFF1004, WIFF1007, WIFF1071, WIFF1072, WIRP0002, WIRP1005, WIRP1073, WIRP1077, WIRP1090, WIRP1092, WIRP3005.

## Description on the Property

These plots mostly occurred on hill slopes, and the canopy is dominated by *Eucalyptus albens* (White Box), *Angophora floribunda* (Rough-barked Apple), *Callitris glaucophylla* (White Cypress Pine), *Eucalyptus blakelyi* (Blakely's Red Gum), *Eucalyptus laevopinea* (Silver-top Stringybark) and *Eucalyptus melliodora* (Yellow Box).

There is a well-developed shrub layer which is dominated by *Notelaea microcarpa* (Native Olive), *Olearia elliptica* (Sticky Daisy-bush) as well as *Alectryon subdentatus f. subdentatus, Olearia viscidula* (Wallaby Weed). Pandorea pandorana (Wonga Wonga Vine) occurs in the upper and mid layers.

The ground layer consisted of *Poa sieberiana* (Snowgrass), *Dichondra* sp. Inglewood, *Vittadinia* spp. (Fuzzweed), *Geranium* spp., *Clematis glycinoides* (Headache Vine), *Glycine tabacina* (Variable Glycine), *Wahlenbergia communis* (Tufted Bluebell), *Sigesbeckia australiensis, Oxytes brachypoda* (Large Tick-trefoil) and *Geranium solanderi* (Native Geranium).

At least 25 exotic species were recorded in this zone during the sampling period. Those with the highest cover were *Hyparrhenia hirta* (Coolatai Grass), *Conyza* spp., *Paspalum dilatatum* (Paspalum), *Bidens pilosa* (Cobbler's Pegs), *Centaurium tenuiflorum* (Slender centaury), *Sonchus oleraceus* (Common Sowthistle), *Petrorhagia nanteuilii* (Proliferous Pink) and *Hypericum perforatum* (St. Johns Wort).

# **BioNet Description**

PCT 563 is typically tall open forest with a variable overstorey dominated by *Eucalyptus albens*, *Eucalyptus laevopinea*, *Angophora floribunda*, *Callitris glaucophylla*, *Eucalyptus blakelyi* and/or *Eucalyptus melliodora*. There is a well developed shrub layer with *Olearia* sp. aff. *elliptica*, *Notelaea microcarpa var. microcarpa* and *Cassinia quinquefaria* the most frequent species, with other shrubs sometimes present including *Olearia viscidula*, *Dodonaea viscosa subsp. angustifolia*, *Acacia neriifolia*, *Melicytus dentatus*, and, rarely, *Olearia alpicola*, *Acacia maidenii* and *Pomaderris betulina subsp. betulina*. The climbers *Jasminum volubile* and *Pandorea jasminoides* are rarely present. The ground layer is usually sparse to mid-dense with common species including *Poa sieberiana*, *Desmodium brachypodum*, *Aristida ramosa* and *Dichondra repens*. Other frequent groundcover species include *Swainsona galegifolia*, *Austrodanthonia racemosa var. racemosa*, *Vittadinia cuneata*, *Themeda australis*, *Cheilanthes sieberi subsp. sieberi* and *Cymbopogon refractus*. Rarely recorded groundcover species include *Bulbine glauca* and *Swainsona brachycarpa*. This community is very poorly represented in the protected area network.

Occupies mid-elevation hilly areas, mainly in the southern parts of Nandewar south from near Watson's Creek, with small pockets east of Kaputar National Park and near Single National Park. It occurs on a variety of substrates including granite, sediments and volcanics.



PCT 588: White Box - White Cypress Pine shrubby hills open forest

<u>PCT Name</u>: White Box - White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion

Vegetation Class: North-west Slopes Dry Sclerophyll Woodlands

EPBC Status: not listed

BC Status: not listed

<u>Sites included:</u> WIFF1003, WIFF1010, WIFF1067, WIOR1101, WIRP1006, WIRP1008, WIRP1067, WIRP1068, WIRP1085, WIRP3001

## Description on the Property

An open forest woodland on a hillslope, the canopy is dominated by *Callitris glaucophylla* (White Cypress Pine) and *Eucalyptus albens* (White Box).

The mid layer contains *Dodonaea viscosa* (Sticky Hop-bush), *Cassinia laevis* (Cough Bush), *Olearia elliptica* (Sticky Daisy-bush) and *Pimelea neo-anglica* (Poison Pimelea).

The ground layer is comprised of grasses and sedges such as *Paspalidium gracile* (Slender Panic), *Austrostipa scabra* (Speargrass), *Aristida ramosa* (Purple Wiregrass), *Cymbopogon refractus* (Barbed Wire Grass) and *Cyperus gracilis* (Slender Flat-sedge) occur in the plots. Forbs and vine species such as *Dichondra* sp. *Inglewood* and *Glycine tabacina* (Variable Glycine) are also scattered across the ground layer of the plots.

# **BioNet Description**

PCT 588 is typically an open forest to woodland dominated by *Eucalyptus albens* and *Callitris glaucophylla* with a shrubby understorey. Other tree species include *Eucalyptus melliodora, Angophora floribunda, Eucalyptus dealbata* or *Eucalyptus melanophloia* may also occur. Contains a mid-dense to sparse shrub layer including *Notelaea microcarpa var. microcarpa, Geijera parviflora, Beyeria viscosa, Olearia elliptica, Dodonaea viscosa subsp. angustifolia, Acacia decora, Bursaria spinosa var. spinosa, Psydrax odorata, Cassinia laevis* and *Olearia ramosissima*. There is usually a mid-dense ground cover of grass species such as *Aristida ramosa, Aristida vagans, Cymbopogon refractus, Austrostipa scabra, Elymus scaber* and *Dichelachne micrantha*. The sub-shrub *Desmodium brachypodum* and climber *Glycine tabacina* are often present. Forb species include *Rostellularia adscendens, Boerhavia repleta, Swainsona galegifolia, Swainsona queenslandica, Vittadinia muelleri, Galium propinquum* and *Dichondra sp. A.* 

Occurs on brown to red clay to loam soils derived from lithic sandstones of finer sedimentary or metamorphic rocks mainly on lower-mid hillslopes in hill landform patterns in the Nandewar Bioregion including around Mount Kaputar extending to Manilla with some outliers in the BBS Bioregion on hills In the Liverpool Plains sub-region and areas to the north of Kaputar.



PCT 592: Narrow-leaved Ironbark - cypress pine - White Box shrubby open forest

<u>PCT Name</u>: Narrow-leaved Ironbark - cypress pine - White Box shrubby open forest in the Brigalow Belt South Bioregion and Nandewar Bioregion

Vegetation Class: Western Slopes Dry Sclerophyll Forests

EPBC Status: not listed

BC Status: not listed

Sites included: 1061

## Description on the Property

The Canopy dominated by *Callitris endlicheri* (Black Cypress Pine), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus albens* (White Box).

There is an upper mid layer comprised of Dodonaea viscosa (Sticky Hop-bush) and a lower mid layer of *Cassinia laevis* (Cough Bush), *Olearia elliptica* (Sticky Daisy-bush), *Pimelea neo-anglica* (Poison Pimelea).

The ground layer consists of grasses *Paspalidium gracile* (Slender Panic), *Austrostipa scabra* (Speargrass), *Aristida ramosa* (Purple Wiregrass), *Cymbopogon refractus* (Barbed Wire Grass). *Cyperus gracilis* (Slender Flat-sedge) also occurs in this layer. *Dichondra* sp. *Inglewood* and *Glycine tabacina* (Variable Glycine) also occur in the ground lay of these plots.

Other species observed were *Euchiton japonicus, Hypericum gramineum* (Small St John's Wort), *Wahlenbergia gracilenta* (Annual Bluebell), *Glossocardia bidens* (Cobbler's Tack), *Calotis lappulacea*, (Yellow Burr-daisy), *Cheilanthes sieberi* (Rock Fern), *Oxalis perennans* and *Hypoxis hygrometrica* (Golden Weather-grass).

## **BioNet Description**

PCT 592 is typically a tall or mid-high open forest to woodland dominated by *Eucalyptus crebra*, *Callitris glaucophylla* and/or *Eucalyptus albens*. Other trees may include *Eucalyptus dealbata* or *Eucalyptus melanophloia*. There is usually a sparse shrubby understorey with *Beyeria viscosa*, *Notelaea microcarpa var. microcarpa* and *Dodonaea viscosa subsp. angustifolia* most frequent. Other shrubs include *Breynia cernua*, *Solanum parvifolium*, *Melichrus urceolatus*, *Spartothamnella juncea* and *Psydrax oleifolia*. The ground layer includes the sub-shrub *Desmodium brachypodum* and grass species such as *Austrostipa scabra subsp. scabra*, *Austrodanthonia racemosa var. obtusata*, *Microlaena stipoides var. stipoides*, *Aristida ramosa* and *Cymbopogon refractus*. Forb species include *Dichondra species A*, *Calotis anthemoides*, *Vernonia cinerea var. cinerea*, *Brunoniella australis* and *Arthropodium sp. B*. Climbers include *Desmodium varians* and *Glycine clandestina*.

Occurs in loamy soils derived from volcanic or sedimentary substrates on hillslopes, footslopes and flats in hill landscape patterns mainly in the Mount Kaputar to Keepit Dam regions with outliers to the east and south of Mount Kaputar.



PCT 1308: White Box - White Cypress Pine shrubby open forest

<u>PCT Name</u>: White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion

Vegetation Class: North-west Slopes Dry Sclerophyll Woodlands

EPBC Status: not listed

BC Status: not listed

Sites included: ETRP0000, WIFF1065, WIOR1100, WIRP1009, WIRP1050, WIRP1069, WIRP1084

## Description on the Property

This PCT occurs as an open forest, with a canopy dominated by *Eucalyptus albens* (White Box) and *Eucalyptus crebra* (Narrow-leaved Ironbark).

The mid layer has two distinct layers, the upper layer is dominated by species such as Acacia *decora* (Western Silver Wattle), *Cassinia quinquefaria*, *Dodonaea viscosa* (Sticky Hop-bush) and *Olearia elliptica* (Sticky Daisy-bush).

The lower mid layer consists of *Callitris glaucophylla* (White Cypress Pine) and *Notelaea microcarpa* (Native Olive).

The ground layer is comprised of *Cymbopogon refractus* (Barbed Wire Grass) and *Desmodium brachypodum*. Ferns such as *Cheilanthes sieberi* (Rock Fern).

## **BioNet Description**

PCT 1308 is typically a tall open forest or woodland dominated by *Eucalyptus albens, Callitris glaucophylla, Angophora floribunda, Brachychiton populneus subsp. Populneus, Eucalyptus melliodora, Eucalyptus dealbata, Eucalyptus crebra and Eucalyptus melanophloia.* The shrub layer is often (what density) and includes *Beyeria viscosa, Bursaria spinosa subsp. Spinosa, Cassinia quinquefaria, Dodonaea viscosa subsp. Angustifolia, Notelaea microcarpa var. Microcarpa, and Olearia elliptica.* The ground layer is often (unknown density) and frequent ground cover species include *Aristida ramosa, Cheilanthes sieberi subsp. Sieberi, Cymbopogon refractus* and *Desmodium brachypodum.* 



PCT 1383: White Box grassy woodland

<u>PCT Name</u>: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion

Vegetation Class: Western Slopes Grassy Woodlands

<u>EPBC Status</u>: Critically endangered: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, wholly subset of TEC.

<u>BC Status</u>: Critically endangered (part): White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, wholly subset of TEC.

<u>Sites included:</u> WIFF1045, WIFF1057, WIFF1089, WIRP1024, WIRP1048, WIRP1049, WIRP1051, WIRP1052, WIRP1053, WIRP1056, WIRP1058, WIRP1059, WIRP1062, WIRP1074, WIRP1079, WIRP1083

## Description on the Property

In this PCT, the canopy is dominated by *Eucalyptus albens* (White Box), *Callitris glaucophylla* (White Cypress Pine), *Eucalyptus crebra* (Narrow-leaved Ironbark). Other tree species included in the plots were *Acacia salicina* (Cooba), *Notelaea microcarpa* (Native Olive) and *Brachychiton populneus* (Kurrajong)

The mid layer consists of *Pimelea neo-anglica* (Poison Pimelea), *Cassinia laevis* (Cough Bush), *Dodonaea viscosa* (Sticky Hop-bush).

The ground layer consists of *Olearia elliptica* (Sticky Daisy-bush), *Cymbopogon refractus* (Barbed Wire Grass) and *Panicum effusum* (Hairy Panic), *Aristida acuta, Sporobolus creber* (Slender Rat's Tail Grass), *Chloris truncata* (Windmill Grass), *Eragrostis leptostachya* (Paddock Lovegrass)

## **BioNet Description**

PCT 1383 is typically a tall grassy woodland dominated by *Eucalyptus albens, Angophora floribunda, Brachychiton populneus* subsp. *Populneus, Callitris glaucophylla, Eucalyptus laevopinea, Eucalyptus melanophloia, Eucalyptus melliodora* and *Eucalyptus pilligaensis*. It has a (density unknown) sparse shrub layer of *Acacia buxifolia, Acacia implexa, Alectryon oleifolius subsp. Canescens, Alstonia constricta, Beyeria viscosa, Cassinia laevis, Geijera parviflora, Notelaea microcarpa* var. *microcarpa* and *Olearia elliptica*. Ground cover is (unknown density) and frequent species are *Aristida ramosa, Austrostipa scabra* subsp. *Scabra, Cymbopogon refractus, Cyperus gracilis, Desmodium brachypodum, Dichanthium sericeum* subsp. *Sericeum, Glycine tabacina* and *Themeda australis*. Occurs on creek flats, lower slopes and alluvial plains mainly on sedimentary substrates.

## Threatened Ecological Communities

The TECs that occur on the Willeroi East offset area are listed in Table 5.2 and shown on Figure 5.1.

Table 5.2	Threatened	Fcological	Communities	listed for	Willeroi Fast
Table J.Z	inteateneu	LCOIOgical	communices	instea ioi	vvinci oi Last

Threatened Ecological Community	Plant Community Type	Willeroi East
Semi-evergreen Vine Thicket EEC	147: Mock Olive - Wilga - Peach Bush - Carissa semi- evergreen vine thicket	6.78
Total Semi-evergreen Vine Thicket EEC		6.78
White Box - Yellow Box - Blakely's Red Gum	563: White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest	27.11
Woodland CEEC (Woodland Form)	1383: White Box grassy woodland	77.94
Total White Box - Yellow Box - Blakely's Red G	105.05	
White Box - Yellow Box - Blakely's Red Gum	563: Derived Native Grassland	35.83
Woodland CEEC (Grassland Form)	1383: Derived Native Grassland	145.09
Total White Box - Yellow Box - Blakely's Red G	180.92	
Total White Box - Yellow Box - Blakely's Red G	285.97	

## Threatened Plants

One threatened plant has been recorded on the Willeroi east offset area: *Swainsona sericea* (Silky Swainson-pea) (Niche 2012).

## 5.1.2 Wean North

## Flora

Two plant community types were mapped across the Wean North offset area. The PCTs are listed in Table 5.3, shown in Figure 5.2 and described below.

Table 5.3 Plant Community Types for Wean North

Vegetation Class (Keith 2004)	PCT Label	Condition	BC Act Status *	EPBC Act Status*	Area (ha)
Flood plain Transition Woodlands	101: Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion	Derived Native Grassland	N/A	N/A	115.13
Flood plain Transition Woodlands	244: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	Derived Native Grassland	-	N/A	72.44
Total					187.56
Other & Non-Native Vegetation				0.25	
TOTAL CONSERVATION AREA					187.81

Interpretation of imagery since 1966 (DCCEEW 2024; Google Earth Pro 2024) indicates that PCTs 101 and 244 have been cleared for grazing since before 1966 (Appendix D). No sign of cultivation was observed and State Land use mapping (NSW Government 2024) indicates that all areas of this property are modified for grazing (Appendix D).



Figure 5.2 Plant community types for Wean North

## Plant Community Types and Descriptions

### PCT 101



<u>PCT Name:</u> Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion

Vegetation Class: Floodplain Transition Woodlands

(Please note PCT 101 was incorrectly assigned to the Keith Formation: Semi Arid Woodlands and the Class: Brigalow Clay Plain Woodlands. It was re assigned to the Keith Formation: Grassy Woodlands and the Class: Floodplain Transition Woodlands in 2024).

<u>EPBC Status:</u> In its current condition state this PCT does not meet the requirements to be listed as a TEC.

<u>BC Status</u>: In its current condition state this PCT does not meet the requirements to be listed as a TEC.

## Sites included: WNFF0000

## Description on Property

There is no canopy or mid layer recorded in this plot, however there are *Eucalyptus populnea* subsp. *bimbil* Poplar Box and *Eucalyptus melliodora* (Yellow Box) occurring as paddock trees nearby.

The ground layer is comprised of grass species such as *Enteropogon acicularis* (Curly Windmill Grass), *Panicum effusum* (Hairy Panic), *Eragrostis leptostachya* (Paddock Lovegrass), *Chloris truncata* (Windmill Grass), *Bothriochloa macra* (Red Grass), *Dichanthium sericeum* (Queensland Bluegrass) and *Themeda australis*. Forb species such as, *Einadia nutans* (Climbing Saltbush), *Vittadinia muelleri, Sida corrugata* (Corrugated Sida). Chenopod species present were *Sclerolaena birchii* (Galvinized Burr) and *Sclerolaena muricata* (Black Rolypoly).

At least 15 exotic species were recorded in this zone during the sampling period. The most abundant were *Carthamus lanatus* (Saffron Thistle), *Trifolium glomeratum* (Clustered Clover), *Centaurium tenuiflorum* (Slender centaury), *Chondrilla juncea* (Skeleton Weed), *Conyza* spp., *Schkuhria pinnata* var. *abrotanoides* (Dwarf Marigold) and *Sonchus oleraceus* (Common Sowthistle).

## **BioNet Description**

PCT 101 is typically a tall woodland or open woodland dominated by *Eucalyptus populnea* subsp. bimbil sometimes with Eucalyptus melliodora, Callitris glaucophylla, Eucalyptus melanophloia or rarely with Eucalyptus microcarpa. A very sparse shrub layer may be present or it is absent. Shrub species include Geijera parviflora, Notelaea microcarpa, Maireana microphylla, Capparis mitchellii and Alectryon oleifolius. The ground cover is usually dense and is dominated by a rich array of grass and forb species. Grass species include Austrostipa verticillata, Dichanthium sericeum subsp. sericeum, Bothriochloa decipiens, Austrodanthonia bipartita, Enteropogon acicularis, Aristida personata, Aristida ramosa, Austrostipa aristiqlumis, Austrostipa scabra subsp. scabra, Themeda australis, Eulalia aurea, Paspalidium jubiflorum, Chloris truncata and Chloris ventricosa. The more palatable grasses such as Themeda australis and Eulalia fulva have often been grazed out. Forb species include Rumex brownii, Einadia nutans, Cotula australis, Maireana enchylaenoides, Erodium crinitum, Calotis lappulacea, Rostellularia adscendens subsp. adscendens, Sida corrugata, Oxalis exilis, Einadia hastata, Vittadinia dissecta var. hirta, Vittadinia muelleri, Vittadinia sulcata, Chrysocephalum apiculatum, Solanum cinereum, Abutilon oxycarpum, Dichondra sp. A, Wahlenbergia stricta subsp. stricta, Pycnosorus globosus, Goodenia fascicularis and Brunoniella australis.



<u>PCT Name</u>: Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).

Vegetation Class: Floodplain Transition Woodlands

<u>EPBC Status:</u> In its current condition state this PCT does not meet the requirements to be listed as a TEC.

<u>BC Status</u>: In its current condition state this PCT does not meet the requirements to be listed as a TEC.

Sites included: WNFF0001

#### **Description on Property**

The canopy is dominated by *Eucalyptus populnea* subsp. *bimbil* (Bimble Box) which occurs as a paddock tree in the plot.

The ground layer is comprised of grass species such as *Enteropogon acicularis* (Curly Windmill Grass), *Panicum effusum* (Hairy Panic), *Eragrostis leptostachya* (Paddock Lovegrass), *Chloris truncata* (Windmill Grass), *Bothriochloa macra* (Red Grass), *Themeda australis, Dichanthium sericeum* (Queensland Bluegrass). Forb species included *Sida corrugata* (Corrugated Sida), *Einadia nutans* (Climbing Saltbush) and *Vittadinia muelleri*.

Other species which occurred in the plot were Austrostipa scabra (Speargrass), Eriochloa pseudoacrotricha (Early Spring Grass), Digitaria divaricatissima (Umbrella Grass), Sporobolus creber (Slender Rat's Tail Grass) Sclerolaena muricata (Black Rolypoly), Salsola australis and Sclerolaena birchii.

At least 15 exotic species were recorded in this zone during the sampling period. The most abundant were *Centaurium tenuiflorum* (Slender centaury), *Carthamus lanatus* (Saffron Thistle), *Chondrilla juncea* (Skeleton Weed), *Centaurea melitensis* (Maltese Cockspur) and *Leontodon rhagadioloides* (Cretan Weed).

## **BioNet Description**

PCT 244 is typically a Mid-high to tall woodland or open woodland, averaging 13 m high, dominated by *Eucalyptus populnea* subsp. *bimbil*. The small trees *Casuarina cristata* or *Alectryon oleifolius* subsp. *canescens* may be present but not co-dominant. The shrub layer is absent or sparse with some thickets in places. Tall shrub species include *Geijera parviflora, Apophyllum anomalum* and *Eremophila mitchellii*. Low shrubs include *Maireana microphylla, Maireana decalvans* and *Rhagodia spinescens*. The ground cover is mid-dense to sparse and contains low shrubs such as *Sclerolaena birchii* and *Sclerolaena muricata* and a range of grass species including *Austrodanthonia setacea, Enteropogon acicularis, Austrostipa scabra subsp. scabra, Elymus scaber* var. *scaber, Eragrostis parvifolia, Chloris truncata, Austrodanthonia fulva* and *Sporobolus caroli*. Forb species include *Calotis cuneifolia, Sida corrugata, Vittadinia dissecta var. hirta, Dichondra repens, Rostellularia adscendens subsp. adscendens, Oxalis perennans* and *Rumex brownii*. Sedges such as *Eleocharis plana* and *Carex inversa,* rushes (*Juncus spp.*) and *Marsilea drummondii* grow in slight depressions. Weed species may be common including *Medicago spp., Trifolium spp., Hypochaeris radicata* and *Rapistrum rugosum*.

## Threatened Ecological Communities

No threatened plant communities occur on the Wean North offset area.

## Threatened Plants

No threatened plants have been recorded on the Wean North offset area.

# 5.1.3 Glenroc

## Flora

Three plant community types were mapped across the Glenroc offset area. The PCTs are listed in Table 5.4, shown in Figure 5.3 and described below.

Vegetation Class (Keith 2004)	PCT Label	Condition	BC Act Status*	EPBC Act Status*	Area (ha)
North-west Floodplain Woodlands	55: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.	Moderate	-	-	0.85
	101: Poplar Box - Yellow Box - Western Greyodplainnsitionmainly in the Liverpool Plains, Brigalow Beltsouth Bioregion	Moderate	-	-	2.12
Floodplain Transition Woodlands		Derived Native Grassland			51.10
Western	145: Western Rosewood - Wilga - Wild Orange	Moderate	-	-	4.97
Peneplain Woodlands	- Belah low woodland of the Brigalow Belt South Bioregion and eastern Darling Riverine Plains Bioregion	Derived Native Grassland			14.05
Total				73.08	
Other & Non-Native Vegetation				0.22	
TOTAL CONSERVATION AREA				73.31	

#### **Table 5.4 Plant Community Types for Glenroc**

Interpretation of imagery since 1966 (DCCEEW 2024; Google Earth Pro 2024) indicates that PCT 101 has been cleared for grazing since before 1966 (Appendix E). Imagery from 1997 shows a portion of this DNG form of PCT 101 to have been cultivated (Appendix E). State Land use mapping (NSW Government 2024) indicates that areas of this property have been cropped (Appendix E). Imagery since 1966 supports this as having occurred to the north east of the creekline but not to the south west of the creekline as shown in the State Landuse Mapping (Appendix E).



Figure 5.3 Plant Community Types for Glenroc
## Plant Community Types and Descriptions

#### PCT 55



<u>PCT Name</u>: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions.

Vegetation Class: North-west Floodplain Woodlands

EPBC Status: not listed

BC Status: not listed.

Sites included: GLFF0003

#### **Description on the Property**

The canopy was dominated by Casuarina cristata (Belah).

There is also an upper mid layer of shrubs which included *Alectryon oleifolius* (Western Rosewood), *Eremophila mitchellii* (Budda) and the weed *Lycium ferocissimum* (African Boxthorn).

The ground layer included *Einadia nutans* (Climbing Saltbush) and *Solanum esuriale*. Other species included grass species such as *Austrostipa aristiglumis* (Plains Grass), *Paspalidium gracile* (Slender Panic), *Aristida personata* and *Cynodon dactylon* (Common Couch). Shrubs included *Sclerolaena muricata* (Black Rolypoly), *Abutilon oxycarpum* (Straggly Lantern-bush) and *Salsola australis*.

At least 15 exotic species were recorded in this PCT during the survey period. The most abundant were *Salvia reflexa* (Mintweed), *Lycium ferocissimum* (African Boxthorn), *Bidens subalternans* (Greater Beggar's Ticks), *Malvastrum Americanum* (Spiked Malvastrum), *Conyza* spp., *Sida spinosa* and *Lepidium africanum*.

#### **BioNet Description**

PCT 55 is typically a tall woodland of about 12 m high, dominated by Casuarina cristata. Other tree species include Eucalyptus largiflorens and Eucalyptus coolabah in depressions and on higher ground Eucalyptus microcarpa and Eucalyptus populnea subsp. bimbil. Acacia pendula may be present as an associate but not as a dominant species. Tall shrubs include Geijera parviflora, Alectryon oleifolius, Eremophila mitchellii, Apophyllum anomalum, Capparis mitchellii and Ventilago viminalis. Shrubs include Myoporum montanum, Rhagodia spinescens, Maireana enchylaenoides, Eremophila maculata and Eremophila deserti. Muehlenbeckia florulenta may be present in frequently flooded areas. Ground cover includes the low shrubs such as Enchylaena tomentosa, many species of copper burrs including Sclerolaena birchii, Sclerolaena divaricata, grasses such as Enteropogon acicularis, wallaby grasses including Monachather paradoxus and Austrodanthonia setacea, Austrostipa scabra, Austrodanthonia fulva, Austrostipa aristiglumis, Austrostipa verticillata, Aristida leptopoda, Paspalidium gracile, Sporobolus caroli and Panicum queenslandicum. Forbs include Einadia nutans, Oxalis chnoodes, Vittadinia cuneifolia, Boerhavia dominii, Goodenia fascicularis and Solanum esuriale. Sedges such as Eleocharis pallens, rushes such as Juncus radula and Marsilea drummondii occur in depressions. Common weed species include Rapistrum rugosum, Carthamus lanatus and Medicago polymorpha.



<u>PCT Name:</u> Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion

#### Vegetation Class: Floodplain Transition Woodlands

(Please note PCT 101 was incorrectly assigned to the Keith Formation: Semi Arid Woodlands and the Class: Brigalow Clay Plain Woodlands. It was re assigned to the Keith Formation: Grassy Woodlands and the Class: Floodplain Transition Woodlands in 2024).

<u>EPBC Status</u>: In its current condition state this PCT does not meet the requirements to be listed as a TEC.

<u>BC Status</u>: In its current condition state this PCT does not meet the requirements to be listed as a TEC.

Sites include: GLFF0000; GLFF0002

### Description on the Property

The canopy was dominated by *Casuarina cristata* (Belah) within the plot and active revegetation has commenced with seedlings planted of *Eucalyptus populnea* subsp. *bimbil* (Poplar Box) as future canopy species.

There is also an upper mid layer of shrubs which included *Alectryon oleifolius* (Western Rosewood), *Eremophila mitchellii* (Budda) and the weed *Lycium ferocissimum* (African Boxthorn).

The ground layer included *Einadia nutans* (Climbing Saltbush) and *Solanum esuriale*. Other species included grass species such as *Austrostipa aristiglumis* (Plains Grass), *Paspalidium gracile* (Slender Panic), *Aristida personata* and *Cynodon dactylon* (Common Couch). Shrubs included *Sclerolaena muricata* (Black Rolypoly), *Abutilon oxycarpum* (Straggly Lantern-bush) and *Salsola australis*.

At least 15 exotic species were recorded in this PCT during the survey period. The most abundant were *Salvia reflexa* (Mintweed), *Lycium ferocissimum* (African Boxthorn), *Bidens subalternans* (Greater Beggar's Ticks), *Malvastrum Americanum* (Spiked Malvastrum), *Conyza* spp., *Sida spinosa* and *Lepidium africanum*.

#### **BioNet Description**

PCT 101 is typically a tall woodland or open woodland dominated by Eucalyptus populnea subsp. bimbil sometimes with Eucalyptus melliodora, Callitris glaucophylla, Eucalyptus melanophloia or rarely with Eucalyptus microcarpa. A very sparse shrub layer may be present or it is absent. Shrub species include Geijera parviflora, Notelaea microcarpa, Maireana microphylla, Capparis mitchellii and Alectryon oleifolius. The ground cover is usually dense and is dominated by a rich array of grass and forb species. Grass species include Austrostipa verticillata, Dichanthium sericeum subsp. sericeum, Bothriochloa decipiens, Austrodanthonia bipartita, Enteropogon acicularis, Aristida personata, Aristida ramosa, Austrostipa aristiqlumis, Austrostipa scabra subsp. scabra, Themeda australis, Eulalia aurea, Paspalidium jubiflorum, Chloris truncata and Chloris ventricosa. The more palatable grasses such as Themeda australis and Eulalia fulva have often been grazed out. Forb species include Rumex brownii, Einadia nutans, Cotula australis, Maireana enchylaenoides, Erodium crinitum, Calotis lappulacea, Rostellularia adscendens subsp. adscendens, Sida corrugata, Oxalis exilis, Einadia hastata, Vittadinia dissecta var. hirta, Vittadinia muelleri, Vittadinia sulcata, Chrysocephalum apiculatum, Solanum cinereum, Abutilon oxycarpum, Dichondra sp. A, Wahlenbergia stricta subsp. stricta, Pycnosorus globosus, Goodenia fascicularis and Brunoniella australis.

Occurs on alluvial cracking clay soils derived from volcanic or sedimentary substrates on alluvial plains or gently undulating slopes in the Brigalow Belt South Bioregion particularly in the Liverpool Plains sub-region with areas also occurring in the Northern Basalts sub-region.

In its current condition state this PCT does not meet the requirements to be listed as a TEC.

#### PCT 145



<u>PCT Name:</u> Western Rosewood - Wilga - Wild Orange - Belah low woodland of the Brigalow Belt South Bioregion and eastern Darling Riverine Plains Bioregion

Vegetation Class: Western Peneplain Woodlands

EPBC Status: Not listed

<u>BC Status:</u> In its current condition state this PCT does not meet the requirements to be listed as a TEC.

Sites included: GLFF0001; VIBP2011

#### Description on the Property

The canopy is absent however there is a mid layer of *Alectryon oleifolius* (Western Rosewood) and an understorey of dead or dying *Lycium ferocissimum* (African Boxthorn) due to weed management by WHC.

Other species in this PCT include shrubs such as *Geijera parviflora* (Wilga), *Myoporum montanum* (Western Boobialla) and *Abutilon oxycarpum* (Straggly Lantern-bush). Forb species such as *Einadia nutans* (Climbing Saltbush), *Solanum esuriale* (Quena) and *Sida corrugata* (Corrugated Sida). Chenopod species include *Sclerolaena birchii* (Galvinized Burr) and *Sclerolaena muricata* (Black Rolypoly). Grass species such as *Paspalidium gracile* (Slender Panic), *Enteropogon acicularis* (Curly Windmill Grass), *Panicum* spp. *Austrostipa scabra* (Speargrass), *Sporobolus caroli* (Fairy Grass), *Chloris ventricosa* (Tall Chloris), *Austrostipa verticillata* (Slender Bamboo Grass), and *Carex inversa* (Knob Sedge)

At least 15 exotic species were recorded in this PCT during the survey period. Species with the highest cover were *Salvia reflexa* (Mintweed), *Conyza* spp., *Malvastrum Americanum* (Spiked Malvastrum), *Sida spinosa, Urochloa panicoides* (Urochloa Grass), *Misopates orontium* (Lesser Snapdragon) and *Rapistrum rugosum* (Turnip Weed).

## **BioNet Description**

PCT 145 is typically a low open woodland or open shrubland to about 8 m high, dominated by the small trees Alectryon oleifolius, Geijera parviflora, Casuarina cristata, Atalaya hemiglauca and Capparis mitchellii. Eucalypts such as Eucalyptus populnea subsp. bimbil, Eucalyptus pilligaensis and Eucalyptus albens may occur as emergent trees. Shrubs include Rhagodia spinescens, Senna spp. form taxon filifolia, Myoporum montanum, Apophyllum anomalum and Eremophila mitchellii. Small shrubs and grasses dominate the ground cover. The main small shrubs are Sclerolaena spp. and Maireana spp. (including Maireana microphylla). Grasses include Enteropogon acicularis, Chloris truncata, Dichanthium sericeum subsp. sericeum, Bothriochloa decipiens, Tragus australianus, Enneapogon gracilis, Austrodanthonia bipartita, Austrostipa setacea and Sporobolus caroli. Forb species include Portulaca oleracea, Ptilotus semilanatus, Tetragonia tetragonioides, Sida corrugata, Vittadinia pterochaeta, Chamaesyce drummondii, Calotis lappulacea, Calotis scapigera and Hibiscus trionum.

Occurs on dark brown, black to reddish clay and loam soils often duplex soils derived from volcanic or fine-grained sedimentary substrates or gravelly soil subject to runoff flow on colluvial footslopes and outwash plains or alluvial plains of the Brigalow Belt South and eastern Darling Riverine Plain Bioregions in NSW. May also occur as an open low woodland shrubland among taller woodland communities and shares many species with those woodlands.

## Threatened Ecological Communities

No threatened plant communities occur on the Glenroc offset area.

## Threatened Plants

No threatened plants have been recorded on the Glenroc offset area.

### 5.1.4 Costavale

#### Flora

One plant community type was mapped across the Costavale offset area. The PCTs are listed in Table 5.5, shown in Figure 5.4 and described below.

Vegetation Class (Keith 2004)	PCT Label	Condition	BC Act Status*	EPBC Act Status*	Area (ha)			
Eloodolain	101: Poplar Poy Vollow Poy Mactorn Cray Poy	Moderate	E	-	16.58			
Transition Woodlands	grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion	Derived Native Grassland	-	-	193.50			
Total								
Other & Non-Native Vegetation								
TOTAL CONSERVATION AREA								

Table 5.5 Plant Community Types for Costavale

Interpretation of imagery since 1966 (DCCEEW 2024; Google Earth Pro 2024) indicates that PCT 101 has been partially cleared for grazing since before 1966 (Appendix E) although the south west corner of the property remained wooded until at least 1975 (Appendix E). Examination of imagery since 1966 shows cultivation having occurred in the north east paddock of the Property, Years 2010 and 2022 (Appendix F). This area is not mapped as PCT 101. State Land use mapping (NSW Government 2024) indicates that other areas of this property including PCT 101 DNG have been cropped (Appendix E). Imagery since 1966 does not supports this as having occurred (Appendix F).



Figure 5.4 Plant Community Types and TECS for Costavale

#### Plant Community Types and Descriptions

#### PCT 101



<u>PCT Name:</u> Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion

#### Vegetation Class: Floodplain Transition Woodlands

(Please note PCT 101 was incorrectly assigned to the Keith Formation: Semi Arid Woodlands and the Class: Brigalow Clay Plain Woodlands. It was re assigned to the Keith Formation: Grassy Woodlands and the Class: Floodplain Transition Woodlands in 2024).

<u>EPBC Status:</u> Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia in woodland areas.

<u>BC Status:</u> Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions in woodland areas.

Sites included: CVFF0000; CVFF0002; VIBP2007; VIBP2009

Description on the Property

The canopy is dominated by *Eucalyptus microcarpa* (Western Grey Box), *Eucalyptus populnea* subsp. *bimbil* (Bimble Box), *Eucalyptus pilligaensis* (Narrow-leaved Grey Box).

There is a sparse shrub layer of Casuarina cristata (Belah) and Eremophila mitchellii (Budda).

The ground layer is comprised of grasses such as Austrostipa verticillata (Slender Bamboo Grass)

Enteropogon acicularis (Curly Windmill Grass), Eragrostis leptostachya (Paddock Lovegrass), Panicum effusum (Hairy Panic), Chloris truncata (Tall Chloris), Sporobolus creber (Slender Rat's Tail Grass), Rytidosperma spp. Forb species occur such as Sida corrugata (Corrugated Sida), Einadia nutans (Climbing Saltbush) and Vittadinia muelleri.

At least 33 exotic species were recorded in this PCT during the survey periods. The most abundant were *Bromus molliformis* (Soft Brome), *Hordeum leporinum* (Barley Grass), *Conyza spp., Urochloa panicoides* (Urochloa Grass), *Trifolium glomeratum* (Clustered Clover), *Lepidium africanum* (Common Peppercress) and *Lycium ferocissimum* (African Boxthorn).

## **BioNet Description**

PCT 101 is typically a tall woodland or open woodland dominated by Eucalyptus populnea subsp. bimbil sometimes with Eucalyptus melliodora, Callitris glaucophylla, Eucalyptus melanophloia or rarely with Eucalyptus microcarpa. A very sparse shrub layer may be present or it is absent. Shrub species include Geijera parviflora, Notelaea microcarpa, Maireana microphylla, Capparis mitchellii and Alectryon oleifolius. The ground cover is usually dense and is dominated by a rich array of grass and forb species. Grass species include Austrostipa verticillata, Dichanthium sericeum subsp. sericeum, Bothriochloa decipiens, Austrodanthonia bipartita, Enteropogon acicularis, Aristida personata, Aristida ramosa, Austrostipa aristiqlumis, Austrostipa scabra subsp. scabra, Themeda australis, Eulalia aurea, Paspalidium jubiflorum, Chloris truncata and Chloris ventricosa. The more palatable grasses such as Themeda australis and Eulalia fulva have often been grazed out. Forb species include Rumex brownii, Einadia nutans, Cotula australis, Maireana enchylaenoides, Erodium crinitum, Calotis lappulacea, Rostellularia adscendens subsp. adscendens, Sida corrugata, Oxalis exilis, Einadia hastata, Vittadinia dissecta var. hirta, Vittadinia muelleri, Vittadinia sulcata, Chrysocephalum apiculatum, Solanum cinereum, Abutilon oxycarpum, Dichondra sp. A, Wahlenbergia stricta subsp. stricta, Pycnosorus globosus, Goodenia fascicularis and Brunoniella australis.

## Threatened Ecological Communities

PCT 101 where it occurs in moderate condition within the offset area conforms to the scientific determination for the TEC Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions which is listed as endangered under the BC Act. The PCT also conforms to the TEC Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia listed as Endangered under the EPBC Act (Figure 5.5).

## Threatened Plants

No threatened plants have been recorded in the Costavale offset area.

# 5.2 Description of Revised BOS Values - Fauna

# 5.2.1 Revised BOS Habitat Values

The fauna habitat values of the original Vickery BOS, as identified in SSD\_7480 & EPBC 2016/7649, and how they have been met by the Willeroi East offset area are shown in Table 5.5.

For the Willeroi East offset area, the following PCTs were considered to be suitable for the Koala (Figure 5.5):

- 84: River Oak Rough-barked Apple red gum box riparian tall woodland;
- 112: Black Tea-tree River Oak Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion
- 563: White Box Silvertop Stringybark +/- White Cypress Pine grass shrub open forest;
- 588: White Box White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion
- 1308: White Box White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion; and,
- 1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion.

For the Willeroi East offset area, the following PCTs were determined to be suitable for the Regent Honeyeater (Figure 5.6):

- 84: River Oak Rough-barked Apple Red Gum box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion
- 112: Black Tea-tree River Oak Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion
- 563: White Box Silvertop Stringybark +/- White Cypress Pine grass shrub open forest of the southern Nandewar Bioregion and New England Tableland Bioregion
- 588: White Box White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion
- 592: Narrow-leaved Ironbark cypress pine White Box shrubby open forest in the Brigalow Belt South Bioregion and Nandewar Bioregion;
- 1308: White Box White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion; and,
- 1383: White Box grassy woodland of the Nandewar Bioregion and Brigalow Belt South Bioregion.

For each species, woodland forms of each PCT (Intact or advanced regeneration, Semi-cleared, semi-cleared regeneration) were considered as Existing Potential Habitat. Areas of DNG were classified as Future Potential Habitat.

#### Table 5.6: Fauna habitat values for the Revised Vickery BOS

Official Area	Area of Potential Existing Habitat (Ha)					
Offset Area	Regent Honeyeater	Koala				
Willeroi East	1,358.11	1,377.98				



Figure 5.5: Koala Existing Potential Habitat and Future Potential Habitat – Willeroi East



Figure 5.6: Regent Honeyeater Existing Potential Habitat and Future Potential Habitat – Willeroi East

## 5.2.2 Willeroi East

Willeroi East is situated within a very large area of remnant vegetation that extends north and south from Mount Kaputar National Park. The vegetation patch has mixed ownership, with large areas forming part of the New South Wales Conservation Estate while other areas are privately owned. To the North, the vegetation patch has continuous landscape connectivity just south of Gravesend (approximately 100 kilometres to the north) and to the south it has connectivity to Wean (approximately 30 kilometres). Fauna movement and landscape connectivity between Willeroi East and other remnant habitat in the vegetation patch is considered to be unimpeded.

Existing Potential Habitat for the Regent Honeyeater on Willeroi East is diverse and extensive. Importantly, Maules Creek runs through the offset area. It is fringed throughout the majority of its length on Willeroi East by Casuarina cunninghamiana (River Sheoak) which host a high abundance of Needle-leaf Mistletoe (*Amyema cambagei*). These habitat types have been identified as important breeding and foraging habitats for the species (DPE 2023c). The riparian strip also supports areas of mature and regenerating River Red Gum, Yellow Box and White Box, all of which are feed trees for the species.

Large areas of the hills and slopes adjacent to the Maules Creek riparian strip on Willeroi East contain Red Ironbark and White Box, many of which host Box Mistletoe (*Amyema miquelii*) and Drooping Mistletoe (*Amyema pendula*). All four species provide foraging resources for the Regent Honeyeater. Other areas that are not mapped as suitable for the species also support trees with Box Mistletoe and Drooping Mistletoe, meaning the area of Existing Potential Habitat on Willeroi East had potentially been underestimated in the past.

Annual bird monitoring undertaken by WHC indicates that aggressive honeyeater abundance on Willeroi West is patchy (AMBS 2018a, 2019a). Monitoring sites along Maules Creek indicate that there are some localised patches were Noisy Miner (*Manorina melanocephala*) and Noisy Friarbird (*Philemon corniculatus*) abundance can be seasonally high. These are most often associated with the areas of the creek which are adjacent to disturbed and regenerating agricultural land. In more vegetated areas of Willeroi West, aggressive honeyeater abundance is within expected ranges. It is likely that this pattern is repeated on Willeroi East, given the similarity of the habitats and the fact that habitats on the two offset areas are connected. As such, aggressive honeyeater abundance is unlikely to influence the quality of the area of mapped Existing Potential Habitat for the Regent Honeyeater on the offset area.

The area of Existing Potential Habitat for Koala on Willeroi East is also considered diverse and extensive. It is comprised of a variety of potential feed trees, including River Red Gum, White Box, Yellow Box, Ribbon Gum and Stringybark as well as shelter trees including Red Ironbark and *Brachychiton populneus*. Importantly, the habitats of Willeroi East have un-interrupted connectivity with a population of Koalas on the Wirradale and Mt Lindesay biodiversity offset areas (and likely within Mount Kaputar National Park) which are managed by WHC (AMBS 2022). Monitoring data indicates that detectability of this population is increasing, which could indicate the population is increasing (AMBS 2023).

# 5.2.3 Glenroc

Glenroc is situated to the direct west of the Boonalla Conservation Area. The small areas of remnant vegetation along the northeast of the offset area have interrupted connectivity with the Boonalla Conservation Area which is currently highly disturbed. Connectivity with the Vickery State Forest to the west is highly interrupted by cleared agricultural land and post-mining landscapes and is currently considered to be incomplete.

Areas of Existing Potential Habitat for the Regent Honeyeater on the offset area are limited to patches of Woodland associated with PCT 101. Aggressive honeyeaters are likely to be presence within these patches. Other areas of the offset area, including PCT 55 could contain foraging resources for the species in the form of mistletoe species. However, the presence of such resources has not been evaluated and as such the areas have not been mapped as Existing Potential Habitat.

Areas of Existing Potential Habitat for the Koala on the offset area are limited to patches of Woodland associated with PCT 101.

Revegetation of cleared areas of Glenroc will enhance connectivity between the Boonalla Conservation Area and Vickery State Forest (when combined with revegetation on Costavale and Wean North). The combination of remnant habitat features within woodland areas of PCTs and revegetated landscape will provide a variable habitat matrix that could be suitable for the Koala and Regent Honeyeater as the revegetation develops. As the revegetation develops, the influence of aggressive honeyeater species could be reduced as the complexity of the habitat increases.

## 5.2.4 Costavale

Costavale is situated between the Boonalla Conservation Area and Vickery State Forest. Areas of remnant vegetation along the western and south-western boundary of the offset area have interrupted landscape connectivity with the Vickey State Forest and no landscape connectivity to the Boonalla Conservation Area. The quality of the connectivity to Vickery State Forest is influenced by historic vegetation clearing and livestock grazing. It occurs through patches of remnant vegetation on the Wean Amalgamated proposed Biodiversity Stewardship Site managed by WHC (Applications submitted and currently being assessed by the Credit Supply Taskforce), which when revegetated, will enhance the connectivity between Vickery State Forest and Wean North.

Areas of Existing Potential Habitat for the Regent Honeyeater on the offset area are limited to patches of Woodland associated with PCT 101. On the offset area, it is represented by three separated remnant patches which show extensive historic signs of disturbance. Historic livestock grazing has impacted ground and midstratum diversity. Aggressive honeyeater species are likely to be abundant in all patches.

Areas of Existing Potential Habitat for the Koala on the offset area are limited to patches of Woodland associated with PCT 101.

Revegetation of cleared areas of Costavale will enhance the landscape connectivity between the Boonalla Conservation Area and Vickery State Forest (when combined with revegetation on Glenroc and Wean North). The combination of remnant habitat features within woodland areas of PCTs and revegetated landscape will provide a variable habitat matrix that could be suitable for the Koala and Regent Honeyeater as the revegetation develops. As the revegetation develops, the influence of aggressive honeyeater species could be reduced as the complexity of the habitat increases.

## 5.2.5 Wean North

Wean North is situated to the north of Vickery State Forest. It has no vegetation connectivity to Vickery State Forest or Boonalla Conservation Area as its entirety is mapped as DNG. There are currently no areas of Existing Potential Habitat for the Regent Honeyeater or Koala.

The value of the Wean North offset area to fauna of the local area is that it further enhances the development of landscape connectivity between Vickery State Forest and the Boonalla Conservation Area. To the south of the offset area is the proposed Wean Amalgamated Biodiversity Stewardship Site (BS0145 approved by the Credit Supply Taskforce), managed by WHC, which

when revegetated, will enhance the connectivity between Vickery State Forest and Costavale. Wean North will widen the initial section of the proposed corridor and as the revegetation develops, edge effects that are associated with narrow vegetation corridors should reduce in intensity.

# 5.3 Comparative Assessment of Vegetation Condition

The results from the BAMC Vegetation Condition Assessment are shown in Table 5.8.

The Current VI scores for woodland zones in the original (74.1) and substituted (73.5) offset areas are similar. Future VI scores for woodland zones in the original (85.1) and substituted (87) offset areas are also similar.

The Current and Future VI scores for the DNG zones are higher in the original offset areas compared to the substituted offset areas. However, there is greater gain in integrity predicted to occur in the substituted offset areas as a result of management (Table 5.8). This difference in scores is primarily the result of a lower Functional Condition Score for the substituted offset area DNG zones (12.1) compared to the original offset area DNG zone (26.6). Structural and Composition Condition Score are similar between DNG in the original and substituted offset areas.

Regeneration, large trees and hollow bearing trees are present in the DNG vegetation zones of both the original and substitute offset areas (Plates 1 and 2).

The BAMC was then used to generate indicative ecosystem credit values for Poplar Box Woodland for the original and substitute offset areas (Table 5.8). The total value of credits generated by the substitute offset areas is far greater that that generated from the original offset areas.



Plate 1 Example of PCT 101 DNG in the original offset area

Plate 2 Example of PCT 244 DNG in the substitute offset areas

Offset area	Zone name	Conditi on	Area	Composition condition score	Structure condition score	Function condition score	Current VI score	Future VI score w/ management	Total gain in VI score	Total indicative credit generation
Original offset areas	PCT 101 Woodland existing	Mod	122.02	90	86.8	52.2	74.1	85.1	17.8	EE1
Original offset areas	PCT 101 DNG existing	DNG	6.04	76.3	54.5	26.6	48	52.1	5.5	221
Substituted offset areas	PCT 101 Woodland replacement	Mod	18.7	93.5	74.2	57.3	73.5	87	16.9	1057
Substituted offset areas	PCT 101 DNG replacement	DNG	432.16	72.9	53.4	12.1	36.1	43.7	9	1027

Table 5.7 Comparative Assessment of Vegetation Integrity between original and substituted offset areas using data generated by the BAMC

# 5.4 Comparative Assessment of Fauna values

Prior to submitting the RBOS, WHC undertook bird and microbat surveys to generate a baseline species richness and abundance estimates across offset areas 2 to 5 and those proposed as a substitute (Glenroc, Wean North, Costavale). These surveys were undertaken on 23 and 24 September 2023. A single 20-minute, 2-hectare bird survey was completed at each property while two nights of Anabat recordings were made at each property. Species richness results are provided in Table 5.8.

Properties	Bird Species Richness	Microbat Species Richness	Number of Threatened Species
Offset area 2	3	2	0
Offset area 3	4	2	0
Offset area 4	11	4	2
Offset area 5	11	5	1
Glenroc	7	4	1
Costavale	10	4	2
Wean North	5	1	0

#### Table 5.8 Bird and microbat species richness comparison

Bird species richness was highest at offset areas 4 and 5, driven by a large diversity of lorikeet and cockatoo species, and lowest at offset areas 2 and 3, which are the most isolated properties in terms of connectivity with other woodland habitats. Two threatened species were detected during the bird surveys; the Grey-crowned Babbler (Eastern Subspecies) (*Pomatostomus temporalis temporalis*) was recorded at Costavale and the Little Lorikeet (*Glossopsitta pusilla*) was recorded at offset area 4. The bird assemblages at all properties were indicative of highly modified agricultural habitats. Woodland bird species were mostly absent and agricultural mosaic specialists including Noisy Miners, Cockatoos and Lorikeets were abundant.

Microbat species richness was also comparable across all properties. All species detected were woodland bat species associated with roosting in tree hollows and under bark. The Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) was detected at offset area 5 and Glenroc.

This simple baseline survey indicates that there is unlikely to be a notable difference in the observed fauna assemblage between the original offset areas 2 to 5 and the substitute offset areas.

# 5.5 Landscape Connectivity

The Vickery Mine conditions of Approval will ensure that the Vickery Extension Project BOS will achieve "no net loss" of biodiversity. The Vickery RBOS will also aim to re-establish landscape connectivity through the revegetation and enhancement of a habitat conservation and restoration corridor from the Vickery State Forest to the Boonalla Aboriginal Area (and other WHC owned Biodiversity Management Areas), which in turn form a component of other larger habitat corridors within the region. This will be achieved by biodiversity management and revegetation of Wean North, Costavale and Glenroc.

Landscape connectivity describes conditions of the landscape which assist or impede movement between habitats (Taylor *et al.* 1993). It is used in conjunction with the concept of fauna movement corridors to describe how animal and plant material could move between remnant patches of habitat in a fragmented and disturbed landscape. The factors that influence movement between habitats varies across species and across wide range of spatial and temporal scales. If landscape connectivity is impeded, the value of a habitat to specific taxa is likely to be reduced. Thus, improving connectivity between vegetation patches will often increase the value of the habitats compared to their individual sum parts (Drielsma *et al.* 2022).

The Vickery Mine exists adjacent or close to two large remnant vegetation patches that are highly valuable to flora and fauna species in the region (Figure 5.8 & 5.9). The Vickery State Forest is located directly adjacent to the Mine while the Boonalla Aboriginal Area and proposed WHC Biodiversity Stewardship Agreement (Applications submitted and currently being assessed by the Credit Supply Taskforce) and other WHC Biodiversity Management Areas (here to referred to as the "Boonalla Conservation Area") are located 4.5 kilometres to the east of the Mine (Figure 5.8 & 5.9).

The Vickery State Forest contains approximately 1900ha of moderate to good condition habitat but as it is an isolated remnant island of vegetation, it has a 22km boundary subject to edge effects (i.e. 11.6m edge to 1ha ratio of conservation area) within the landscape surrounded by agriculture and mining. These nearby land uses would impact on both the quantity and richness of fauna populations in the local area and would significantly limit landscape connectivity. The Boonalla Conservation Area is likely to have similar conditioned areas of woodland habitat but also experiences similar landscape connectivity and edge effect challenges to the Vickery State Forest.

WHC's Vickery RBOS recognises that the original requirements to offset impacts to TEC's and threatened fauna species, as described in SSD-7480, can be achieved using the habitat values identified on Willeroi East. Through careful management and restoration; the inclusion of Wean North, Glenroc and Costavale can improve landscape connectivity between the Vickery State Forest and Boonalla Conservation Area, resulting in increased biodiversity benefits for the region in conjunction with completed, and committed to, revegetation and habitat augmentation (i.e. nest boxes) of other proposed Biodiversity Stewardship Agreement (Applications submitted and currently being assessed by the Credit Supply Taskforce) and Conservation Offset Areas also managed by WHC (Figure 5.8). Further, these existing Conservation Areas managed by NPWS and WHC are within and a part of the regionally significant Nandewar Range Biodiversity Corridor that connects habitat with the Mount Kaputar National Park to the north (and through to NSW/Queensland border) as well as with the Hunter Valley and Liverpool (Great Dividing) Range in the south (a part of Great Eastern Ranges Initiative Conservation Corridor) (Figure 5.9). As such, any improvement in connectivity will have positive impacts on the functionality of these regionally significant corridors.

To facilitate the concept of the proposed habitat corridor and its potential benefits, the existing landscape connectivity of each offset area has been described. The following factors have been assessed and described for each offset area:

- Distance to the nearest, large remnant vegetation patch;
- Whether the connectivity between the offset area and large vegetation patch is complete or impeded;
- Identification of what features are aiding connectivity; and
- Identification of what processes are impeding connectivity.

The application of revegetation and habitat augmentation programs described in this RBOS will result in significantly improved landscape connectivity between large remnant woodland patches in Vickery State Forest and Boonalla Conservation Area. The enhancement of landscape connectivity between these two vegetation patches will generate positive biodiversity outcomes which are not possible through revegetation and augmentation of original offset areas 2,3,4 and 5. When combined with the revegetation and management of Willeroi East, the RBOS also generates regional landscape connectivity enhancements that are not achievable through revegetation and augmentation and 5. (Figure 5.9).



Figure 5.7: Location of revegetation to provide connectivity between offset areas, Vickery State Forest and the Boonalla Conservation Area



Figure 5.8 Improving connectivity across the Region

# 6 Summary of Findings

The following section provides a comparative summary of the original BOS to those of proposed RBOS.

# 6.1 Plant Community Types

A comparison between the BOS and the RBOS shows variation between the vegetation classes mapped (Table 6.2). While there is variation; overall the RBOS meets the biodiversity value requirements as per the Vickery Coal Mine Extension Project Approvals (SSD-7480 & EPBC 2016/7649) relating to TECs, Koala and Regent Honeyeater habitat, and the extent of offset area and area required for "enhanced with the restoration" (i.e. revegetation and habitat augmentation).

# 6.2 Threatened Ecological Communities

The RBOS will result in an increase in the area of TECs within the offsets (Table 6.1). There will be an overall increase of 134.76 ha of TECs due to the revisions made as a result of the high accuracy of spatial data delineating the cadastral boundaries of the properties surveyed, and the application of contemporary vegetation community mapping standards.

	Origina	al BOS	Re			
Threatened Ecological Community	Willeroi East	Total	Costavale	Willeroi East	Total	Difference
Grey Box Grassy Woodland EEC		0.00	16.58		16.58	16.58
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	19.33	19.33		6.78	6.78	-12.55
White Box Yellow Box Blakely's Red Gum Woodland	155.23	155.23		285.97	285.97	130.73
Total Threatened Ecological Community	174.56	174.56	16.58	292.75	309.33	134.76

## Table 6.1 Summary Table Willeroi east previous and revised TEC areas

# 6.3 Threatened Plants

There will be no change to the status of the threatened plant recorded on the Willeroi East offset area as a result of the Vickery RBOS.

Keith			Original BOS						Revised BOS				
Vegetation Class	PCTs	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5	Willeroi East	Total (ha)	Costavale	Glenroc	Wean North	Willeroi East	Total (ha)	(ha)
Floodplain Transition Woodlands	101; 244	28.26	25.8	53.66	20.34		128.06	210.08	53.22	187.56		450.86	322.8
Eastern Riverine Forests	84					98.77	98.77				38.79	38.79	-59.98
Inland Floodplain Swamps	238			2.43			2.43					0	-2.43
Inland Riverine Forests	78; 112			55.06			55.06				4.08	4.08	-50.97
New England Grassy Woodlands	1118; 1354					108.09	108.09					0	-108.09
Northern Montane Heaths	520; 884					10.3	10.3				11.92	11.92	1.62
North- west Floodplain Woodlands	55						0		0.85			0.85	0.85
North- west Slopes Dry Sclerophyll Woodlands	563; 588; 1308					829.72	829.72				1237.44	1237.44	407.72

#### Table 6.2 Vegetation Classes recorded in the original BOS and RBOS and the area of each

Keith		Original BOS							Revised BOS				Difference
Vegetation PCTs Class	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5	Willeroi East	Total (ha)	Costavale	Glenroc	Wean North	Willeroi East	Total (ha)	(ha)	
Western Peneplain Woodlands	145						0		19.02			19.02	19.02
Western Slopes Dry Sclerophyll Forests	592; 1313					417.45	417.45				15.09	15.09	-402.36
Western Slopes Grasslands	102; 710	35.6	1.49	100.63	26.11		163.83					0	-163.83
Western Slopes Grassy Woodlands	599; 1329; 1383	17.03	2.81		22.65	155.23	197.72				275.91	275.91	78.19
Western Vine Thickets	147					19.33	19.33				6.78	6.78	-12.55
Total Native	Vegetation	80.9	30.1	211.77	69.11	1638.89	2030.76	210.08	73.08	187.56	1590.01	2060.73	29.97
Not Native			20.79	1.17	1.32	26.88	50.17	49.38	0.22	0.25	1.19	51.04	0.87
Total		80.9	50.89	212.94	70.43	1665.76	2080.92	259.45	73.31	322.71	1591.2	2246.67	165.75

## 6.4 Fauna

WHC's RBOS for the Vickery Project recognises that the existing requirements to offset impacts to Koala and Regent Honeyeater, as described in EPBC 2016/7649, can be achieved using the habitat values identified on Willeroi East (Sections 5.2.1). The habitat values for Koala and Regent Honeyeater identified on Willeroi East are further enhanced by its connectivity to similar habitats on Willeroi West (Section 5.3) and onto Mount Kaputar National Park. Neither species has been detected on both offset areas but Koala has been recorded on the adjoining WHC offset areas of Wirradale and Mt Lindesay since 2020.

The current fauna habitat value for Koala and Regent Honeyeater on Wean North, Glenroc and Costavale are limited (Sections 5.2.3, 5.2.4 & 5.2.5). However, their true benefit for fauna in the region, including the Koala and Regent Honeyeater, is facilitating the development and improvement of landscape habitat connectivity between the Vickery State Forest and the Boonalla Conservation Area (Section 5.3).

In summary the habitat area identified in Table 6.3 contains 1,358.11 ha of potential Regent Honeyeater (*Anthochaera phrygia*) habitat (greater than the minimum 293.9 ha which is the equivalent of 2087 species credits) and 1,377.98 ha of potential Koala (*Phascolarctos cinereus*) habitat (greater than the minimum 112 ha which is the equivalent of 795 species credits) as required under Condition 21 of the EPBC Act Approval 2016/7649.

PCT ID	PCT Name	Koala Existing Potential Habitat (ha)	Regent Honeyeater Existing Potential Habitat (ha)
84	River Oak - Rough-barked Apple - red gum - box riparian tall woodland	37.59	37.59
112	Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland	1.18	-
147	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket	6.78	-
520	Heathy outcrop shrublands	11.92	-
563	White Box - Silvertop Stringybark +/- White Cypress Pine grass shrub open forest	641.14	641.14
588	White Box - White Cypress Pine shrubby hills open forest	212.03	212.03
592	Narrow-leaved Ironbark - cypress pine - White Box shrubby open forest	15.09	15.09
1308	White Box - White Cypress Pine shrubby open forest	337.32	337.32
1383	White Box grassy woodland	114.94	114.94
Total Area	a (ha)	1,377.98	1,358.11

Table 6.3 PCTs providing potential existing habitat for the Regent Honeyeater and Koala in Willeroi East.

Baseline survey undertaken indicate that there is unlikely to be a notable difference in the observed fauna assemblage between offset areas 2 to 5 and the substitute offset areas. Given the challenges of improving habitat connectivity and reducing fragmentation at offset areas 2 to 5, and given the large distance between these Properties and other larger patches of remnant woodland, it is likely that the substitute offset areas have a greater chance of experiencing biodiversity gains, in terms of species richness, over time.

# 6.5 Vegetation Condition

The assessment of data using the BAMC shows only small differences in Vegetation Integrity Current and Future between woodland areas of original and substitute offset areas. The Vegetation Integrity Scores in the DNG area of original offset areas is higher than in the substitute offset areas however, when broken into the data components, structural and compositional condition are similar.

Given that the composition of the DNG areas is similar between the original and substitute offset areas, revegetating the canopy layer of Poplar Box Woodland in the substitute offset areas will increase the overall functional condition score over time with a steady build up of litter and woody debris as the planted canopy grows and matures. Revegetation methods used by WHC to restore canopy are described in Section 6.7.

Hypothetical ecosystem credits generated for the Poplar Box Woodland PCTs 101 and 244 (Table 5.8) show that there is greater overall credit value in the woodland form of these PCTs in the substitute offset areas. While the woodland form of these PCTs in the original offset areas is currently greater than that in the substitute offset areas at this point in time, the greater area of these PCTs provided by the substitute offset areas results in a higher number of hypothetic ecosystem credits being generated currently and potentially a higher number in to the future as the DNG areas undergo restoration.

# 6.6 Rehabilitation Area as part of the approved BOS

This RBOS does not alter or vary the existing commitment from the original Vickery BOS (SSD-5000) for a Rehabilitation Area of 1,360 ha as part of the BOS package that has been transferred through to SSD-7480 Condition B56. This RBOS only addresses the external land based components of the Vickery BOS; and as such the description and implementation of the Rehabilitation Area offset will be documented in future Vickery Coal Mines' Rehabilitation Management Plan (current version 31 May 2023 only describes the proposed rehabilitation Strategy (current version July 2023 only describes the proposed rehabilitation Strategy (current version July 2023 only describes the proposed rehabilitation strategy (current version) revisions to be updated prior to major construction works and full scale mining (i.e. no bulk rehabilitation works at this stage thus no Rehabilitation Area offset yet created).

# 6.7 Restoration of Substitute Offsets

WHC will restore Poplar Box Woodland canopy in DNG across the substitute offset areas using the well developed, reliable processes that have achieved revegetation at large spatial scales associated with WHCs other Biodiversity Management Areas (existing Offset Areas/Conservation Agreements and Biodiversity Stewardship Sites). WHC has internal knowledge, infrastructure and resources that are capable of successfully achieving the restoration program described in this RBOS. The proposed revegetation regime described below is adapted from Wean Amalgamated BSA (BS0145 that includes Active Restoration Management Action program across 1400ha) for areas of Poplar Box Woodland DNG within the substitute offset areas.

# Objectives of a Restoration Program

- Reintroduce the canopy layers in DNG vegetation which will, over time, reflect the structure and species composition observed in good or moderate forms of these PCTs located within proximity to the substitute offset areas using appropriate benchmarks to measure improvement.
- After Year 10 (allowing time for seedlings to grow to a size to be able to be measure canopy cover) the canopy cover will increase after each subsequent monitoring event.

## **Restoration Methods**

• As the canopy of these areas is largely absent; canopy species are selected for planting based on their dominance in the 20 x 20m plots surveyed in good or moderate forms of

the PCTs, anecdotal observations within mapped areas of the relevant PCT, and the relevant PCT descriptions (DPIE 2023c).

- Planting densities are determined using plot data and prioritising species on their relevance in the PCT description as well as the current level of occurrence across the area to be revegetated. For example, *Callitris glaucophylla* is often remnant within a DNG area while other canopy species are missing for this reason a lower density of *Callitris* would be planted compared to another canopy species currently in lower-than-expected numbers or missing from the PCT DNG.
- The revegetation timing occurs during periods of desirable seasonal conditions (times of opportunistic high soil moisture and moderate diurnal temperature variation).
- Seed collection, management, propagation, storage and record-keeping are undertaken in consideration of Florabank and Greening Australia Guidelines best practice seed collection.
  - Seeds collected for revegetation projects are collected from several source sites with similar rainfall, soil, altitude, aspect, and slope position and from between 20-50 plants of each species.
  - Collection of seeds will be undertaken from plants spaced approximately three plant-heights apart to prevent collection of too many closely related seeds.
  - Whitehaven Coal will utilise their existing seed collection programs and propagation facilities.
- The 2020 Biodiversity Conservation Trust (BCT) Restoring Native Vegetation Guidelines for assisted regeneration and revegetation specifies weed control be taken at least six months prior to planting to reduce competition from pasture and weeds for native plants to establish and grow. Weed control to meet this requirement includes:
  - Herbaceous weed control with a selective herbicide spraying regime undertaken at least six months prior to planting, as required by seasonal weed growth.
  - Ground preparation methods (i.e., augering, mounding, ripping, harrowing or ploughing) will be complemented by the weed control regime and will include ground layer competition suppression if required (e.g., slashing).
  - Post planting (Year 3-20) revegetated areas will be maintained within the weed maintenance program.
- Areas with regenerating shrubs and trees are limited to ground preparation techniques which minimise disturbance
- Planting densities are monitored every two years from Year 3 10 and then very five years from Year 11 to 20. A minimum abundance of a Predicted Future Value for Composition per monitoring plot (0.04 ha) is required of the number of species listed as the benchmark for the relevant PCT.

An example of a planting regime is provided in Table 3.2, and images from recent plantings in 2022 on the Glenroc offset area are shown in Plates 3 and 4. Plate 5 shows WHC revegetation in the Bimbooria offset/conservation area at 4 years post planting.

Restoration planting will be implemented in 2024 on the Costavale and Glenroc offset areas.

## Table 6.4 Example of a planting regime

Plant Community Type	#Benchmark % Canopy Cover for PCT (BAMC)	Benchmark number of canopy species for PCT (BAMC	Core Canopy Species to Plant (based on BAM data and PCT description)	Core Canopy Species Planting Densities	Additional canopy species	Additional canopy species Planting Densities
101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the	37	4	Eucalyptus populnea	50/ha	Callitris glaucophylla	2/ha
			Eucalyptus melliodora	12/ha	Fucalvatus	4/ha
			Eucalyptus pilligaensis	8/ha	melanophloia	

Plant Community Type	<sup>#</sup> Benchmark % Canopy Cover for PCT (BAMC)	Benchmark number of canopy species for PCT (BAMC	Core Canopy Species to Plant (based on BAM data and PCT description)	Core Canopy Species Planting Densities	Additional canopy species	Additional canopy species Planting Densities
Liverpool Plains, Brigalow Belt South Bioregion						
244 – Poplar Box grassy woodland			Eucalyptus populnea	70/ha		
on alluvial clay- loam soils mainly			Casuarina cristata	20/ha		
in the temperate (hot summer) climate zone of central NSW (wheatbelt).	33	4*	Callitris glaucophylla	10/ha		

\*Please note PCT 244 is described as having only 3 canopy species (*Eucalyptus populnea* subsp. *bimbil; Casuarina cristata; Callitris glaucophylla*) (DPIE 2023c)

\*Expected values for 0.04 ha plot based on benchmarks



Plate 3: Revegetation in PCT 101 DNG on Glenroc showing planted sapling trees



Plate 4: Revegetation efforts commenced on Glenroc in 2022 showing seedling planting lines that will form part of the vegetated corridor linking the substituted offset areas with the surrounding WHC Biodiversity Management Areas from Boonalla Conservation Area to Vickery State Forest



Plate 5: Example of canopy restoration 4 years after planting (Bimbooria offset area for the Maules Creek Coal Mine)

# 7 Conclusions

The property of Willeroi East, and substitute offset areas of Wean North, Costavale and Glenroc, as proposed in this RBOS, collectively fulfill, and exceed, the requirements of SSD 7480 and/or EPBC 2016/7649 (Table 7.1). The following parameters are addressed in Table 7.1.

- Area requirements of the original BOS for Willeroi East and offset areas 2 5 have been combined and compared against the revised BOS (i.e. 1,671 ha in Willeroi East and 404.5 ha in offset areas 2 5 = Total requirement of 2,075.5 ha); which has been confirmed by the extent of the revised Willeroi East plus Wean North, Glenroc, and Costavale offset areas).
- Area requirements of the original BOS for Willeroi East and offset areas 2 5 have been combined and compared against the RBOS (i.e. Box Gum Woodland 156 ha in Willeroi East and 45 ha in offset areas 2 5 = Total requirement of 201 ha); all of which has been confirmed within the revised Willeroi East offset area).
- Area requirements of the original BOS for "Existing vegetation to be enhanced with the restoration of at least 127 ha of Poplar Box Woodland" is achieved by all of the intact and DNG areas of PCT 101 (Poplar Box Yellow Box Western Grey Box Grassy Woodland) and PCT 244 (Poplar Box Grassy Woodland) across Wean North, Glenroc, and Costavale.
- Potential Regent Honeyeater and Potential Koala habitat in total areas as per "Existing Potential Habitat" in maps for Willeroi East and Costavale (i.e. All Native Woody vegetation for PCTs associated with the species) offset areas.

Biodiversity Offset Strategy Criteria (SSD 7480 and/or EPBC 2016/7649)	Required Quantum for Biodiversity Offset Strategy (ha)	Quantum in Revised Biodiversity Offset Strategy (ha)	Difference (Revised BOS - Required BOS)		
Minimum Area	2,075.5 (1,671 + 404.5)	2,111.77	+ 36.27		
Box Gum Woodland CEEC	201 (156 + 45)	285.97	+ 84.97		
Poplar Box Woodland	127	449.98	+ 322.98		
Potential Regent Honeyeater Habitat	293.9	1,358.11	+ 1,064.21		
Potential Koala Habitat	112	1,377.98	+ 1,265.98		

#### Table 7.1 Summary of requirements of SSD 7480 and/or EPBC 2016/7649 and how they have been met.

Additionally, the following conclusions are made in relation to the proposed substitution of the original offset areas.

- 1. Incorporating substitute offset areas in place of the original offset areas into the Vickery RBOS, will develop an important linkage between the Boonalla Conservation Area, Vickery State Forest and other WHC Biodiversity Management Areas enhancing connectivity within the broader environment. This connectivity facilitates the movement of species, allowing for gene flow, dispersal, and ecological resilience. The integration of these substituted offset areas into the RBOS demonstrates a meaningful approach towards preserving and enhancing the ecological integrity of the region, ensuring the long-term viability of its biodiversity and supporting the overall objectives of conservation.
- 2. There will be an increase in the area of TEC within the RBOS.
- 3. There is unlikely to be a notable difference in the observed fauna assemblage between the original and substituted offset areas.
- 4. Given the challenges of improving habitat connectivity and reducing fragmentation at the original offset areas, and given the large distance between the original offset areas 2 to 5

and other larger patches of remnant woodland, it is likely that the substitute offset areas have a greater chance of experiencing biodiversity gains, in terms of fauna species richness, over time.

- 5. Despite variation in time since cessation of agricultural practices and varying agricultural history, the Current and Future VI Score when compared between the original and substitute offset areas for woodland vegetation zones are similar, although slightly lower VI scores record for the DNG within the substitute offset areas, however the restoration program through tree canopy revegetation is expected to increase the Functional Condition Score overtime.
- The substitute offset areas, being larger in area, contribute a greater number of hypothetical biodiversity credits at commencement of management than do the original offset areas.
- 7. Restoration planting was commenced on Glenroc in 2022 and will be implemented in Costavale and Glenroc in 2024.
- 8. The substitute offset areas have the potential to generate a greater number of ecosystem credits with restoration.
- Long-term limitations due to the isolation of offset areas 2 to 5 would be overcome more easily at the substitute offset areas through restorative canopy revegetation and active management.
- 10. This RBOS does not alter or vary the existing commitment from the original Vickery BOS (SSD-5000) for a Rehabilitation Area of 1,360 ha as part of the BOS package that has been transferred through to SSD-7480 Condition B56. The description and implementation of the Rehabilitation Area offset will be documented in future Vickery Coal Mines' Rehabilitation Management Plan and Rehabilitation Strategy revisions to be updated prior to major construction works and full-scale mining (i.e. no bulk rehabilitation works at this stage thus no Rehabilitation Area offset yet created).

Based on the above information, it was determined that, considering these conclusions collectively, the key objectives of the original BOS could be achieved using the substitute offset areas and that additional gains to biodiversity, in the long term, would be facilitated by the adoption of the substitute offset areas as proposed in this RBOS.

# 8 References

- AMBS (2018) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Offset Areas Spring 2017. AMBS Ecology and Heritage
- AMBS (2019a) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Biodiversity Offset Areas – Spring 2018. AMBS Ecology and Heritage
- AMBS (2019b) Bird Surveys in Whitehaven Offset Areas Winter 2018. AMBS Ecology & Heritage
- AMBS (2020a) Fauna Monitoring of the Maules Creek and Tarrawonga Mine Biodiversity Offset Areas – Spring 2019 AMBS Ecology and Heritage
- AMBS (2020b) Bird Surveys in Whitehaven Offset Areas Winter 2019 AMBS Ecology & Heritage
- AMBS (2020c) 5 Year Review of the Annual Fauna Monitoring Program Data for the Maules Creek and Tarrawonga Biodiversity Offsets. AMBS Ecology & Heritage
- AMBS (2020d) Habitat Needs Assessment for the Whitehaven Offset Properties; AMBS Ecology & Heritage
- AMBS (2021) Vickery Coal Mine EPBC Condition 21. AMBS Ecology & Heritage;
- AMBS (2022) Koala Monitoring on the Whitehaven Coal Biodiversity Offset Areas 2020 2022 AMBS Ecology & Heritage
- AMBS (2023a) Koala Monitoring on the Whitehaven Coal Biodiversity Offset Areas 2022 2023 AMBS Ecology & Heritage
- AMBS (2023b), Fauna Monitoring of the Whitehaven Coal Biodiversity Offset Properties June 2020 to July 2023. Consultancy report to Whitehaven Coal Limited.
- Atlas of Living Australia, (2023) Atlas of Living Australia Website [Accessed 2023]. https://www.ala.org.au/
- BirdLife Australia, (2023). Birdlife Australia Website [Accessed 2023]. https://birdlife.org.au/
- Braun-Blanquet, J. (1932) Plant Sociology. McGraw-Hill Book Company, New York. ABSTRACT: In biodiversity management, spatio-temporal heterogeneity is important to consider conserving high levels of habitat diversity and ecosystems
- Cenwest Environmental Services (2011) Willeroi Fauna Survey Report prepared for Whitehaven Coal Limited
- DAWE (2021). Approval Vickery Extension Project, Gunnedah (EPBC2016/7649). Commonwealth Department of Agriculture, Water and the Environment.
- DCCEEW (2024), NSW Landuse 2017 v1.5, accessed from The Sharing and Enabling Environmental Data Portal [https://datasets.seed.nsw.gov.au/dataset/68722535-74fb-4096-82baa908c611c53f], date accessed 2024-02-16, doi: 10.25948/6fcf-gc02. for landuse data. NSW Department of Climate Change, Energy, the Environment and Water [Accessed February 2024]
- DECC (2002). Descriptions for NSW (Mitchell) Landscapes. Version 2. Department of Environment and Climate Change NSW [Accessed 2023] https://www.environment.nsw.gov.au/resources/conservation/landscapesdescriptions.pdf
- DECCW (2010) Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar bioregions NSW Government Office of Environment and Heritage. [Accessed 2023] https://www.environment.nsw.gov.au/resources/threatenedspecies/SvetEECweb.pdf
- DoE (2023) White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands listing advice and conservation advice [Accessed 2023]. <u>https://www.dcceew.gov.au/sites/default/files/env/pages/dcad3aa6-2230-44cb-9a2f-5e1dca33db6b/files/box-gum.pdf.</u> Commonwealth Department of the Environment.
- DPE (2014a). Development Consent Vickery Coal Mine (SSD5000), Section 89E of the Environmental Planning and Assessment Act 1979. NSW Department of Planning.
- DPE (2014b). State Significant Development Assessment Report. Vickery Coal Mine (SSD5000). Secretary's Environmental Assessment Report Section 89E of the Environmental Planning and Assessment Act 1979. NSW Department of Planning.

- DPE (2020a). Development Consent Vickery Extension Project (SSD7480), Section 89E of the Environmental Planning and Assessment Act 1979. NSW Department of Planning, Industry and Environment.
- DPE (2020b). Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method. Published by the NSW Department of Planning, Industry and Environment. [Accessed 2023]
- DPE (2020c.) Threatened Biodiversity Data Collection. New South Wales Department of Planning, Industry and Environment Website: <u>http://www.bionet.nsw.gov.au/.</u> [Accessed 2023].
- DPE (2023a). BioNet Atlas, State Government of NSW, and Department of Planning, and Environment, May 2023
- DPE (2023b). Threatened Biodiversity Data Collection. New South Wales Department of Planning, and Environment Website: <u>http://www.bionet.nsw.gov.au/.</u> [Accessed 2023].
- DPE (2023c). Biometric Vegetation Classification. NSW Department of Planning and Environment. https://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx
- DPIE (2017). Biometric Vegetation Type Archives. NSW Department of Planning, Industry and Environment. [Accessed 2023] <u>https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/about-bionet-vegetation-classification/archived-biometric-datasets</u>
- DPIE (2019). Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. NSW Scientific Committee - final determination. [Accessed 2023] https://www.environment.nsw.gov.au/topics/animals-and-plants/threatenedspecies/nsw-threatened-species-scientific-committee/determinations/finaldeterminations/2011-2012/inland-grey-box-woodland-in-the-riverina-minor-amendmentdetermination (page last updated 28 May 2019).
- Drielsma, M. J., Love, J., Taylor, S., Thapa, R., Williams, K. J., (2022) General Landscape Connectivity Model (GLCM): a new way to map whole of landscape biodiversity functional connectivity for operational planning and reporting. *Ecological Modelling* 465.
- Google Earth Pro (2024) Historical Imagery for imagery 2010 2022. [Accessed February 2024]
- Kassambara, A and Mundt, F 2020, factoextra: Extract and Visualize the Results of Multivariate Data Analyses, R package version 1.0.7, <u>https://CRAN.R-project.org/package=factoextra</u>
- Niche (2012). Vickery Coal Mine Ecological Assessment. Appendix K: Willeroi East Offset Area Flora and Fauna Assessment. Prepared for Whitehaven Coal Limited.
- Niche Environment and Heritage Services (2013). Flora and fauna survey of potential offset site (Willeroi East Offset Area) for the Vickery Coal Project
- NSW Government (2024) NSW Historical Imagery Viewer, Spatial Services, Department of Customer Service for imagery 1965-1997. [Accessed February 2024]
- OEH (2006). White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland [Accessed 2023]
- OEH (2023). Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions profile NSW Government Office of Environment and Heritage. [Accessed 2023] <u>https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10749</u>
- OEH (2023). White Box Yellow Box Blakely's Red Gum Grassy Woodland Profile NSW Government Office of Environment and Heritage. [Accessed 2023] <u>https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10837</u>
- OEH (2023). White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the Brigalow Belt South NSW Government Office of Environment and Heritage. [Accessed 2023]

https://www.environment.nsw.gov.au/threatenedspeciesapp/profileData.aspx?id=10837& cmaName=Brigalow+Belt+South

- Oksaren, J, Simpson, Guillaume Blanchet, F, Kindt, R, Legendre, P, Minchin, P, O'Hara, R et al. 2022, vegan: Community Ecology Package, R package version 2.6.2, <u>https://CRAN.R-project.org/package=vegan</u>
- P.D. Taylor, L. Fahrig, K. Henein, G. Merriam (1993) Connectivity is a vital element of landscape structure. *Oikos*, **68**, 571-573.
- Sivertsen, D (2009). Native Vegetation Interim Type Standard, Department of Environment, Climate Change and Water NSW, Sydney
- Whitehaven (2018). Vickery Extension Environmental Impact Assessment. Appendix F Biodiversity Assessment Report and Biodiversity Offset Strategy. Whitehaven coal Limited

# Appendix A: Historic Imagery and Land Use Mapping Original Offset Area 2








## Appendix B: Historic Imagery and Land Use Mapping Original Offset Area 3









## Appendix C: Historic Imagery and Land Use Mapping Original Offset Areas 4 & 5









## Appendix D: Historic Imagery and Land Use Mapping Wean North









## Appendix E: Historic Imagery and Land Use Mapping Glenroc and Costavale







