

EPURON

Biodiversity Offset Strategy

LIVERPOOL WIND FARM PROJECT

MAY 2017



Document Verification



Project Title:

Biodiversity Offset Strategy
Liverpool Wind Farm Project

Project Number:

Project File Name: liverpool offset strategy v1_010217_bh170417bm.docx

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Final v1	01/02/2017	Brooke Marshall	Dave Maynard	Brooke Marshall
Final v2	05/05/2017	Bianca Heinze Brooke Marshall	Brooke Marshall	Brooke Marshall

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www.nghenvironmental.com.au

engh@nghenvironmental.com.au

Sydney Region

18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Newcastle - Hunter and North Coast

153 tudor st
hamilton nsw 2303 (t 02 4969 4910)

Canberra - NSW SE & ACT

unit 17/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Bega - ACT and South East NSW

suite 1, 216 carp st (po box 470)
bega nsw 2550 (t 02 6492 8333)

Wagga Wagga - Riverina and Western NSW

suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Bathurst - Central West and Orana

35 morrisset st (po box 434)
bathurst nsw 2795 (m 0448 820 748)

CONTENTS

1	INTRODUCTION	1
1.1	PURPOSE OF THIS STRATEGY	1
1.2	DATA SOURCES.....	1
2	PRELIMINARY CREDIT CALCULATIONS: DEVELOPMENT SITE	3
2.1	OVERVIEW.....	3
2.2	BIOBANKING ASSESSMENT CENTRAL WEST CMA.....	4
2.2.1	Landscape assessment.....	4
2.2.2	Vegetation zones	6
2.2.3	Plot data used in the assessment	7
2.2.4	Geographic features	12
2.2.5	Ecosystem credit species	12
2.2.6	Threatened species credit species.....	13
2.2.7	Credit statement.....	14
2.3	BIOBANKING ASSESSMENT HUNTER / CENTRAL RIVERS CMA.....	15
2.3.1	Landscape assessment.....	15
2.3.2	Vegetation zones	18
2.3.3	Plot data used in the assessment	18
2.3.4	Geographic features	24
2.3.5	Ecosystem credit species	24
2.3.6	Threatened species credit species.....	24
2.3.7	Credit statement.....	25
2.4	CREDIT CONVERSION	27
3	PRELIMINARY OFFSET EVALUATION	31
3.1	CANDIDATE OFFSET SITES	31
3.2	FINAL SELECTION OF SITES.....	31
3.3	COMMONWEALTH OFFSET REQUIREMENTS	32
4	IMPLEMENTATION	37
4.1	OPTIONS TO SATISFY THE PROJECT'S CREDIT REQUIREMENT	37
4.2	TIMING OF IMPLEMENTATION	37
5	CONCLUSION	41
APPENDIX A	OFFSET STRATEGY MAP SET	A-I
APPENDIX B	BIODIVERSITY CREDIT REPORTS	B-I

TABLES

Table 2-1 Break down of LRWF project component clearing areas, and comparison of original and revised layout	3
Table 2-2 Area to perimeter ratio	5
Table 2-3 Future patch size and perimeter	5
Table 2-3 Impacts in vegetation zones within the project's Central West CMA, northern section (Endangered Ecological Communities (EECs) shown in bold)	8
Table 2-4 Plot data, derived from OEH database benchmarks	9
Table 2-5 Geographic features	12
Table 2-6 Species predicted to occur	12
Table 2-7 Species that generate species credits if impacted	13
Table 2-8 Credit statement for the Central West northern section of the proposal	14
Table 2-9 Area to perimeter ratio	16
Table 2-10 Future patch size and perimeter	17
Table 2-11 Vegetation zones within the project (EECs shown in bold)	19
Table 2-12 Plot data, derived from OEH database benchmarks	21
Table 2-13 Species predicted to occur	24
Table 2-14 Species that generate species credits if impacted	24
Table 2-15 Credit statement for the Hunter / Central Rivers southern section of the proposal	26
Table 2-16 Credit conversion: area estimated to achieve offset requirement	27
Table 2-17 Project credit and area summary	30
Table 3-1 Offset site overview	33
Table 4-1 Example offset site management measures	39

1 INTRODUCTION

1.1 PURPOSE OF THIS STRATEGY

The objective of this Offset Strategy is to demonstrate that suitable and adequate offsets will be achievable for the Liverpool Range Wind Farm Project, with reference to the Framework for Biodiversity Assessment (FBA, 2016) for Major Projects. This strategy includes:

Section 2 Preliminary development site credit calculations

- A preliminary assessment of the offset requirement for the proposal, sourcing VIS benchmark plot data, in advance of obtaining project specific plot data and using the Major Projects option of the NSW Office of Environment and Heritage (OEH) BioBanking Credit Calculator (BCC) and the rules under the FBA.
- An estimate of the areas that would be required to meet the offset requirement.

Section 3 Preliminary offset candidate evaluation

- Identification of candidate offset sites within the vicinity of the project, their availability and general adequacy to meet the offset requirements.

Section 4 Implementation

- Options being considered to secure and manage the offset sites.
- Time lines for implementation of a detailed offset plan.

1.2 DATA SOURCES

Data for this assessment was sourced as follows:

- | | |
|--|--|
| <ul style="list-style-type: none">• Vegetation type and condition of the development site: | Biodiversity Assessment Addendum of the Liverpool Wind Farm (NGH Environmental 2017). The addendum provides the most complete dataset, including areas surveyed in the 2013 Biodiversity Assessments for the project as well as additional areas surveyed in 2015 and 2016. |
| <ul style="list-style-type: none">• Impact area calculations: | Biodiversity Assessment Addendum of the Liverpool Wind Farm (NGH Environmental 2017 v1), using 'worst case' or 'upper limit values' where multiple route options / layouts are proposed. Areas were calculated using a GIS by Epuron, using the project infrastructure layout, buffered by required widths for road, transmission lines, turbine footings and hardstands etc. ¹ |

¹ The impact area figures in the final Biodiversity Assessment Addendum of the Liverpool Wind Farm (NGH Environmental 2017 **v2**) have changed slightly from those used in this assessment ; an addition of 7.8 ha.

- Plot data (vegetation survey data required to be entered into the online BCC):

OEH vegetation database benchmark data is used to derive plot data. Using benchmark data assumes all vegetation to be impacted is of high quality; scores for native species diversity, native overstorey regeneration, fallen timber, hollow-bearing trees, weediness and other parameters reflect a vegetation community in good condition.

Median parameter values are entered in this preliminary assessment, within the benchmark range. No Biometric surveys have been undertaken for the project at this stage.
- Threatened species:
 - o Threatened species likely or unlikely to be impacted
 - o Threatened species habitat impact areas

Biodiversity Addendum of the Liverpool Wind Farm (NGH Environmental 2017). As above, the addendum provides the most complete dataset including an assessment of threatened species impacts for the project.
- BioBanking calculations:

OEH BioBanking online calculator, commencing December 2016; selecting Major Project and Linear Assessment. ID 0035/2016/4151MP and 0035/2017/4183MP; two assessments are required as the project spans two Catchment Management Area boundaries.
- Offset area estimate:

OEH credit converter tool, accessed January 2017.

2 PRELIMINARY CREDIT CALCULATIONS: DEVELOPMENT SITE

2.1 OVERVIEW

Key aspects of this credit assessment methodology are detailed below. The assessment is considered preliminary, to ensure suitable and adequate offsets will be achievable for the Liverpool Wind Farm Project, in advance of plot data collection and some remaining pre-clearance surveys to be undertaken prior to construction.

The impact area figures have changed slightly (an addition of 7.8 ha) since the preparation of this Offset Strategy. However, the offset calculations have not been re-done as the process used in preparation of the offset requirement was precautionary and the additional 7.8 ha would not have a material impact to the preliminary offset calculations. A commitment to undertake the final Biobanking calculations based on the approved construction footprint and field data remains and would address any discrepancies. The impact areas used in the current calculations are shown below.

Table 2-1 Impact areas used in this assessment by vegetation type (EECs in blue shading).

Vegetation type	Impact area (ha)
River Oak Woodland (ID 084)	6.5
Blakely's Red Gum – Grey Box-White Box – riparian woodland (ID 278) EEC	3.6
Riparian forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box (ID 281) EEC	18.9
Native Pasture (ID 395) (some parts are EEC)	86.6
Yellow Box Woodland (ID 437) EEC	1.5
Sandstone Forest - Blue-leaved Ironbark dominant (ID 467)	3.3
Sandstone Forest - Inland Scribbly Gum dominant (ID 477)	31.5
Sandstone Forest - Red Ironbark dominant (ID 478)	1.2
Sandstone Forest - Black Cypress dominant (ID 480)	10.3
Riparian forest - Rough-barked Apple and Blakely's Red Gum (ID 481)	30.0
White Box - Grey Box Grassy Woodland (ID 483) EEC	101.1
Norton's Box Woodland (ID 488)	59.8
Mountain Gum - Silvertop - Stringybark Forest (ID 490)	1.1
Brittle Gum - Stringybark Woodland (ID 495)	3.1
White Box - White Cypress Pine shrubby open forest (ID 588)	0.4
Sandstone Forest - Narrow-leaved Ironbark dominant (ID 468 and 479)	42.6
Exotic	343.4

Vegetation type	Impact area (ha)
Unknown ²	0
Disturbed	0.05
Total	745.0

The final offset requirement is proposed to be calculated using field collected plot data, and would be based on the final impact areas derived from civil construction drawings (not yet available). This will provide a further incentive throughout the detailed design to minimise the clearing impacts of the works and thereby reduce the offset requirement.

Two assessments were run as the development spans two CMAs:

- The northern section: Central West CMA, Section 2.2 (map provided in Appendix A.1)
- The southern section: Hunter / Central Rivers CMA, Section 2.3 (map provided in Appendix A.5)

2.2 BIOBANKING ASSESSMENT CENTRAL WEST CMA

2.2.1 Landscape assessment

Native vegetation extent, before and after the project

In accordance with Appendix 5 of the FBA, using a GIS generated 550 m buffer from the centreline of infrastructure components:

- The total area of the project buffer is 23,522.48 ha.
- The total area of native vegetation mapped within the buffer (using canopy connected by less than 100m as a surrogate for native vegetation, as woody vegetation would have originally covered the site) is 15,193.14 ha.

The current native vegetation cover score is therefore 65%.

- The total area of native vegetation within the buffer that would be impacted by the project is 154.35 ha.

The future native vegetation cover score is therefore 64%. The extent of native vegetation within the buffer is mapped in Appendix A.1

Rivers and streams

The proposal traverses several waterways. The largest include:

- In the north, the proposed infrastructure crosses several waterways with their headwaters in Coolah Tops National Park. The largest is **Trabragar River**, a second order river where the project transmission line crosses it. It would not be impacted directly.

² Unknown areas mapped in the original assessment have now either been avoided or classified based on field assessment results.

- Near Cassilis, the transmission line crosses **Four Mile Creek**, a second order river in this location. It would not be impacted directly.

Native vegetation in the area is generally 1,000-5,000ha with connecting widths 100-500m; as such a 'large biodiversity link' has been entered in the BCC.

Patch size

For a development that is linear shaped or a multiple fragmentation development, the assessor must assess the patch size for each **Mitchell landscape** in which the development occurs, averaging the scores. For this project, several landscapes are impacted:

- Liverpool Range Valleys and Foothills 80% cleared – most of the wind farm site
- Coolah Tops 61% cleared – small area at the very northern extent of wind farm site
- Liverpool Tops 20% cleared – small area at the north east extent of wind farm site

Refer to map of Mitchell Landscapes, Appendix A.2. The average patch size score is 12.5.

Area to perimeter ratio

One representative patch within the GIS produced buffer would be affected by the project (ID: A). The patch is made up of one polygon. The area and perimeter ratio before development is shown below.

Table 2-2 Area to perimeter ratio

Patch	Area (m ²)	Perimeter (m)
A	5,026,890	26,435.54
Area m² / Perimeter m	190.16	

Patch A is shown in Appendix A.3.

The effect of the development (the future score) is to increase the number of polygons. Taking into account the development, the future area and perimeter ratio of Patch A after development is shown below.

Table 2-3 Future patch size and perimeter

Patch A	Area (m ²)	Perimeter (m)
a	3,313,070	14,647.75
b	1,650,160	20,287.60
Totals:	4,963,230	34,935.35
Area m² / Perimeter m	142.07	

As the current ratio is greater than the future ratio, the calculator returns a proportional change % and score of Zero (0).

The landscape assessment score resulting from these inputs is 25.5.

Location of the site

IBRA SUBREGIONS

The proposed infrastructure crosses three IBRA subregions:

- Brigalow Belt South - Liverpool Range – northern area and the majority of site, including most wind turbines
- Brigalow Belt South - Pilliga – central area, south of Cassilis
- Sydney Basin – Kerrabee – southern area

Refer to map of IBRA regions, Appendix A.4. The Liverpool Range - Central West was entered into the BCC.

LOCAL GOVERNMENT AREAS (LGA)

The proposed infrastructure crosses three LGAs:

- Warrumbungle Shire
- Upper Hunter Shire
- Mid-Western Regional

Upper Hunter is the central LGA and has been entered in the calculator.

CATCHMENT MANAGEMENT AREAS

- The majority of the wind farm infrastructure proposed would be located in the Central West CMA.
- The majority of the transmission line is in the Hunter Rivers CMA.

This assessment considers infrastructure proposed in the Central West CMA only.

The resulting landscape score is 20.5.

2.2.2 *Vegetation zones*

The native vegetation zones that would be impacted by the northern section of the project (within the Central West CMA) as entered into the BCC (including their condition class, number of biometric plots required for them, as determined by the BCC), are provided below.

For one community, not plot data were available on the VIS database (Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region ID 395). In the northern section of the project, this community often occurs adjacent to Silvertop Stringybark - Yellow Box – Norton’s Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range ID 488. This community and benchmark data were utilised in the BCC, deleting the overstorey cover to zero and reducing the species richness by two (to account for overstorey species). This vegetation type is of the same formation (Grassy Woodlands) in accordance with OEH advice (S. Cox, 19 Jan 2017).³

³ Vegetation communities of the same class were also considered but had poor species assemblage overlap.

2.2.3 Plot data used in the assessment

Use of benchmark data

As plot field data has not been collected for the project, the proposed approach of this preliminary assessment, as discussed in the OEH submission, is to use OEH benchmark plot data. This approach has also been used recently for the Rye Park Wind Farm; OEH held benchmark data specific to the vegetation communities to be impacted are used and are considered representative of the values that would be obtained in vegetation onsite in good condition. It may therefore be considered a conservative approach, over estimating areas that are actually of lesser quality. It is considered reasonable as this is a preliminary assessment used to determine whether offsets are feasible for the project. Having determined the likely scope of offsets, a commitment is made by the project to secure offsets in accordance with the FBA BCC methodology, using field collected plot data and based on the final construction footprint.

Modifications to benchmark data

The following plot data have been derived from benchmark data on the OEH vegetation data base. The number of plots required, as shown in Table 2-4, have been duplicated for each zone. In the cases where no benchmark is provided for a parameter, a precautionary treatment has been applied as follows:

- Exotic cover is scored as zero, assuming the vegetation is weed free.
- Regeneration is scored as 1, assuming all occurring trees are regenerating.
- Where hollow-bearing tree bench marks are listed as a decimal (ie 0.8), 1 is entered in the plot data.

Note, as the data were not collected in the field, no Easting and Northing locations apply; '111111, 1111111' has been entered for each plot.

The management scores *with development* have been entered as zero for each parameter – that is, total removal of habitat would result from the development. Future site value scores would all be zero.

Table 2-4 Impacts in vegetation zones within the project's Central West CMA, northern section (Endangered Ecological Communities (EECs) shown in bold)

Reported as:	Formation	Biometric name	Impact area	Plot number
River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084)	Forested wetlands	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	6.47	3
Rough-barked Apple - Blakely's Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley floors in the northern south-west slopes and BBS Bioregions (ID281)	Grassy woodlands	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South bioregion	7.79	3
Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395) ⁴	Grassy woodland	Changed in the BCC to: Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488) This could not be entered in the BCC as an EEC.	9.34	3
Yellow Box Gum Woodland (ID 437)	Grassy woodland	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	1.51	1
Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)	Grassy Woodlands	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	64.94	5
Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488)	Grassy Woodlands	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	59.77	5
Silvertop Stringybark – Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range (ID490)	Grassy Woodlands	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	1.05	1

⁴ This vegetation type is described and mapped in the biodiversity addendum report. As no benchmark data is available and this community occurs adjacent to Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range ID488 onsite, an additional ID 488 zone was created and ID 488 modified plot data were used in the assessment (overstorey reduced to zero, species richness reduced by two).

Reported as:	Formation	Biometric name	Impact area	Plot number
Brittle Gum - Silvertop Stringybark grassy open forest of the Liverpool Range (ID495)	Dry Sclerophyll Forests (Shrub/grass sub-formation)	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	3.12	2
White Box - White Cypress Pine shrubby open forest (ID588)	Dry Sclerophyll Forests (Shrub/grass sub-formation)	White Box - White Cypress Pine shrubby hills open forest mainly in the Nandewar Bioregion	0.36	1

Table 2-5 Plot data, derived from OEH database benchmarks

River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084)

084	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	21	29	10	16	3	10	0	1	1	50	111111	1111111	1

Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)

281	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	19	18	10	30	4	10	0	0.8	1	66	111111	1111111	1

Derived Speargrass – Wallaby Grass – Wire Grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395); plot data entered into BCC was derived from Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488) and not VIS plot data for 395 is available.

488 modified ⁵	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	0	8	40	12	10	0	2	1	15	111111	1111111	1

Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion (ID437)

437	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	25	20	12	30	4	12	0	1	1	50 ⁶	111111	1111111	1

Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)

483	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	23	30	30	30	8	20	0	2	1	50	111111	1111111	1

Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488)

488	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	32	40	8	40	12	10	0	2	1	15	111111	1111111	1

⁵ ID 488 plot modified as follows: overstorey scored as zero, overstorey richness reduced by two to account for said overstorey species.

⁶ There is a suspected error in the benchmark data that lists this score as 0.5m. 50m has been used instead, which more closely resembles the score for similar vegetation types.

Silvertop Stringybark – Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range (ID490)

490	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	32	40	8	40	12	10	0	2	1	15	111111	1111111	1

Brittle Gum - Silvertop Stringybark grassy open forest of the Liverpool Range (ID495)

495	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	33	30	12	19	8	4	0	2	1	20	111111	1111111	1

White Box - White Cypress Pine shrubby open forest (ID588)

588	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	26	18	18	25	6	4	0	1	1	15	111111	1111111	1

2.2.4 Geographic features

The following features returned in the BCC would/would not be impacted:

Table 2-6 Geographic features

• Impacted	Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber
• Impacted	Grey Falcon	<i>Falco hypoleucos</i>	land containing within 100 m of riparian woodland on inland rivers containing mature living eucalypts or isolated paddock trees overhanging water or dry watercourses
• Not impacted ⁷	Large-eared Bat	Pied <i>Chalinolobus dwyeri</i>	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels

2.2.5 Ecosystem credit species

The following species are all species predicted by the BCC to occur, based on the data entered for the landscape assessment and the geographic and habitat features in the assessment. These constitute all species which will generate ecosystem credits in the credit calculations.

Table 2-7 Species predicted to occur.

• Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis subsp. gularis</i>
• Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus subsp. victoriae</i>
• Bush Stone-curlew	<i>Burhinus grallarius</i>
• Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>
• Diamond Firetail	<i>Stagonopleura guttata</i>
• Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>
• Flame Robin	<i>Petroica phoenicea</i>
• Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
• Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis subsp. temporalis</i>
• Hooded Robin (south-eastern form)	<i>Melanodryas cucullata subsp. cucullata</i>
• Little Eagle	<i>Hieraaetus morphnoides</i>

⁷ In response to the OEH submission, this species is assumed to occur in the southern assessment (Hunter/Central Rivers). However, no caves now occur in the project footprint and so no impact on this geographic feature has been entered.

• Little Lorikeet	<i>Glossopsitta pusilla</i>
• Masked Owl	<i>Tyto novaehollandiae</i>
• Painted Honeyeater	<i>Grantiella picta</i>
• Powerful Owl	<i>Ninox strenua</i>
• Scarlet Robin	<i>Petroica boodang</i>
• Speckled Warbler	<i>Chthonicola sagittata</i>
• Spotted Harrier	<i>Circus assimilis</i>
• Spotted-tailed Quoll	<i>Dasyurus maculatus</i>
• Swift Parrot	<i>Lathamus discolor</i>
• Turquoise Parrot	<i>Neophema pulchella</i>
• Varied Sittella	<i>Daphoenositta chrysoptera</i>
• Yellow-bellied Glider	<i>Petaurus australis</i>
• Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>

2.2.6 Threatened species credit species

The following species were returned by the BCC as requiring survey. The table below states whether each species was detected during surveys and furthermore, if impacts are likely.

Table 2-8 Species that generate species credits if impacted.

• Australasian Bittern	<i>Botaurus poiciloptilus</i>	Not identified	No impact
• Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Not identified	No impact
• Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Not identified	No impact
• Grey Falcon	<i>Falco hypoleucos</i>	Not identified	No impact
• Koala	<i>Phascolarctos cinereus</i>	Not identified	No impact
• Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Identified	Impact
• Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Not identified	No impact
• Regent Honeyeater	<i>Anthochaera phrygia</i>	Not identified	No impact
• Squirrel Glider	<i>Petaurus norfolcensis</i>	Identified in WFSA	Impact

The Large-eared Bat and Squirrel Glider were returned by the BCC. Based on habitat modelling an estimated 19 ha of potential moderate or better woodland habitat would be impacted for each species. This has been entered as a loss.

Additionally, the following species are known to occur and have been entered into the BCC as being impacted as follows:

- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*

If species are identified in consultation with OEH or in subsequent surveys, this information would inform the final offset package to be developed for the project.

2.2.7 Credit statement

The following credit statement was returned from the BCC.

Table 2-9 Credit statement for the Central West northern section of the proposal

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
CW180	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	6.47	Masked Owl	518
CW111	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	7.79	Powerful Owl	562
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	9.34	Powerful Owl	581
CW322	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	64.94	Powerful Owl	4078
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	59.77	Powerful Owl	4789
CW303	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	1.05	-	32

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
CW210	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	3.12	Masked Owl	210
CW225	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	1.51	Masked Owl	118
CW214	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	0.36	Masked Owl	22
Scientific name		Common name	TS offset multiplier	Species credits required
<i>Petaurus norfolcensis</i>		Squirrel Glider	2.2	418
Chalinolobus dwyeri		Large-eared Pied Bat	1.3	247
Miniopterus schreibersii subsp. oceanensis		Eastern Bentwing-bat	1.3	247

2.3 BIOBANKING ASSESSMENT HUNTER / CENTRAL RIVERS CMA

2.3.1 Landscape assessment

Native vegetation extent, before and after the project

In accordance with Appendix 5 of the FBA, using a GIS generated 550 m buffer from the centreline of infrastructure components:

- The total area of the project buffer is 9,789.16 ha.
- The total area of native vegetation mapped within the buffer (using canopy connected by less than 100m as a surrogate for native vegetation) is 3,076.93 ha.

The current native vegetation cover score is therefore 31%.

- The total area of native vegetation within the buffer that would be impacted by the project is 247.13 ha.

The future native vegetation cover score is therefore 29%. The extent of native vegetation within the buffer is mapped in Appendix A.5.

Rivers and streams

The proposal traverses several waterways. The largest include:

- Near Turil, the transmission line crosses **Curryall Creek**, a third order river in this location. It would not be impacted directly.
- In the south, the transmission line crosses **Goulburn River**, a fourth order river in this location. It would not be impacted directly.

As the easements may require additional clearing within these riparian corridors, impact on a 'riparian buffer of a 4th or 5th order stream has been selected.

Patch size

For a development that is linear shaped or a multiple fragmentation development, the assessor must assess the patch size for each **Mitchell landscape** in which the development occurs, averaging the scores. For this project, several landscapes are impacted:

- Cassillis Slopes 65% cleared - most of the transmission line easement
- Talbragar – Upper Macquarie Terrace Sand 93% cleared – small areas of transmission line and access
- Goulburn River Channels and Floodplains 71% cleared – very small area of transmission line at south of project site

Refer to map of Mitchell Landscapes, Appendix A.2. The average patch size score is 12.5.

Area to perimeter ratio

One representative patch within the GIS produced buffer would be affected by the project (ID: A). The patch is made up of one polygon. The area and perimeter ratio before development is shown below.

Table 2-10 Area to perimeter ratio

Patch	Area (m ²)	Perimeter (m)
A	33,130,700	14,647.75
B	16,501,600	20,287.60
Area m² / Perimeter m	142	

Patch A is shown below in Appendix A.6.

The effect of the development (the future score) is to increase the number of polygons. Taking into account the development, the future area and perimeter ratio of Patch A after development is shown below.

Table 2-11 Future patch size and perimeter

Patch A	Area (m ²)	Perimeter (m)
a	1,481,580	11,229.79
b	949,369	6,455.49
c	4,943	412.47
d	6,518	328.40
e	1,031	268.25
Totals:	2,443,441	18,694.39
Area m2 / Perimeter m	131	

As the current ratio is greater than the future ratio, the calculator returns a proportional change % and score of Zero (0).

The landscape assessment score resulting from these inputs is 23.45.

Location of the site

IBRA SUBREGIONS

The proposed infrastructure crosses three IBRA subregions:

- Brigalow Belt South - Liverpool Range – northern area
- Brigalow Belt South - Pilliga – central area, south of Cassilis
- Sydney Basin – Kerrabee – southern area

Refer to map of regions, Appendix A.4. The Kerrabee – Hunter central rivers was entered into the BCC.

LOCAL GOVERNMENT AREAS (LGA)

The proposed infrastructure crosses three LGAs:

- Warrumbungle Shire
- Upper Hunter Shire
- Mid-Western Regional

Upper Hunter is the central LGA and has been entered in the calculator.

CATCHMENT MANAGEMENT AREAS

- The majority of the wind farm infrastructure proposed would be located in the Central West CMA.
- The majority of the transmission line is in the Hunter / Central Rivers CMA.

This assessment considers infrastructure proposed in the Hunter / Central Rivers CMA only.

The resulting landscape score is 24.75.

2.3.2 Vegetation zones

The native vegetation zones that would be impacted by the southern section of the project (within the Hunter Rivers / Central CMA) as entered into the BCC (including their condition class, number of biometric plots required for them, as determined by the BCC), are provided below.

For one community, not plot data were available on the VIS database (Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region ID 395). In the southern section of the project, this community occurs most often adjacent to Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region ID 483, this community and benchmark data were utilised in the BCC, deleting the overstorey cover to zero and reducing the species richness by two (to account for overstorey species). This vegetation type is of the same formation (Grassy Woodlands) in accordance with OEH advice (S. Cox, 19 Jan 2017).⁸

2.3.3 Plot data used in the assessment

As stated in Section 2.2.3, the following plot data have been derived from benchmark data on the OEH vegetation data base. The number of plots required, as shown in Table 2-4, have been duplicated for each zone. In the cases where no benchmark is provided for a parameter, a precautionary treatment has been applied as follows:

- Exotic cover is scored as zero, assuming the vegetation is weed free.
- Regeneration is scored as 1, assuming all occurring trees are regenerating.
- Where hollow-bearing tree bench marks are listed as 0.8, 1 is entered in the plot data.

Note, as the data were not collected in the field, no Easting and Northing locations apply; '111111, 1111111' has been entered for each plot.

The management scores *with development* have been entered as zero for each parameter – that is, total removal of habitat would result from the development. Current site value scores are shown in Table 2-4. Future site value scores would all be zero.

⁸ Vegetation communities of the same class were also considered but had poor species assemblage overlap.

Table 2-12 Vegetation zones within the project (EECs shown in bold)

Reported as:	Formation	Biometric name	Impact area	Plot number
Riparian Blakely's Red Gum - box - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion (ID 278).⁹	Grassy Woodlands	Entered in BCC as: Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion HU681, 278 plot data used.	3.55	2
Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)	Grassy woodlands	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South bioregion HU714	11.15	3
Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395)¹⁰	Grassy woodland	Entered in the BCC as Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483). 483 plot data used. Could not be selected as an EEC in the BCC.	77.26	5
Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)	Dry Sclerophyll Forests (Shrubby sub-formation)	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo) HU 682	3.30	2

⁹ Not available to be selected in the BCC.

¹⁰ This vegetation type is described and mapped in the biodiversity addendum report. As no benchmark data is available and this community occurs adjacent to Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region ID483 onsite, an additional ID 483 zone was created and ID 483 modified plot data were used in the assessment (overstorey reduced to zero, species richness reduced by two).

Reported as:	Formation	Biometric name	Impact area	Plot number
Inland Scribbly Gum – Red Stringybark – Black Cypress Pine – Red Ironbark Open Forest on Sandstone Hills in the Southern Brigalow Belt South Bioregion and Northern NSW South Western Slopes Bioregion (ID 477) ¹¹	Dry Sclerophyll Forests (Shrubby sub-formation)	Entered into BCC as Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion HU 707	31.51	4
Narrow-leaved Stringybark – Narrow-leaved Wattle Forest (478)	Dry Sclerophyll Forests (Shrubby sub-formation)	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion HU 707	1.20	1
Black Cypress Pine – Ironbark – Wattle Low Open Forest Mainly on Narrabeen Sandstone (ID 480)	Dry Sclerophyll Forests (Shrubby sub-formation)	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion HU 678	10.32	3
Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481)	Dry Sclerophyll Forests (Shrubby sub-formation)	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region HU713	30.04	4

¹¹ Not available to be selected in the BCC.

Reported as:	Formation	Biometric name	Impact area	Plot number
Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)	Grassy Woodlands	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley HU690	36.16	4
Narrow-leaved Ironbark – Blakeley's Red Gum shrubby open forest on sandstone low hills (ID468) and Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479) ¹²	Dry Sclerophyll Forests (Shrubby sub-formation)	Entered as one zone in the BCC as ID 479 in the BCC. Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion HU 702 479 plot data used.	42.65	4

Table 2-13 Plot data, derived from OEH database benchmarks

Riparian Blakely's Red Gum - box - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion (ID 278); entered in BCC as Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion HU681

278 – 2 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	25	22	10	50	4	10	0	0.8	1	66	111111	1111111	1

Rough-barked Apple - Blakely's Red Gum – Yellow Box Woodland on Alluvial Clay to Loam Soils on Valley Floors in the Northern South-West Slopes and BBS Bioregions (ID281)

281 – 3 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	19	18	10	30	4	10	0	0.8	1	66	111111	1111111	1

¹² As per the Biodiversity Addendum, these vegetation types are combined as one zone. The 479 plot data are entered into the BCC as Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone Hills ID 479, given the benchmark data are slightly higher values and this may be a conservative approach.

Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483)

483 – 5 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	23	30	30	30	8	20	0	2	1	50	111111	1111111	1

Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)

467 – 2 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	20	20	20	20	0	2	1	46	111111	1111111	1

Inland Scribbly Gum – Red Stringybark – Black Cypress Pine – Red Ironbark Open Forest on Sandstone Hills in the Southern Brigalow Belt South Bioregion and Northern NSW South Western Slopes Bioregion (Benson Id477)

477 – 4 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	22	15	15	15	0	2	1	46	111111	1111111	1

Narrow-leaved Stringybark – Narrow-leaved Wattle Forest (478)

478 – 1 plot	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	20	20	20	18	0	2	1	20	111111	1111111	1

Black Cypress Pine – Ironbark – Wattle Low Open Forest Mainly on Narrabeen Sandstone (Benson Id480)

480 – 3 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	30	20	20	20	18	0	2	1	20	111111	1111111	1

Rough-barked Apple / Blakely's Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481)

481 – 4 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	31	30	30	30	30	20	0	1.5	1	10	111111	1111111	1

Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone Hills (Benson Id479)

479 – 4 plots	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Overstorey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	30	22	20	20	20	18	0	2	1	66	111111	1111111	1

2.3.4 Geographic features

No features were returned by the BCC.

2.3.5 Ecosystem credit species

The following species are all species predicted by the BCC to occur, based on the data entered for the landscape assessment and the geographic and habitat features in the assessment. These constitute all species which will generate ecosystem credits in the credit calculations.

Table 2-14 Species predicted to occur.

• Barking Owl	<i>Ninox connivens</i>
• Little Lorikeet	<i>Glossopsitta pusilla</i>
• Painted Honeyeater	<i>Grantiella picta</i>
• Square-tailed Kite	<i>Lophoictinia isura</i>
• Turquoise Parrot	<i>Neophema pulchella</i>
• Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>

2.3.6 Threatened species credit species

The following species were returned by the BCC as requiring survey. The table below states whether each species was detected during surveys and furthermore, if impacts are likely.

Table 2-15 Species that generate species credits if impacted.

• <i>Commersonia procumbens</i>	<i>Commersonia procumbens</i>	Not identified	No impact
• Large leafed Monotaxis	<i>Monotaxis macrophylla</i>	Not identified	No impact
• Regent Honeyeater	<i>Anthochaera phrygia</i>	Not identified	No impact
• Scant Pomaderris	<i>Pomaderris queenslandica</i>	Not identified	No impact

Silky Swainson-pea was recorded in the TLSA in native pasture / White Box-Grey Box Grassy Woodland; one individual. It is not listed above as either predicted to occur or requiring survey. It was entered as being impacted into the BCC.

Additionally, the following species are known to occur and have been entered as being impacted as follows:

- Squirrel Glider *Petaurus norfolcensis* – 19 ha of moderate or better woodland habitat.¹³
- Large-eared Pied Bat *Chalinolobus dwyeri* - 19 ha of moderate or better woodland habitat.¹⁴

¹³ All habitat impacts have been added to the norther section assessment and not split between the southern section impacts.

- Diamond Firetail *Stagonopleura guttata* — 19 ha of moderate or better woodland habitat.
- Black-chinned Honeyeater *Melithreptus gularis gularis* - 19 ha of moderate or better woodland habitat.
- Grey-crowned Babbler *Pomatostomus temporalis*- 19 ha of moderate or better woodland habitat.
- Speckled Warbler *Pyrrholaemus sagittatus* - 19 ha of moderate or better woodland habitat.¹⁵
- Eastern Cave Bat *Vespadelus trougtoni* - 19 ha of moderate or better woodland habitat.
- Corben's Long-eared Bat *Nyctophilus corbeni* (form. *timorensis*) - 19 ha of moderate or better woodland habitat.
- Masked Owl *Tyto novaehollandiae* - 19 ha of moderate or better woodland habitat.
- Glossy Black Cockatoo *Calyptorhynchus lathami* - 19 ha of moderate or better woodland habitat.
- Powerful Owl *Ninox strenu* - 19 ha of moderate or better woodland habitat.
- Dusky Woodswallow *Artamus cyanopterus* - 19 ha of moderate or better woodland habitat.¹⁶

If species are identified in consultation with OEH or in subsequent surveys, this information would inform the final offset package to be developed for the project.

2.3.7 Credit statement

The following credit statement was returned from the BCC.

¹⁴ All habitat impacts have been added to the northern section assessment and not split between the southern section impacts.

¹⁵ Not available in the BCC to add to the species list.

¹⁶ Not available in the BCC to add to the species list.

Table 2-16 Credit statement for the Hunter / Central Rivers southern section of the proposal

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
HU681	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	3.55	Barking Owl	266
HU714	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	11.15	Barking Owl	836
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	77.26	Barking Owl	6273
HU682	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	3.3	Barking Owl	242
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	31.51	Barking Owl	2511
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	1.2	Barking Owl	85
HU678	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	10.32	Barking Owl	838
HU713	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	30.04	Barking Owl	2439
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	36.16	Barking Owl	2936
HU702	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney	42.65	Barking Owl	3196

PC type code	Plant community type name	Management zone area (ha)	TS with highest credit req	Ecosystem credits required
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Basin Bio

Scientific name	Common name	TS offset multiplier	Species credits required
<i>Melithreptus gularis subsp. gularis</i>	Black-chinned Honeyeater (eastern subspecies)	1.3	247
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	2.1	399
<i>Stagonopleura guttata</i>	Diamond Firetail	1.3	247
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	1.3	247
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	1.8	342
<i>Pomatostomus temporalis subsp. Temporalis</i>	Grey-crowned Babbler (eastern subspecies)	1.3	247
<i>Tyto novaehollandiae</i>	Masked Owl	3	570
<i>Ninox strenua</i>	Powerful Owl	3	570
<i>Swainsona sericea</i>	Silky Swainson-pea	1.8	18

2.4 CREDIT CONVERSION

The OEH 'credit converter' tool has been used to convert the credit requirements of the development into an estimate of the areas of each vegetation type needed to satisfy those credit requirements.

Table 2-17 Credit conversion: area estimated to achieve offset requirement

Entity requiring offsets		Credit requirement	Area of land required, as determined by the credit calculator (ha)
Northern section: Central West Catchment Management Area			
CW180	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	518	55.7
CW111	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	562	60.4

Entity requiring offsets		Credit requirement	Area of land required, as determined by the credit calculator (ha)
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	581	62.5
CW322	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	4078	438.5
CW304	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	4789	514.9
CW303	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	32	3.4
CW210	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	210	22.6
CW225	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	118	12.7
CW214	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	22	2.4
Subtotal		10,910	1,173.10
<i>Petaurus norfolcensis</i>	Squirrel Glider	418	70
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	247	41
<i>Miniopterus schreibersii subsp. Oceanensis</i>	Eastern Bentwing-bat	247	41
Subtotal		912	152.00
Southern section: Hunter Rivers Catchment Management Area			
HU681	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	266	28.6
HU714	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	836	89.9
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	6273	674.5
HU682	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	242	26

Entity requiring offsets		Credit requirement	Area of land required, as determined by the credit calculator (ha)
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	2511	270
HU707	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	85	9.1
HU678	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	838	90.1
HU713	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	2439	315.7
HU690	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	2936	315.7
HU702	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bio	3196	343.7
Subtotal		19,622	2,163.30
<i>Swainsona sericea</i>	Silky Swainson-pea	18	2
<i>Calyptrorhynchus lathami</i>	Glossy Black-Cockatoo	342	52
<i>Melithreptus gularis</i> subsp. <i>gularis</i>	Black-chinned Honeyeater (eastern subspecies)	247	41
<i>Ninox strenua</i>	Powerful Owl	570	90
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	399	70
<i>Pomatostomus temporalis</i> subsp. <i>Temporalis</i>	Grey-crowned Babbler (eastern subspecies)	247	41
<i>Stagonopleura guttata</i>	Diamond Firetail	247	41
<i>Tyto novaehollandiae</i>	Masked Owl	570	90
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	247	41
Subtotal		2,887	468.00

Table 2-18 Project credit and area summary

Entity requiring offsets	Credit requirement	Area of land required, as determined by the credit calculator (ha)
Ecosystem credits		
Northern section ecosystem credit subtotal	10,910	1,173.10
Southern section ecosystem credit subtotal	19,622	2,163.30
Total	30,532	3,336.40
Species credits		
Northern section species credit subtotal	912	152.00
Southern section species credit subtotal	2,887	468.00
Total	3,799	620.00

Combined for the project, approximately 3,336.40 ha would be required to satisfy ecosystem credits. Subject to this area being able to also satisfy species credits, up to an additional 620 ha may be required for species credits.

Note:

The requirements are not cumulative. If species credit requirements are required, an area may concurrently satisfy the vegetation community and one or more threatened species requirements, subject to confirmation that the site provides habitat for the species.

3 PRELIMINARY OFFSET EVALUATION

3.1 CANDIDATE OFFSET SITES

Given the extensive offsets required, a suite of sites is likely to be required if physical offsets are secured for the project, rather than the purchase of credits or payment into and offset fund (refer to Section 4.1 for discussion on options available to satisfy the offset requirement). The intention of this evaluation is to demonstrate that physical offsets are feasible and achievable for the project.

The proponent has indicated a preference to secure offset areas within the project boundary. Involved landowners within the project boundary are able to be involved in the offset package, rather than involving a third party or external site. As they already own the site, no purchase of a BioBanking site is required. Mapping and surveys undertaken to date suggest that there is vegetation within the site boundary that is similar to that being cleared and therefore is highly likely to offer a like for like offset. It is noted that some additional sites outside the project boundary have also been identified as they offer strategic benefits for connectivity to existing reserves.

Based on the preliminary assessment of likely credit requirements in Section 2, ten candidate offset sites have been so far been identified, totalling 3,025 ha. These landowners have been approached and are amenable to further investigation and to having suitable areas managed for conservation in perpetuity. As such, all of the candidate sites so far considered are feasible to include within the offset package for the project, subject to further investigation to verify their suitability.

An overview of the suitability of these sites is presented overleaf, with reference to what is known either from rapid field assessment conducted during the 2015 and 2016 additional surveys, or because of surveys adjacent to these areas Table 3-1. The location of each site is mapped in Appendix A.7 and A.8.

Note on impacts to Ulan Mine offset areas:

All areas impacted by the wind farm and ancillary infrastructure would be offset, as demonstrated by this strategy. However, it is noted that a section of the proposed main powerline passes through the Bobadeen East Vegetation Offset Area (BEVOA) which is a proposed offset area for the Ulan Mine. An amendment to the boundary of the BEVOA has been made such that the wind farm's impact area is now outside the BEVOA. The amendment now ensures no impact on the BEVOA. All native vegetation impacts would be offset in accordance with the FBA offset requirements.

3.2 FINAL SELECTION OF SITES

Use of actual rather than benchmark plot data in this final offset calculations is likely to reduce the credit requirement somewhat as not all parameters of the vegetation to be impacted are expected to be within benchmark. Determining and securing offsets in accordance with the FBA for Major Projects, and in consultation with OEH, is a commitment of this project.

In delineating the final offset site boundaries, a minimum distance from infrastructure would be implemented to ensure the sites are not affected in the long term by indirect impacts. For example:

- 300m from wind turbines (300m from centres);
- 50m from tracks, powerlines and other linear infrastructure (50m from centrelines); and
- 50m from the outer edge of all other infrastructure.

3.3 COMMONWEALTH OFFSET REQUIREMENTS

Commonwealth offsets are not considered specifically in this assessment. It is noted that all vegetation communities and threatened species that could be impacted significantly and therefore required to be offset under the Commonwealth requirements are already included in the NSW assessment. It is further noted that the NSW offset requirements are usually more onerous than the Commonwealth requirements and therefore, as a preliminary assessment, Commonwealth offset requirements (if needed) are similarly expected to be able to be offset.

Table 3-1 Offset site overview

Site and size	Vegetation	Threatened species	Landscape position / connectivity
1 262.29 ha	Vegetation in this area is in good condition and includes: - Narrow-leaved Ironbark – Blakeley’s Red Gum shrubby open forest on sandstone low hills (ID468) - Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479) - Rough-barked Apple / Blakely’s Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481) - Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395)	Threatened species recorded from the proposed transmission line that dissects the site include: - Glossy Black Cockatoo - Corbens long eared bat - Speckled warbler	The site is to the immediate west of Curryall State Forest. It provides an important east-west link in an area where woodland habitat narrows and a landscape scale. It is understood OEH have intended to purchase this area and manage it for biodiversity conservation. Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of these impacts could be best managed and the link’s function maintained.
2 219.65 ha	Vegetation in this area is in moderate to good condition and includes: - Narrow-leaved Ironbark – Blakeley’s Red Gum shrubby open forest on sandstone low hills (ID468) - Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479) - Rough-barked Apple / Blakely’s Red Gum / Narrow-leaved Stringybark +/- Grey Gum Sandstone Riparian Grass Fern Open Forest in the Southern BBS and Upper Hunter Regions (ID481) - Blue-Leaved Ironbark – Black Cypress Pine Shrubby Sandstone Open Forest in the Southern BBS Bioregion (Benson ID 467)	Threatened species recorded from the proposed transmission line that dissects the site include: - Powerful Owl - Black Cockatoo Fauna habitat includes: - Open forest - Woodland and, - Riparian areas	Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of the transmission line could be specifically managed.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
3 17.74 ha	The vegetation in this area unknown, but based on adjacent vegetation is likely to include: - Narrow-leaved Ironbark – Blakeley’s Red Gum shrubby open forest on sandstone low hills (ID468) - Narrow-Leaved Ironbark – Black Cypress Pine – Stringybark – Wattle Shrubby Open Forest on Sandstone (ID 479)	Threatened species recorded from the proposed transmission line nearby include: - Black Cockatoo Fauna habitat includes: - Pasture with scattered trees and, - Woodland	Occurring adjacent the proposed transmission line, it is expected to be very suitable to offset the vegetation and habitat required to be cleared for the transmission line. If secured, edge effects of the transmission line could be specifically managed.
4 399.42 ha	Unknown	Unknown	Located along the northern edge of more extensive woodland, management of this large land parcel may reduce edge effects in adjacent habitats to the south and thereby contribute to landscape connectivity.
5 78.22 ha	Vegetation in this area is in moderate to good condition. It may contain vegetation including: - Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley HU690, - Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo) HU682, - Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion HU678 and - Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion HU702.	Fauna habitat features mapped in this area include - two rocky outcrops and - one hollow bearing tree.	This area is surrounded by Goulburn River National Park. Converting this area to conservation management objectives would consolidate the existing reserve and remove threats that may affect adjacent areas in the park, such as weed or feral animal spread resulting from agriculture. While located within an extensive vegetated area, this location provides a diversity of habitat, from more open woodland to gullies. Ecotonal areas can have higher diversity of flora and fauna.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
6 186 ha	Occur adjacent to: poor condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: Woodland	Includes the lower slope and northern bank of a riparian corridor and may therefore enhance local movement corridors if managed for biodiversity conservation.
7 192 ha	Occurs adjacent to: poor – moderate condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: - Pasture with scattered trees and, - Woodland	Relatively isolated but includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
8 535 ha	Includes: - moderate condition River Oak – Rough-barked Apple – red gum – box riparian tall woodland (ID084) as well as - poor condition Rough-barked Apple - Blakely's Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley floors in the northern south-west slopes and BBS Bioregions (ID281) and - poor condition Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488), based on surveys conducted through this area for a transmission line that has since been rerouted. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Fauna habitat includes: - Pasture with scattered trees and, - Woodland	Through candidates 9 and 10, this candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.

Site and size	Vegetation	Threatened species	Landscape position / connectivity
9 121 ha	Occurs adjacent to: poor – moderate condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483), however, the tree cover on the offset candidate site is likely to mean this vegetation is of higher quality than the mapped vegetation. Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Nearby records include: - Varied Sittella, - Wedge-tailed Eagle, - Nankeen Kestrel and - Brown Falcon. Fauna habitat includes: - Pasture with scattered trees and, - Woodland	Through candidate 10, this candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
10 1021 ha	Occurs adjacent to: - moderate condition Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488) and - poor condition Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483). Note: infrastructure buffers would be applied to minimise impacts of infrastructure, if this site is included in the offset package.	Nearby records include: - Wedge-tailed Eagle, - Nankeen Kestrel and - Brown Falcon. Fauna habitat includes: - Pasture with scattered trees and, - Woodland	This candidate would contribute to a large connected area contiguous with Coolah Tops National Park. Includes steep slopes and gullies that could provide good habitat if managed for biodiversity conservation.
3,025 ha	Total		

4 IMPLEMENTATION

4.1 OPTIONS TO SATISFY THE PROJECT'S CREDIT REQUIREMENT

The proponent commits to securing a formal vehicle to secure and manage the project's offset sites in perpetuity. It is understood that a number of options may be available including:

- Purchase of existing credits from the BioBanking Public Register
- Establishment of BioBanking sites
- Payment into an Offset Fund.

The proponent commits to working with the DPE and OEH to find a suitable security mechanism for the project.

4.2 TIMING OF IMPLEMENTATION

Assuming that not all of the credits can be found on the BioBanking Public Register and that an Offset Fund is not available for the project, this implementation section focusses on identifying and securing physical offset sites from among the project's involved landowners.

It is proposed that the project's offsets requirement should accurately reflect the project's final impact on biodiversity values as much as possible and not be based on concept drawings, as are currently available. This is particularly important for wind farm projects where the detailed design phase can require adjustments to access tracks and turbine locations. Additionally, this will provide a further incentive throughout the detailed design to minimise the clearing impacts of the works and thereby reduce the offset requirement.

The following stages of implementing the final Offset Package for the project are proposed. The aim of this timeline is to provide a clear path to identifying, securing and managing suitable offset lands prior to any construction impact.

Post approval, documented within the project's detailed Offset Plan

1. Determine final credit requirement using the FBA in consultation with OEH, based on:
 - a. Detailed construction drawings, (which will be submitted to Department of Planning and Environment (DPE) and deemed by the proponent to be final)
 - b. Plot data collected for the project footprint, in accordance with the FBA.
2. Select the final suite of offset sites including accurate calculation of credits able to be retired at each offset site based on plot data collected for the offset sites, in accordance with the FBA.
3. Develop detailed management actions in consultation with the landowners who will be responsible for implementing the actions, referencing the templates provided by OEH for BioBank site management. An example of typical management measures expected to be carried out is provided overleaf, Table 4-1.

After construction

4. Verify that the actual post construction impact area does not exceed that used to calculate the offset requirement in Step 1.
5. Formally secure the offset sites as BioBanking sites, including detailed management plans for each offset site and delineation of the final offset site boundaries. All costs of site assessment and credit purchase will be borne by the proponent.
6. Landowners become responsible for Biobank site management actions in accordance with the site specific management plans, with funding provided by the Biobanking fund, to ensure ongoing biodiversity improvement at the offset sites for the life of the project.

Table 4-1 Example offset site management measures

Management measure	Objective	Justification	Action	Timing
Exclusion of stock	To prevent overgrazing and encourage regeneration of native vegetation and maintenance of tussocks in grasslands.	Grazing would be likely to degrade habitat.	Install stock proof fencing around the perimeter of the Offset Site.	- At establishment of the Offset Site. - Ongoing repairs as required.
Weed control	To minimise the occurrence of weeds within the Offset Site particularly Weeds of National Significance (WoNS) and listed noxious weeds.	Weeds compete with native species and degrade habitats.	- Survey to identify target locations for weed control. - Weed control using appropriate methodologies considering target species and landscape context.	- At establishment of the Offset Site. - Ongoing as required.
Planting trees in pasture	To enhance connectivity in secondary grasslands.	Planting would provide greater connectivity and potential for hollows in the long term. In turn, it would also increase tree numbers through natural recruitment.	- Plant tube stock trees, appropriate to the vegetation type, in native pasture and derived grasslands - Placement to consider strategic connectivity.	At establishment of the Offset Site.
Feral animal control	To minimise the risk of the Offset Site becoming a refuge for feral animals.	Feral animals can reduce native vegetation quality, compete with native fauna for resources and/or prey on native fauna.	- Monitor for presence of feral animals. - Conduct control appropriate to the feral animal species	Consideration given to action on the basis of monitoring results.

Management measure	Objective	Justification	Action	Timing
			detected during monitoring. Where possible, coordinate control efforts with adjacent landowners to maximise effects	

5 CONCLUSION

This strategy demonstrates means to secure suitable and adequate offsets, prior to any construction impacts, with reference to the Framework for Biodiversity Assessment (FBA, 2016) for Major Projects.

Combined for the project, approximately 3,336.40 ha would be required to satisfy ecosystem credits. Subject to this area being able to also satisfy species credits, up to an additional 620 ha may be required for species credits.

It is understood that several options may be considered for transitional major project offsets:

- Purchase of existing credits from the BioBanking Public Register
- Establishment of BioBanking sites
- Payment into an Offset Fund.

Several candidate offset sites have currently been investigated to varying degrees. The offset candidates in total equal 3,025 ha and include vegetation and habitat types required to be offset.

The proponent commits to working with the DPE and OEH to find a suitable in perpetuity security mechanism for the project. Implementation notes are included in this strategy to ensure the final offsets account for the final clearing impacts.

APPENDIX A OFFSET STRATEGY MAP SET

A.1 Extent of native vegetation: northern section, central west CMA

A.2 Mitchell landscapes for the project area

A.3 Representative patch used in landscape assessment: northern section, central west CMA

A.4 IBRA subregions for the project area

A.5 Extent of native vegetation: southern section, hunter / central rivers CMA

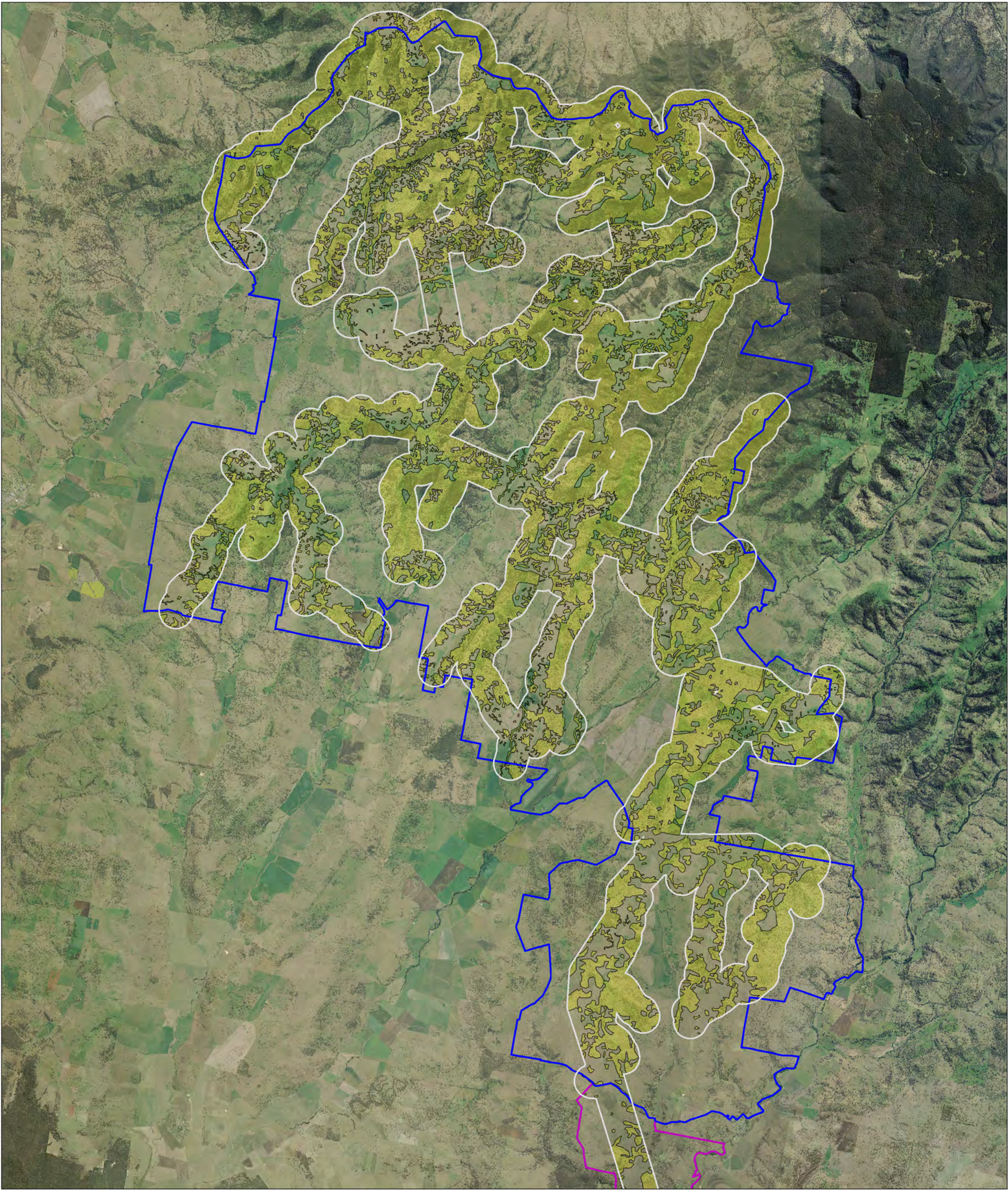
A.6 Representative patch used in landscape assessment: southern section, hunter / central rivers CMA

A.7 Offset candidates north

A.8 Offset candidates south

A.1 EXTENT OF NATIVE VEGETATION: NORTHERN SECTION, CENTRAL WEST CMA

A.1 - Extent of Native Vegetation Northern Overview Map



- 550m infrastructure buffer
- Site perimeter
- Wind Turbine Area
- Transmission Area
- Additional data
- Native vegetation

EPURON



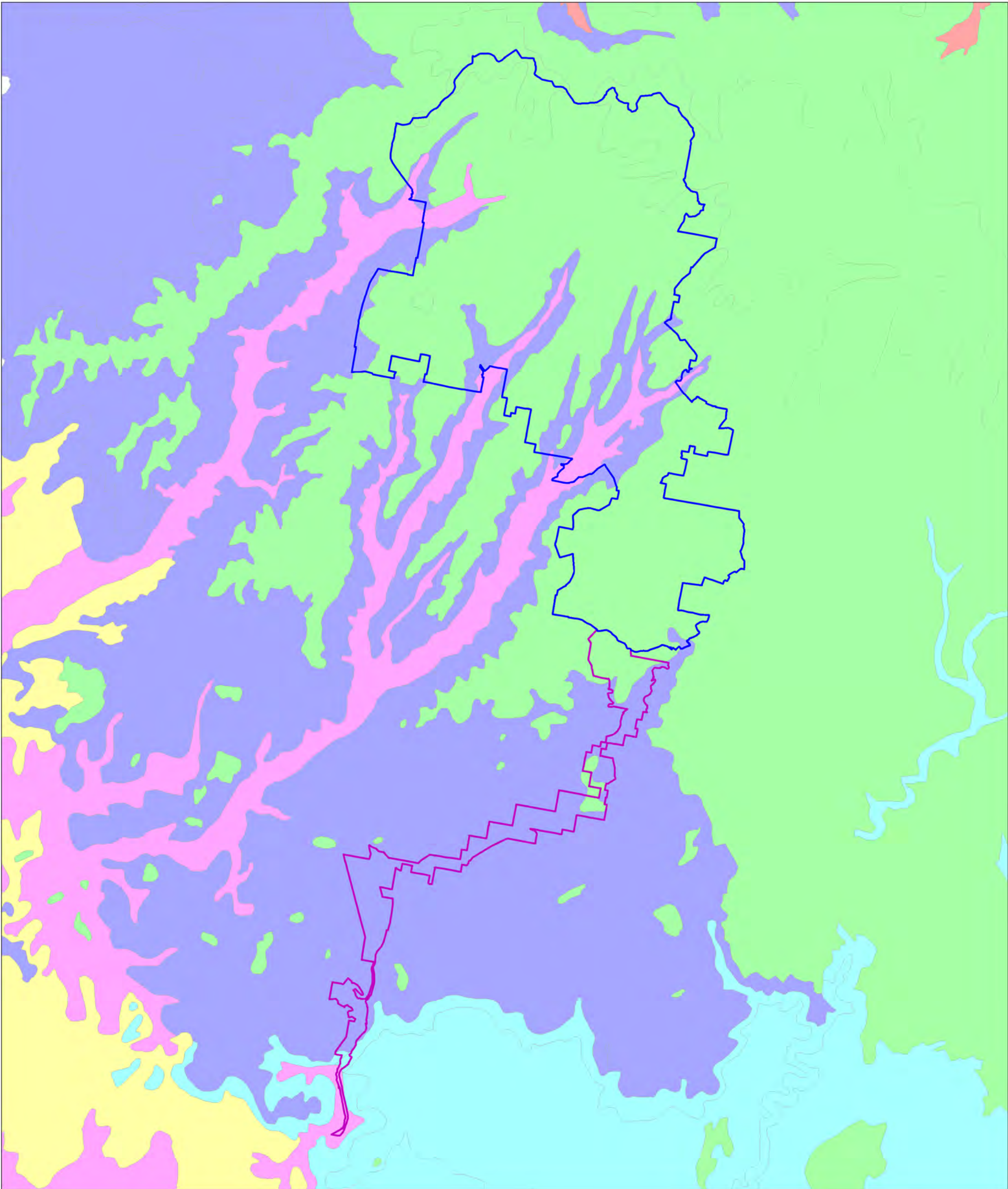
A3 @ 1:120,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55



A.2 MITCHELL LANDSCAPES FOR THE PROJECT AREA

A.2 - Mitchell Landscapes Site Overview Map



Site perimeter
Wind Turbine Area
Transmission Area

Mitchell Landscapes
BBS Liverpool Plains
BBS Liverpool Range
BBS Pilliga
NSS Upper Slopes
NSS Upper Slopes Granites
SB Kerrabee

EPURON

0 3 6 9
Kilometers

A3 @ 1:220,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55



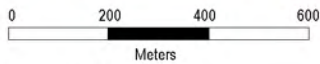
A.3 REPRESENTATIVE PATCH USED IN LANDSCAPE ASSESSMENT: NORTHERN SECTION, CENTRAL WEST CMA

A.3 - Representative Patch used in Landscape Assessment: Northern Section, Central West CMA



Northern Patch
Segment a
Segment b

EPURON



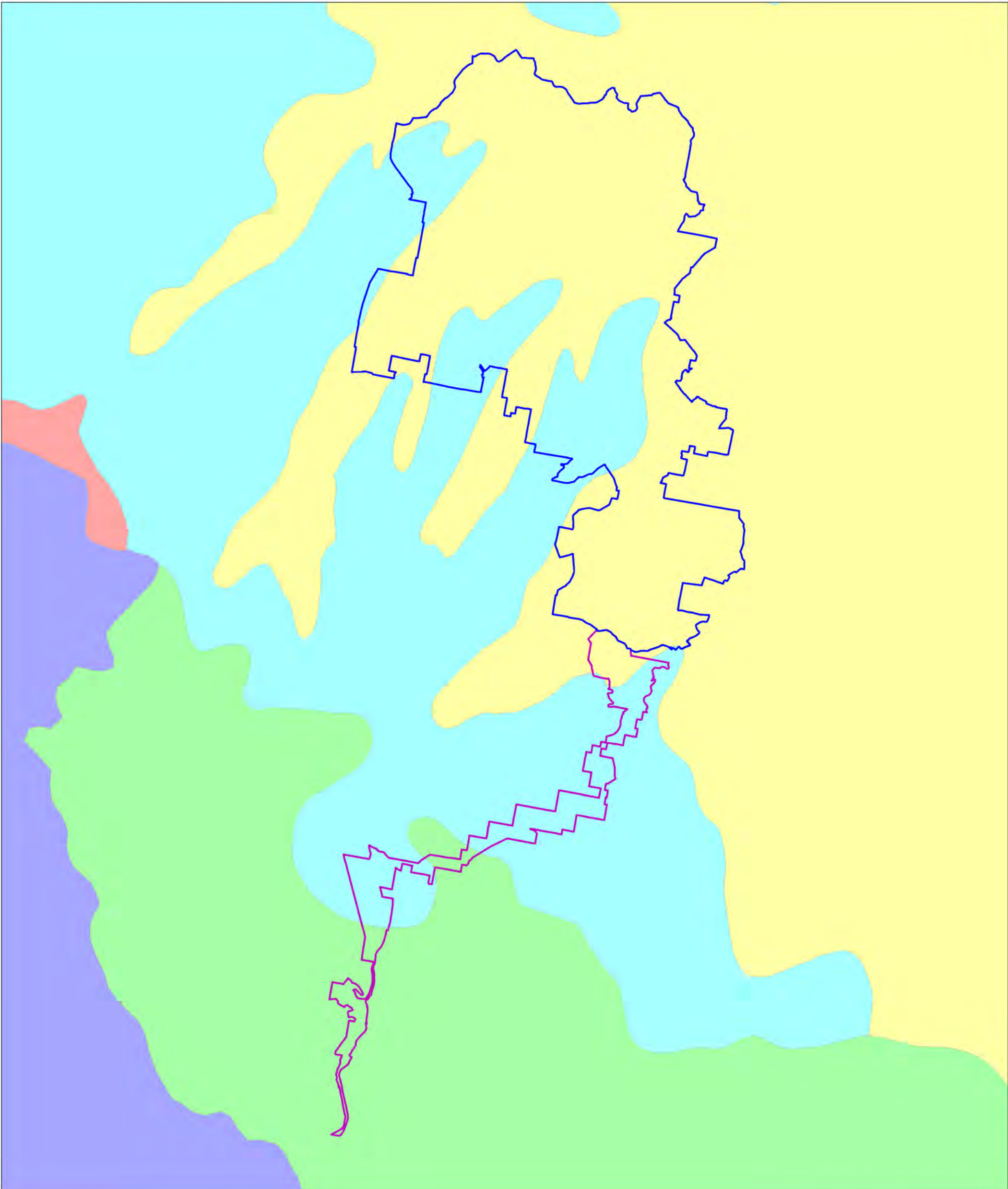
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Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55



A.4 IBRA SUBREGIONS FOR THE PROJECT AREA

A.4 - NSW Subregions Site Overview Map



Site perimeter
Transmission Area
Wind Turbine Area

NSW Subregions
Inland Slopes
Kerrabee
Liverpool Range
Pilliga
Talbragar Valley

EPURON



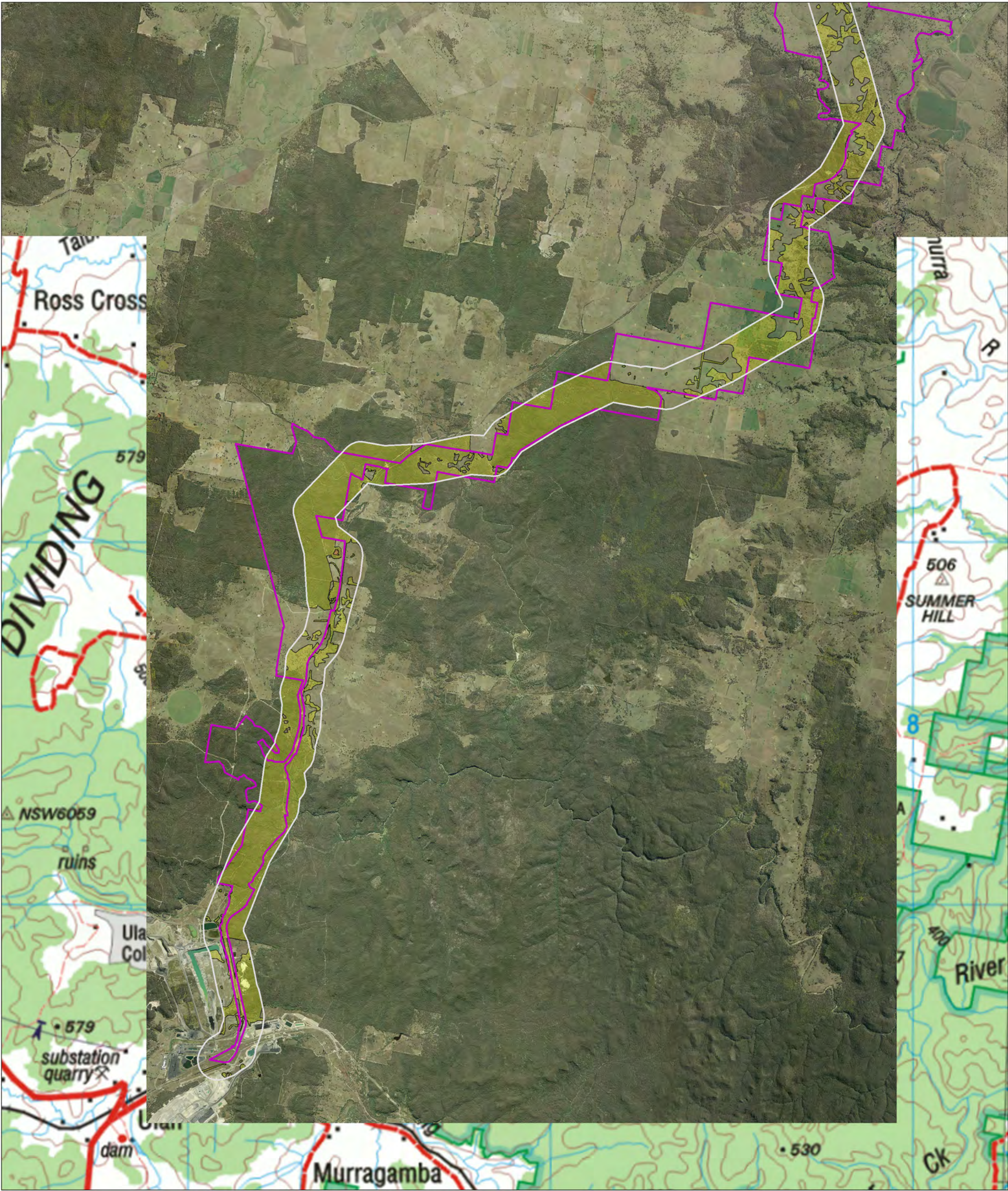
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Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55



A.5 EXTENT OF NATIVE VEGETATION: SOUTHERN SECTION, HUNTER / CENTRAL RIVERS CMA

A.5 - Extent of Native Vegetation Southern Overview Map



- 550m infrastructure buffer
- Site perimeter
- Wind Turbine Area
- Transmission Area
- Additional data
- Native vegetation

EPURON



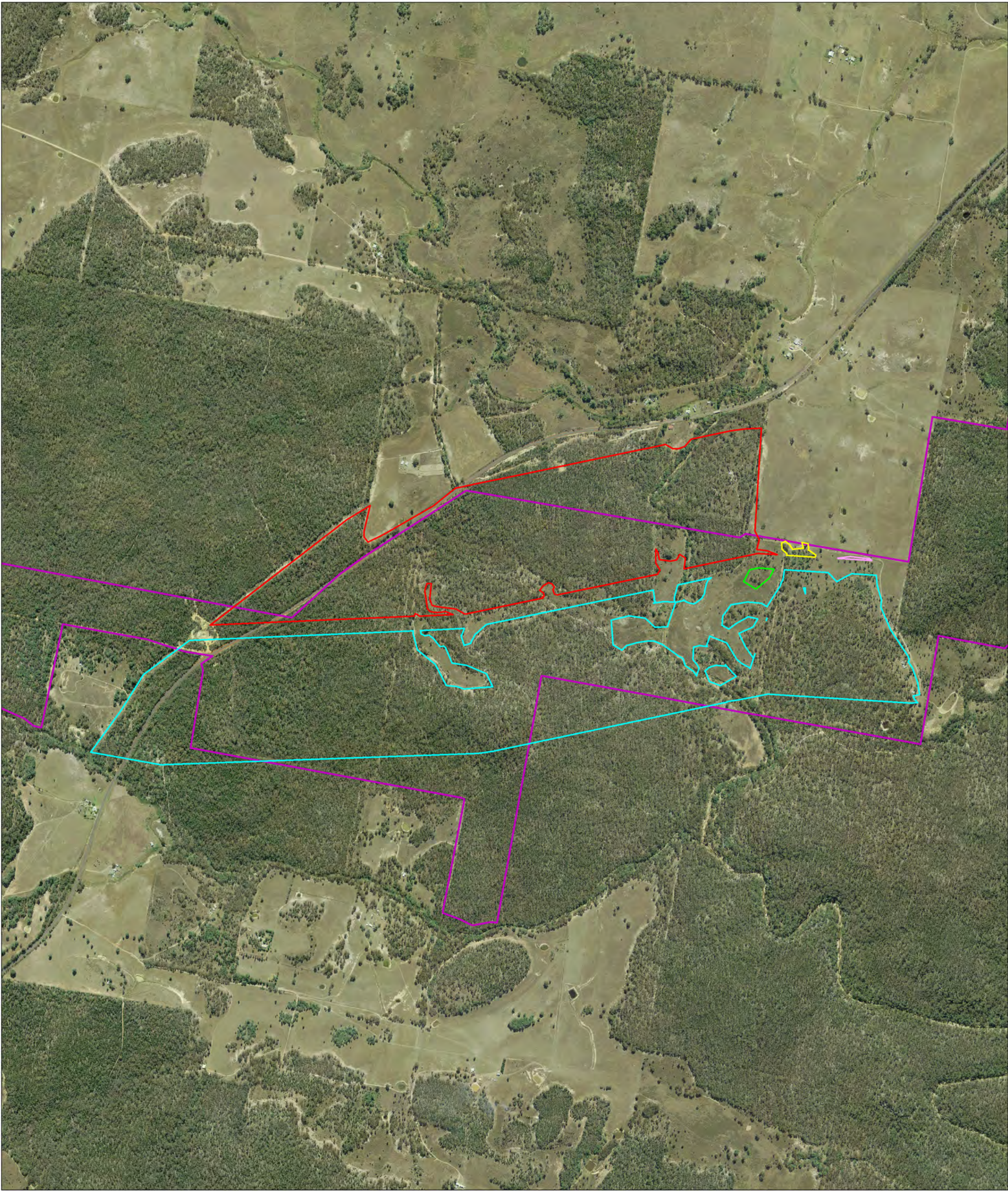
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Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55



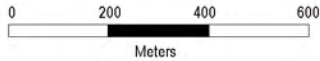
A.6 REPRESENTATIVE PATCH USED IN LANDSCAPE ASSESSMENT: SOUTHERN SECTION, HUNTER / CENTRAL RIVERS CMA

A.6 - Representative Patch used in Landscape Assessment: Southern Section, Central West CMA



- Site perimeter
- Transmission Area
- Southern Patch
- Segment a
 - Segment b
 - Segment c
 - Segment d
 - Segment e

EPURON



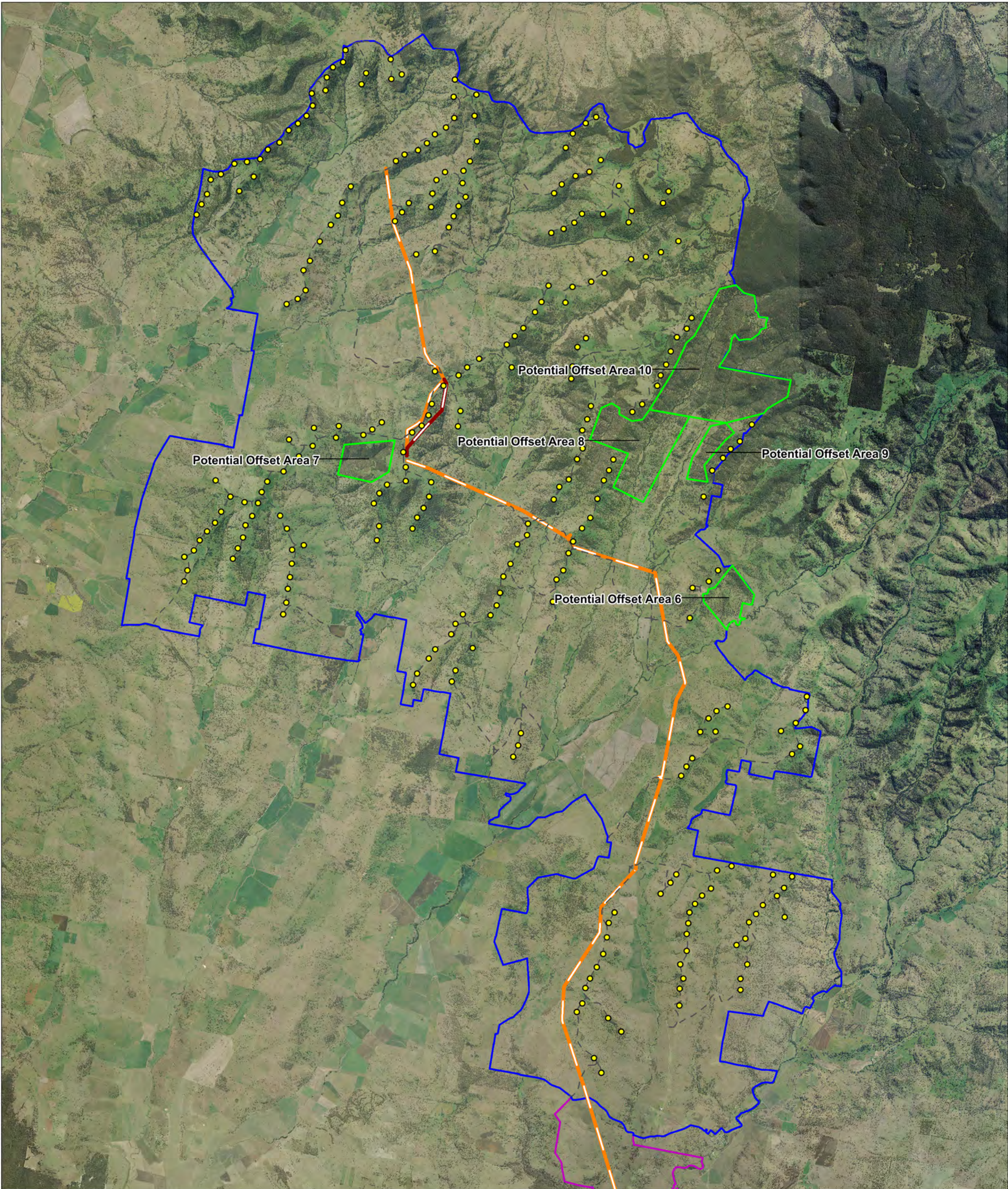
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Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 February 2017
Projection: GDA94 MGA Zone 55

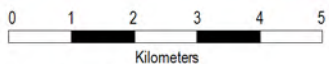


A.7 OFFSET CANDIDATES NORTH

A.7 - Potential Offset Areas Northern Overview Map



- Site perimeter
- Wind Turbine Area
 - Transmission Area
- Additional data
- Potential Offset Area



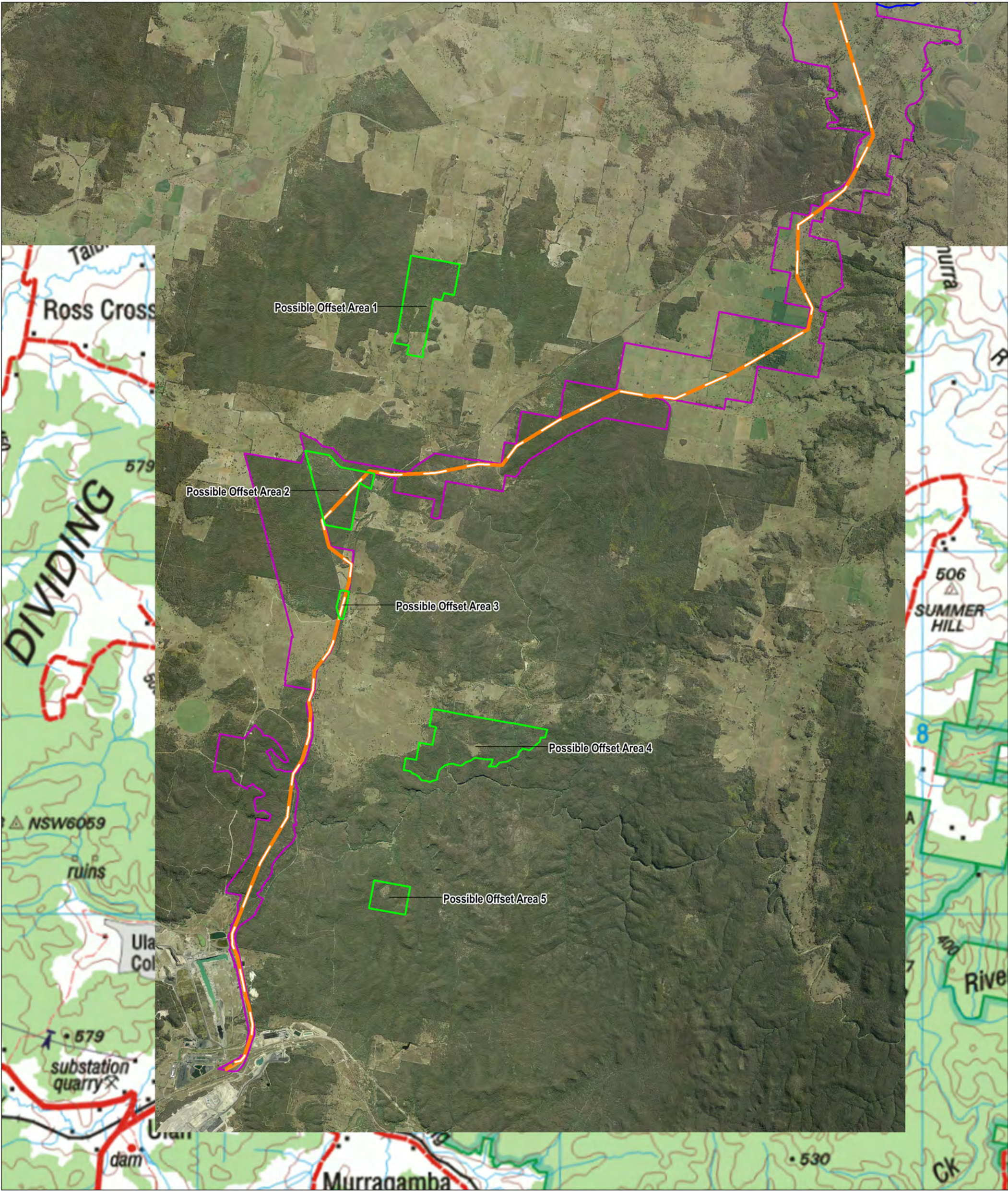
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Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55



A.8 OFFSET CANDIDATES SOUTH

A.8 - Potential Offset Areas Northern Overview Map



- Site perimeter
- Wind Turbine Area
 - Transmission Area
- Additional data
- Potential Offset Area

EPURON

0 1 2 3 4 5
Kilometers

A3 @ 1:100,000

Project: Liverpool Range Wind Farm
Produced by: Virgil Robinson
Date: 3 April 2017
Projection: GDA94 MGA Zone 55

APPENDIX B BIODIVERSITY CREDIT REPORTS

BioBanking Credit Calculator

Ecosystem credits

Proposal ID : 0035/2016/4151MP

Proposal name : Liverpool wind farm north

Assessor name : Brooke Marshall

Assessor accreditation number : 0035

Tool version : v4.0

Report created : 30/01/2017 12:38

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
liverpool wind farm	20.50	CW180_Moderate/Good	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Moderate/Good	Yes	1	6.47	100.00	0.00	100.00	0	518	Masked Owl	100.00	3.00	518
liverpool wind farm	20.50	CW111_Moderate/Good	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	7.79	89.33	0.00	89.33	562	562	Powerful Owl	100.00	3.00	562
liverpool wind farm	20.50	CW304_Moderate/Good_Other	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good_Other	Yes	1	9.34	76.04	0.00	76.04	0	581	Powerful Owl	83.33	3.00	581
liverpool wind farm	20.50	CW322_Moderate/Good	White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion	Moderate/Good	Yes	1	64.94	76.89	0.00	76.89	4,078	4,078	Powerful Owl	80.00	3.00	4,078
liverpool wind farm	20.50	CW304_Moderate/Good	Silvertop Stringybark - Yellow Box +/- Nortons Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good	Yes	1	59.77	100.00	0.00	100.00	0	4,789	Powerful Owl	100.00	3.00	4,789
liverpool wind farm	20.50	CW303_Moderate/Good	Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range, Brigalow Belt South Bioregion	Moderate/Good	Yes	1	1.05	100.00	0.00	100.00	0	0		0.00	0.00	32
liverpool wind farm	20.50	CW210_Moderate/Good	White Box - Red Stringybark shrubby woodlands on basalt slopes of the Nandewar Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	3.12	82.81	0.00	82.81	0	210	Masked Owl	94.44	3.00	210
liverpool wind farm	20.50	CW225_Moderate/Good	Yellow Box - Blakely's Red Gum grassy woodland of the Nandewar Bioregion	Moderate/Good	Yes	1	1.51	97.33	0.00	97.33	118	118	Masked Owl	94.44	3.00	118

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Manage ment zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
liverpool wind farm	20.50	CW214_Mo derate/Goo d	White Box - White Cypress Pine shrubby open forest of the Nandewar Bioregion and Brigalow Belt South Bioregion	Moderate/Goo d	Yes	1	0.36	73.96	0.00	73.96	0	22	Masked Owl	88.89	3.00	22

BioBanking Credit Calculator

Species credits

Proposal ID : 0035/2016/4151MP
Proposal name : Liverpool wind farm north
Assessor name : Brooke Marshall
Assessor accreditation number : 0035
Tool version : v4.0
Report created : 30/01/2017 12:38

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Chalinolobus dwyeri	Large-eared Pied Bat	1.30	No		19.00	0.00	No	247
Miniopterus schreibersii subsp. oceanensis	Eastern Bentwing-bat	1.30	No		19.00	0.00	No	247
Petaurus norfolcensis	Squirrel Glider	2.20	No		19.00	0.00	No	418

BioBanking Credit Calculator

Ecosystem credits

Proposal ID : 0035/2017/4183MP

Proposal name : Liverpool wind farm south

Assessor name : Brooke Marshall

Assessor accreditation number : 0035

Tool version : v4.0

Report created : 30/01/2017 12:56

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
hunter	24.75	HU681_Moderate/Good	Blakely's Red Gum - Yellow Box grassy woodland of the New England Tableland Bioregion	Moderate/Good	Yes	1	3.55	91.67	0.00	91.67	266	266	Barking Owl	100.00	3.00	266
hunter	24.75	HU714_Moderate/Good	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Moderate/Good	Yes	1	11.15	91.67	0.00	91.67	836	836	Barking Owl	100.00	3.00	836
hunter	24.75	HU690_Moderate/Good_Other	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Moderate/Good_Other	Yes	1	77.26	100.00	0.00	100.00	6,273	6,273	Barking Owl	100.00	3.00	6,273
hunter	24.75	HU682_Moderate/Good	Blue-leaved Ironbark - Black Cypress Pine shrubby sandstone open forest in the southern Brigalow Belt South Bioregion (including Goonoo)	Moderate/Good	Yes	1	3.30	89.33	0.00	89.33	0	242	Barking Owl	61.90	3.00	242
hunter	24.75	HU707_Moderate/Good	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Moderate/Good	Yes	1	31.51	98.00	0.00	98.00	0	2,511	Barking Owl	100.00	3.00	2,511
hunter	24.75	HU707_Moderate/Good_Other	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Moderate/Good_Other	Yes	1	1.20	86.67	0.00	86.67	0	85	Barking Owl	100.00	3.00	85
hunter	24.75	HU678_Moderate/Good	Black Cypress Pine - ironbark +/- Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion	Moderate/Good	Yes	1	10.32	100.00	0.00	100.00	0	838	Barking Owl	100.00	3.00	838

Assessment circle name	Landsc ape score	Vegetation zone name	Vegetation type name	Condition	Red flag status	Management zone name	Management zone area	Current site value	Future site value	Loss in site value	Credit required for bio diversity	Credit required for TS	TS with highest credit requirement	Average species loss	Species TG Value	Final credit requirement for management zone
hunter	24.75	HU713_Moderate/Good	Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern Brigalow Belt South Bioregion and Upper Hunter region	Moderate/Good	Yes	1	30.04	100.00	0.00	100.00	0	2,439	Barking Owl	100.00	3.00	2,439
hunter	24.75	HU690_Moderate/Good	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Moderate/Good	Yes	1	36.16	100.00	0.00	100.00	2,936	2,936	Barking Owl	100.00	3.00	2,936
hunter	24.75	HU702_Moderate/Good	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bio	Moderate/Good	Yes	1	42.65	91.67	0.00	91.67	0	3,196	Barking Owl	100.00	3.00	3,196

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Proposal name : Liverpool wind farm south
Assessor name : Brooke Marshall
Assessor accreditation number : 0035
Tool version : v4.0
Report created : 30/01/2017 12:56

Scientific name	Common name	Species TG value	Identified population?	Can Id. popn. be offset?	Area / number of loss	Negligible loss	Red flag status	Number of credits
Swainsona sericea	Silky Swainson-pea	1.80	No		1.00	0.00	Yes	18
Calyptorhynchus lathami	Glossy Black-Cockatoo	1.80	No		19.00	0.00	No	342
Melithreptus gularis subsp. gularis	Black-chinned Honeyeater (eastern subspecies)	1.30	No		19.00	0.00	No	247
Ninox strenua	Powerful Owl	3.00	No		19.00	0.00	No	570
Nyctophilus corbeni	Corben's Long-eared Bat	2.10	No		19.00	0.00	No	399
Pomatostomus temporalis subsp. temporalis	Grey-crowned Babbler (eastern subspecies)	1.30	No		19.00	0.00	No	247
Stagonopleura guttata	Diamond Firetail	1.30	No		19.00	0.00	No	247
Tyto novaehollandiae	Masked Owl	3.00	No		19.00	0.00	No	570
Vespadelus troughtoni	Eastern Cave Bat	1.30	No		19.00	0.00	Yes	247