



Great Western Highway Upgrade Program – Little Hartley to Lithgow (West Section)

Biodiversity Addendum Report

Transport for NSW | April 2022

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Prepared by Arcadis Australia Pacific and Transport for NSW

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1. Introduction

1.1 Background

This report has been drafted as an addendum to the Biodiversity Development Assessment Report (BDAR) (Arcadis, 2021) prepared for Transport for New South Wales (Transport) as part of the Review of Environmental Factors (REF) for the Great Western Highway Upgrade: Little Hartley to Lithgow (West Section) project ('the proposal') report.

Biodiversity impacts associated with the proposal were identified in Appendix D: Biodiversity development assessment report (BDAR) of the REF and were also summarised in Chapter 6.1 of the REF.

The REF was placed on public exhibition from 23 November 2021 to 16 January 2022. Public exhibition provides the community, interested parties and key stakeholders (including government agencies and Councils) with an understanding of the project and the opportunity to make a submission on the REF.

Several species identified as requiring assessment have seasonal survey requirements, as outlined in Section 5.3.2 of the BDAR (Arcadis, 2021), that were unable to be met prior to the exhibition of the REF. Additionally, a number of submissions have been received that include concerns that the impacts on the Platypus (*Ornithorhynchus anatinus*) were insufficiently explored, triggered by recent sightings of the species recorded by community members in the River Lett within the subject land. Platypus are not listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), however, are protected in New South Wales (NSW) under the BC Act. In response to these submissions the species has been considered in the current assessment.

1.2 Purpose of this assessment

This addendum report has been prepared to provide results of targeted species surveys, additional vegetation surveys, updated assessment of impacts and relevant additional mitigation measures. Subsequent offset requirements will also be outlined. Table 1-1 summarises the assessment requirements remaining following BDAR submission.

Table 1-1 Tasks requiring completion

Subject	Required tasks	Where addressed in this report
Native vegetation	Complete BAM plots	Section 2.1.1
	Confirming PCT occurrence and total areas	Section 2.2.1
	Confirming TEC occurrence and total areas	Section 2.2.3
Threatened flora	Conducting targeted surveys to detect the following threatened flora species within areas of suitable habitat to correspond with seasonal survey guidelines:	Section 3.1.1
	<i>Acacia flocktoniae</i> , <i>Asterolasia buxifolia</i> , <i>Baloskion longipes</i> , <i>Boronia deanei</i> , <i>Eucalyptus pulverulenta</i> , <i>Kunzea cabbagei</i> , <i>Persoonia glaucescens</i> , <i>Swainsona sericea</i> , <i>Thesium australe</i> and <i>Veronica blakelyi</i>	Section 3.2.1 Section 4.2.1
	Targeted surveys:	Section 3.1.2

Subject	Required tasks	Where addressed in this report
	<ul style="list-style-type: none"> - to detect breeding of Gang-gang Cockatoos (<i>Callocephalon fimbriatum</i>) - to detect Booroolong Frog (<i>Litoria booroolongensis</i>) on the subject land, specifically around identified areas of habitat at River Lett - for threatened microbats within culverts in the subject land, with a focus on Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>) 	<p>Section 3.2.3</p> <p>Section 4.2.2</p>
Locally significant fauna	Targeted surveys for Platypus (<i>Ornithorhynchus anatinus</i>) at River Lett	<p>Section 3.1.3</p> <p>Section 3.2.3</p> <p>Section 4.2.3</p>

1.3 Subject land

The term used throughout the report to refer to the location of the proposal is 'subject land'. It encompasses the construction and operational footprints of the proposal and is a term prescribed by the Biodiversity Assessment Method (BAM) (DPIE (EES), 2020). The subject land is outlined in Figure 1-2 of the BDAR (Arcadis, 2021).

1.4 Personnel

Preparation of this addendum report including the field surveys the were conducted by appropriately qualified and experienced environmental professionals, ecologists and accredited people as demonstrated in Table 1-2 below.

Table 1-2 Personnel

Name	Role	Qualifications and experience
Kate Carroll	Flora and fauna surveys	<p>Bachelor of Science (Ecology) (Hons)</p> <p>Accredited Biodiversity Assessment Method Assessor (Accreditation number BAAS17070)</p> <p>Kate has delivered biodiversity assessments for a range of projects, with a focus on linear infrastructure, including road, rail, renewable energy, gas, urban development and waste over the past 14 years. She has strong experience in threatened fauna survey and assessment. Kate is accredited to apply the BAM under the NSW BC Act.</p>
Jane Rodd	Flora surveys	<p>Bachelor of Science (Ecology)</p> <p>Accredited Biodiversity Assessment Method Assessor (Accreditation number BAAS17030)</p> <p>Jane Rodd is a Principal Ecologist with over twenty years of experience in biodiversity assessment, maintaining a strong focus on impact assessment and biodiversity offsetting. She has completed specialist assessments for several major</p>

Name	Role	Qualifications and experience
		road and rail infrastructure projects in the Sydney region and across NSW in recent years. Jane is accredited to apply the BAM under the NSW BC Act.
Nathan Banks	Flora and fauna surveys, reporting	<p>Bachelor of Zoology</p> <p>Nathan is an experienced ecologist and has prepared a variety of ecological deliverables for a suite of clients and has been involved in large, complex projects across NSW. He is experienced in applying the BAM and has a good understanding of environmental planning legislation, policy, biodiversity assessment and threatened species survey guidelines in New South Wales.</p>
William Terry	Fauna surveys, reporting	<p>Bachelor of Biological Sciences (Zoology), Post-graduate Diploma of Environmental Management and Ecology (Zoology)</p> <p>William Terry is a Senior Ecologist with over 12 years' experience conducting field surveys and ecological research. William has lead surveys for threatened species. He has produced several peer reviewed publications on managing threatened species in disturbed landscapes and road construction.</p>
Taylor Bliss-Henaghan	Fauna surveys, reporting	<p>Master of Conservation Biology, Bachelor of Science (Zoology)</p> <p>Taylor is a graduate environmental consultant at Arcadis, with experience in ecological assessments. She has worked on large scale infrastructure projects undertaking targeted threatened species surveys and reporting, GIS mapping and data analysis, including the preparation of a BDAR and management of BAM data.</p>
Thea Kane	Flora surveys, reporting	<p>Bachelor of Environmental Management (Geography)</p> <p>Thea is a graduate environmental consultant at Arcadis, with experience in ecological assessments. She has worked on large scale infrastructure projects across NSW undertaking targeted threatened species surveys and reporting, GIS mapping and data analysis, including the preparation of BDAR and management of BAM data.</p>

2. Native vegetation

2.1 Methodology

Methodologies applied to complete the remaining flora and fauna surveys to satisfy the BAM (DPIE (EES), 2020) were consistent with those identified in the BDAR. Where additional survey methodologies have been employed, they have been described within this addendum report. Ground-truthing of vegetation on the subject land was conducted over four days on the following dates:

- 20.12.2021
- 21.12.2021
- 24.01.2021
- 25.01.2021

Weather conditions on the dates of surveys are included in Table 3-1.

2.1.1 Vegetation surveys

Nine 0.1 hectare plots, additional to the 27 identified in the BDAR, were used to sample vegetation on the subject land (Figure 2-1). The methodology for conducting plots is summarised in Section 4.1.2 of the BDAR. The completion of these nine plots fulfils the survey effort guidelines identified in Section 4.3.4 of the BAM to sample native vegetation across the subject land, and includes plot requirements for vegetation zones that contain multiple threatened ecological communities (TECs). A summary of the plots used to survey vegetation zones across the subject land is displayed in Table 2-1 below.

Table 2-1 Comparison of number of plots required and completed per vegetation zone

Vegetation zone	Vegetation zone area (hectares (ha))	BAM plots required	Bam plots completed	Plots (completed prior to submission)	Plots (completed following submission)
85 (moderate)	3.95	2	2	Q18	Q29
85 (disturbed)	0.35	1	1	Q09	-
731 (good)	12.44	3	3	Q06, Q07	Q34
731 (variant – good)	3.08	2	2	Q22, Q25	-
731 (moderate)	12.09	3	3	Q21, Q27	Q32
732 (moderate)	4.98	2	2	Q08, Q23	-
963 (good)	1.92 (1.04 in exclusion zone)	1	1	Q13	-
1103 (disturbed) Tablelands Basalt Forest TEC	1.32	1	1	Q03	-
1103 (disturbed) Box Gum Woodland TEC	0.52 (0.14 in exclusion zone)	1	1	-	Q35

Vegetation zone	Vegetation zone area (hectares (ha))	BAM plots required	Bam plots completed	Plots (completed prior to submission)	Plots (completed following submission)
1103 (good) Tablelands Basalt Forest TEC	8.04	3	4	Q04, Q11, Q16	Q28
1103 (good) Box Gum Woodland TEC	5.00 (0.9 in exclusion zone)	2	3	Q01, Q02, Q05	-
1103 (low-moderate) Tablelands Basalt Forest TEC	3.97	2	2	Q19, Q20	-
1103 (low-moderate) Box Gum Woodland TEC	0.82	1	1	Q26	-
1103 (moderate) Tablelands Basalt Forest TEC	6.31	3	3	-	Q30, Q31, Q36
1103 (moderate) Box Gum Woodland TEC	1.26 (0.74 in exclusion zone)	1	2	Q10, Q15	-
1155 (moderate)	10.45 (0.49 in exclusion zone)	3	4	Q12, Q14, Q17, Q24	-
1330 (moderate) Box Gum Woodland TEC	1.90	1	1	-	Q33

2.1.2 Limitations

Field surveys to ground truth native vegetation was unable to be completed for several properties due to access restrictions by the landholders. Vegetation mapping for these areas of the subject land has been based on existing mapping paired with observations made from outside of the properties. Property lots not surveyed included:

- Lot 1 / 587763; Lot 2,3,4 DP1130441- 2200 Great Western Highway, Little Hartley NSW 2790
- Lot 10 DP1134053 'Fernhill' 3109 Great Western Highway, South Bowenfels NSW 2790
- Lot 154 DP1122453 'Misty View' 3055 Great Western Highway, Hartley NSW 2790

A recommendation to conduct additional survey, following acquisition of the properties, to ground-truth vegetation is included in Section 5.

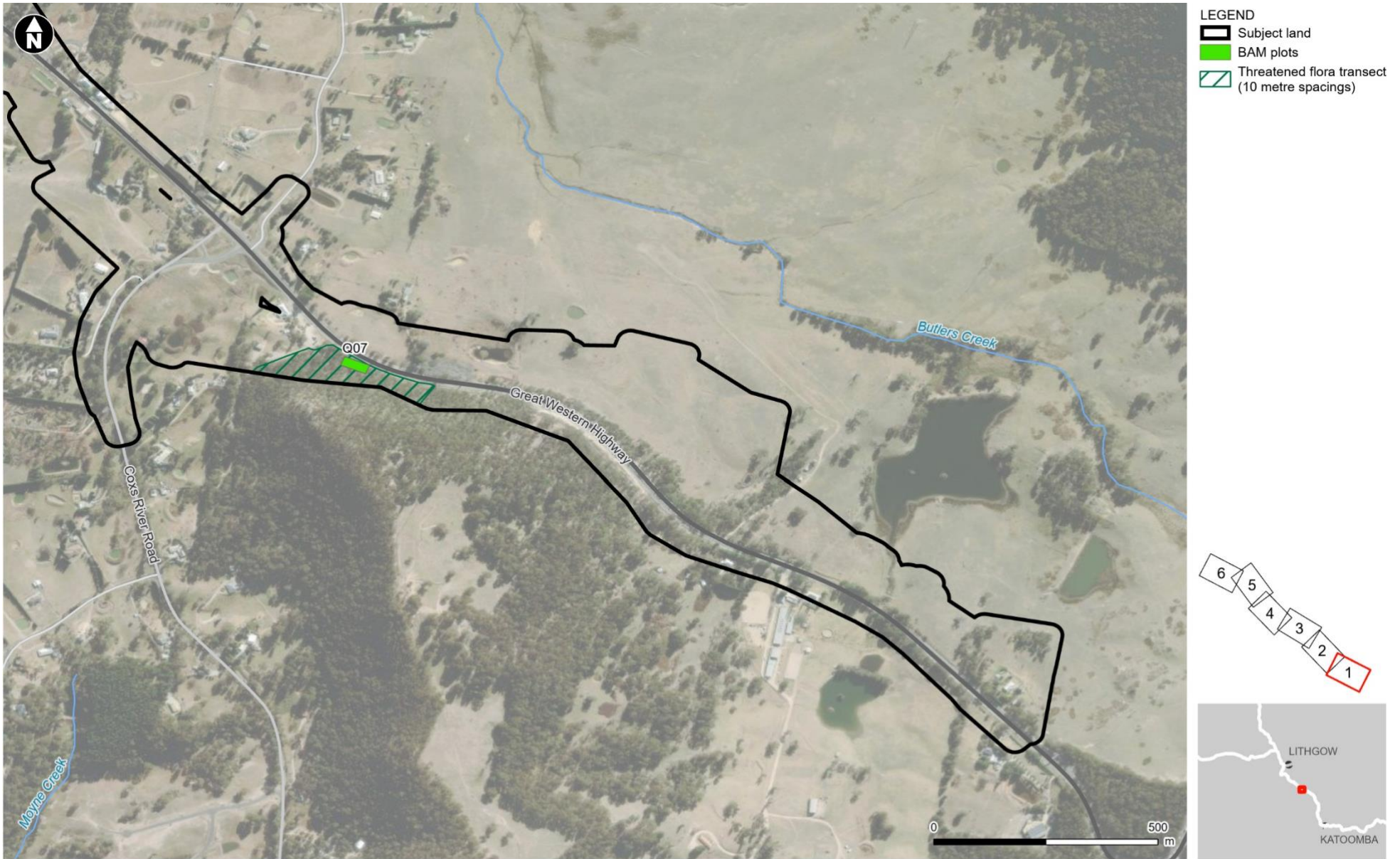


Figure 2-1 Flora survey effort within the subject land (1 of 6)

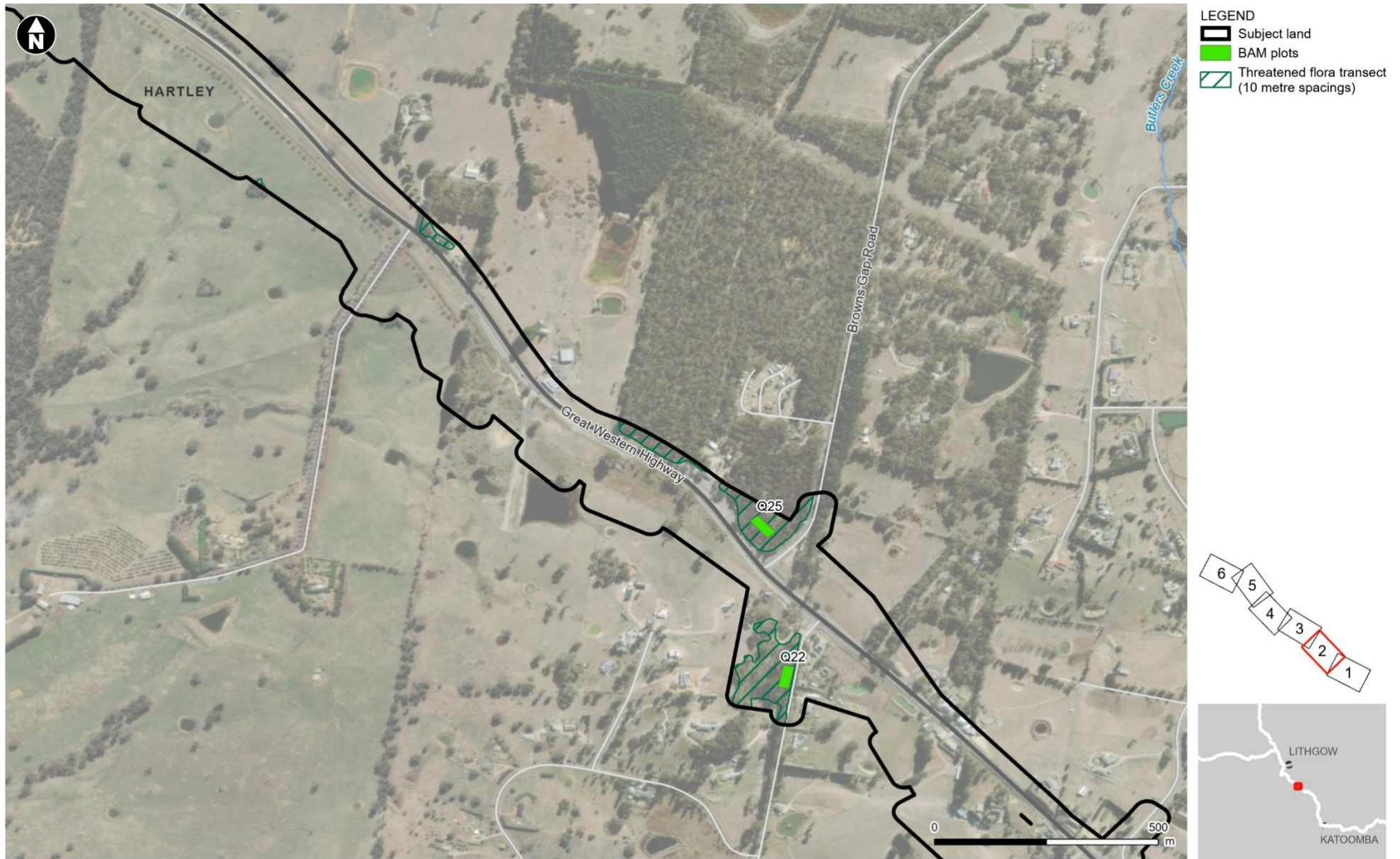
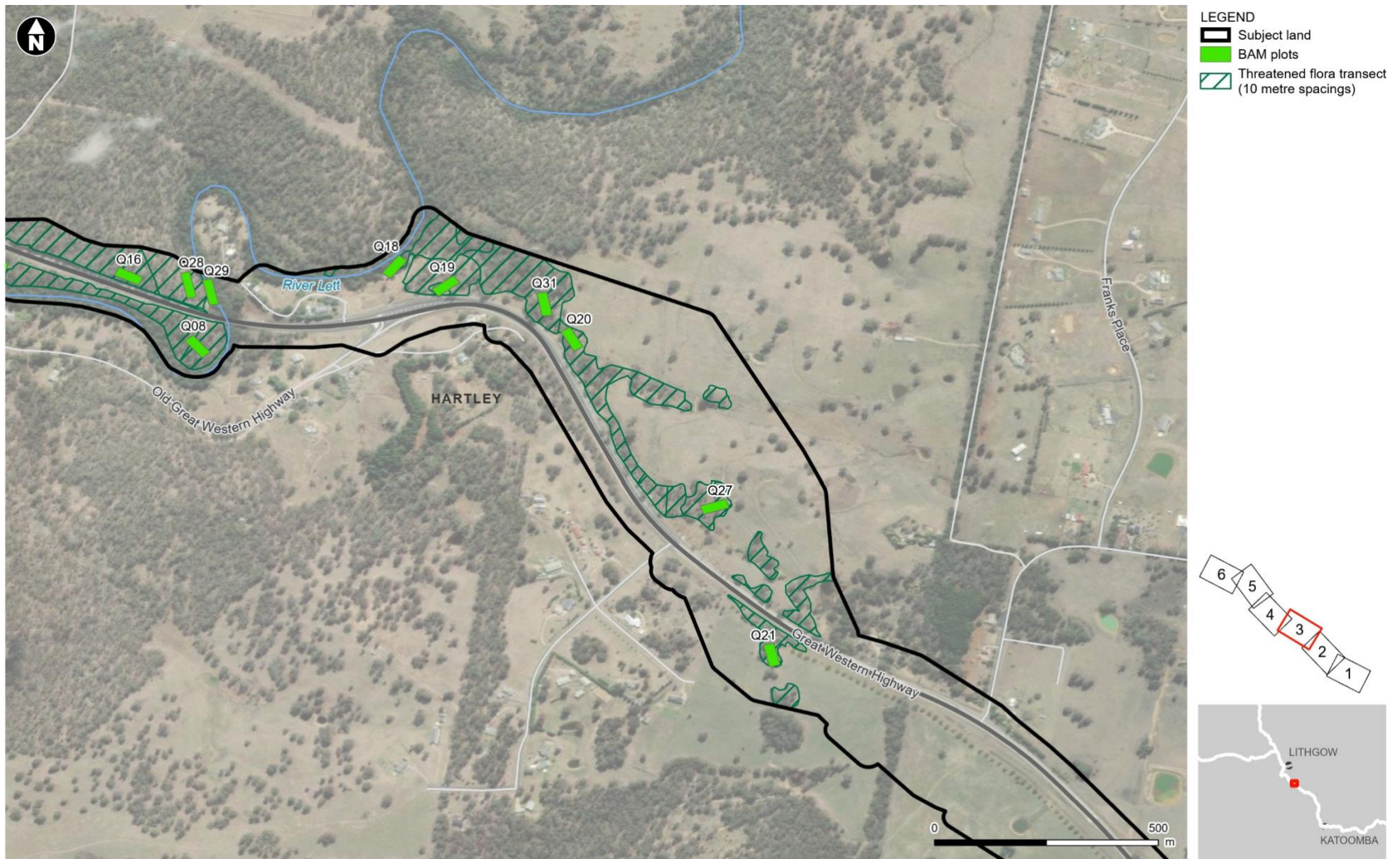


Figure 2-1 Flora survey effort within the subject land (2 of 6)



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Figure 2-1 Flora survey effort within the subject land (3 of 6)

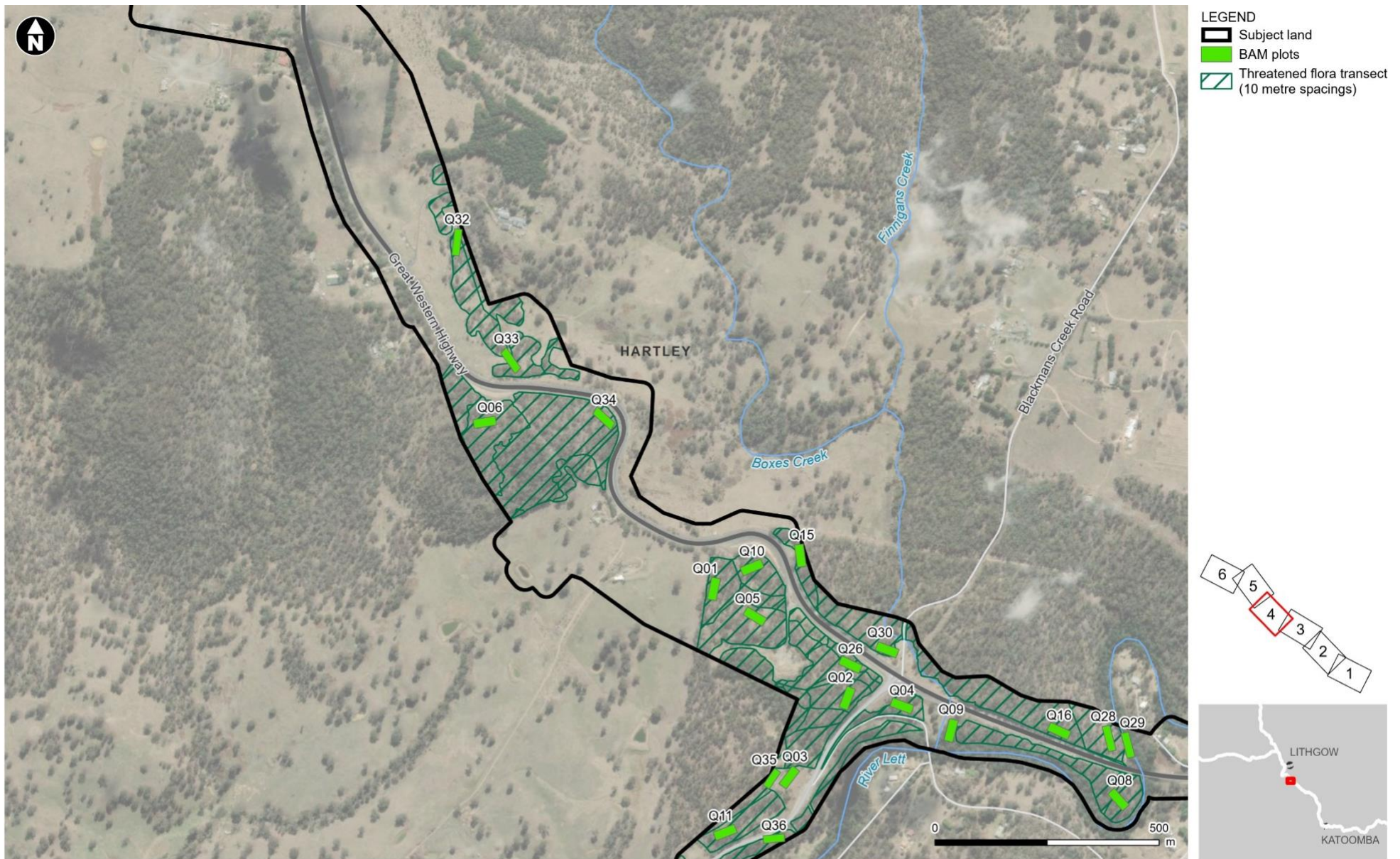
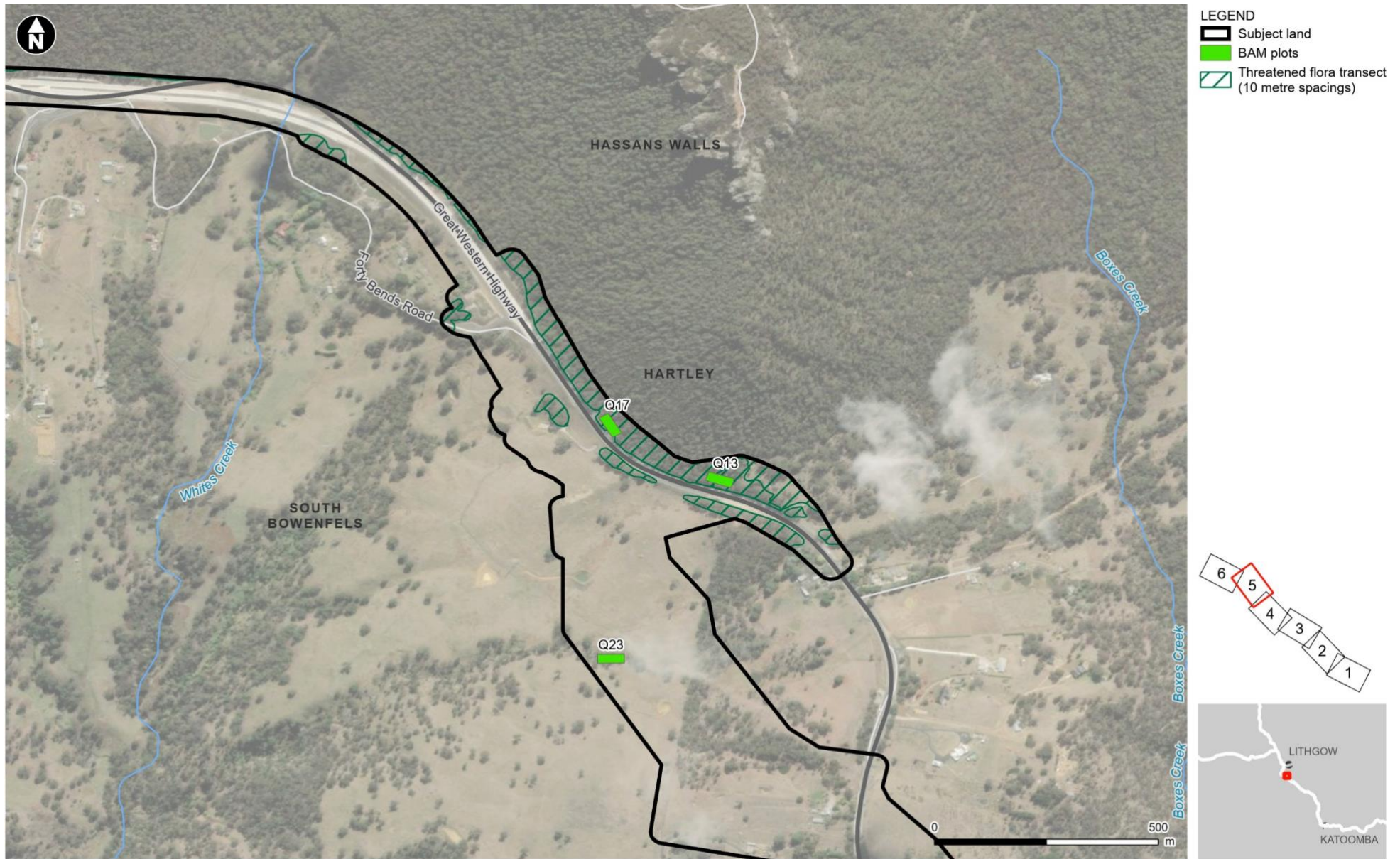


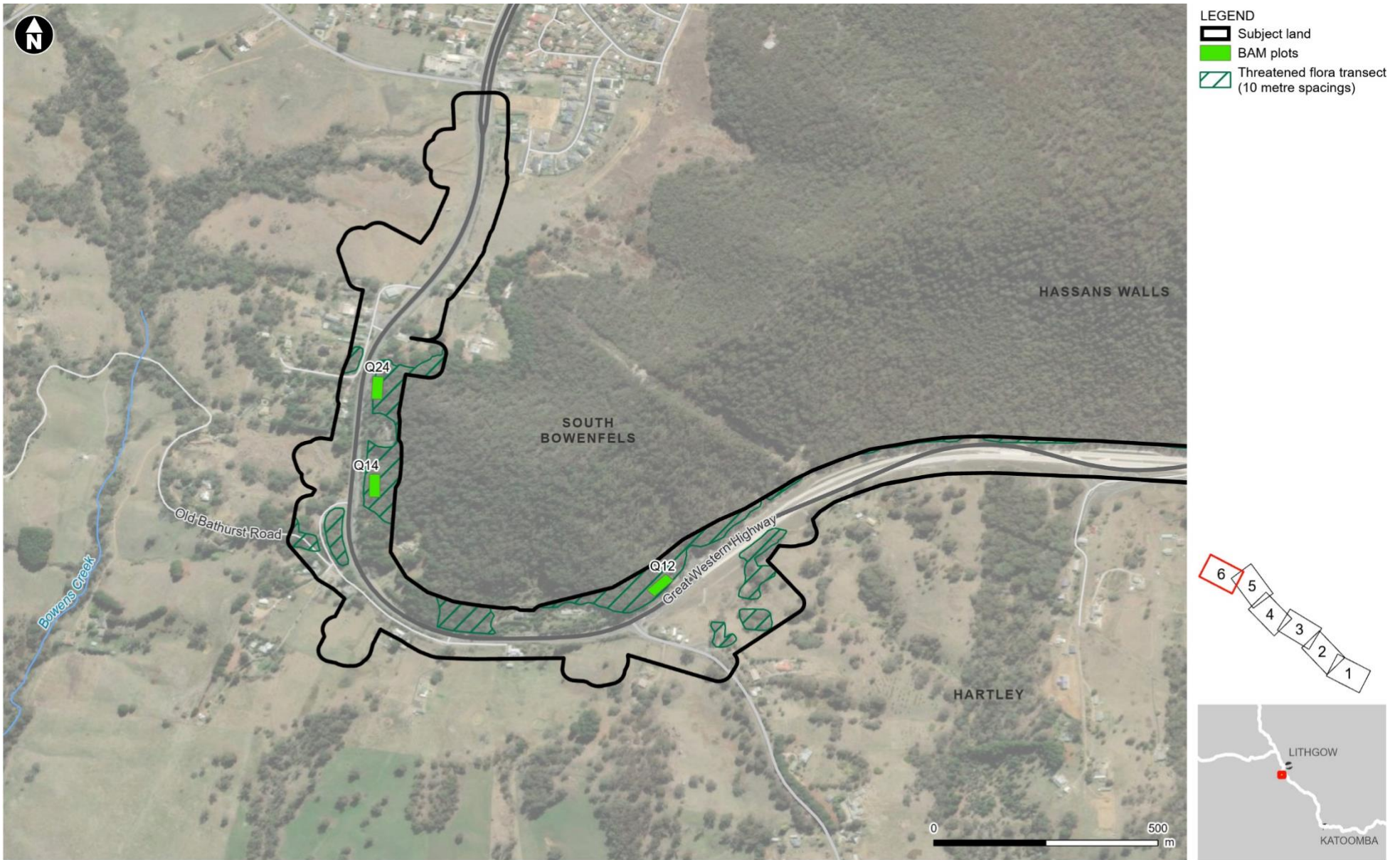
Figure 2-1 Flora survey effort within the subject land (4 of 6)

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Figure 2-1 Flora survey effort within the subject land (5 of 6)



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Figure 2-1 Flora survey effort within the subject land (6 of 6)

2.2 Results

2.2.1 Ground-truthed Plant Community Types

Regional vegetation maps, as well as previous studies, were ground-truthed and PCT boundaries and classifications were refined to reflect site observations. Majority of native vegetation surveys including vegetation plots were conducted prior to the BDAR finalisation in November 2021. Some areas of the subject land with prior restricted access, were visited between December 2021 and January 2022 to complete ground-truthing of vegetation mapping and fulfil plot requirements of Table 3 of the BAM (DPIE (EES), 2020).

The occurrence of PCTs across the subject land was similar BDAR mapping with some minor changes occurring to the extent of some patches. One additional PCT was identified on the northern side of the highway, centrally within the alignment:

- 1330 Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion

A description of PCT 1330 is given in Section 2.2.2. All other PCTs on the subject land listed in Table 2-2 have been described within the BDAR and are mapped in Figure 2-2.

Table 2-2 Plant community types in the subject land

PCT code	Plant community type (PCT)	Threatened ecological community?	Area (ha) mapped within the subject land
85	River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	Not listed	4.30
731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	Not listed	27.61
732	Broad-leaved Peppermint - Ribbon Gum grassy open forest in the north east of the South Eastern Highlands Bioregion	Not listed	4.98
963	Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains; Sydney Basin Bioregion	Not listed	1.92
1103	Ribbon Gum - Yellow Box grassy woodland on undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion	Endangered (BC Act): Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Critically Endangered (BC Act): White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland	27.25

PCT code	Plant community type (PCT)	Threatened ecological community?	Area (ha) mapped within the subject land
1155	Silvertop Ash - Narrow-leaved Peppermint open forest on ridges of the eastern tableland, South Eastern Highlands Bioregion and South East Corner Bioregion	Not listed	10.45
1330	Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion	Critically Endangered (BC Act): White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1.90
Total Native vegetation			78.41
N/A	Non-native		215.31

2.2.2 Vegetation zones

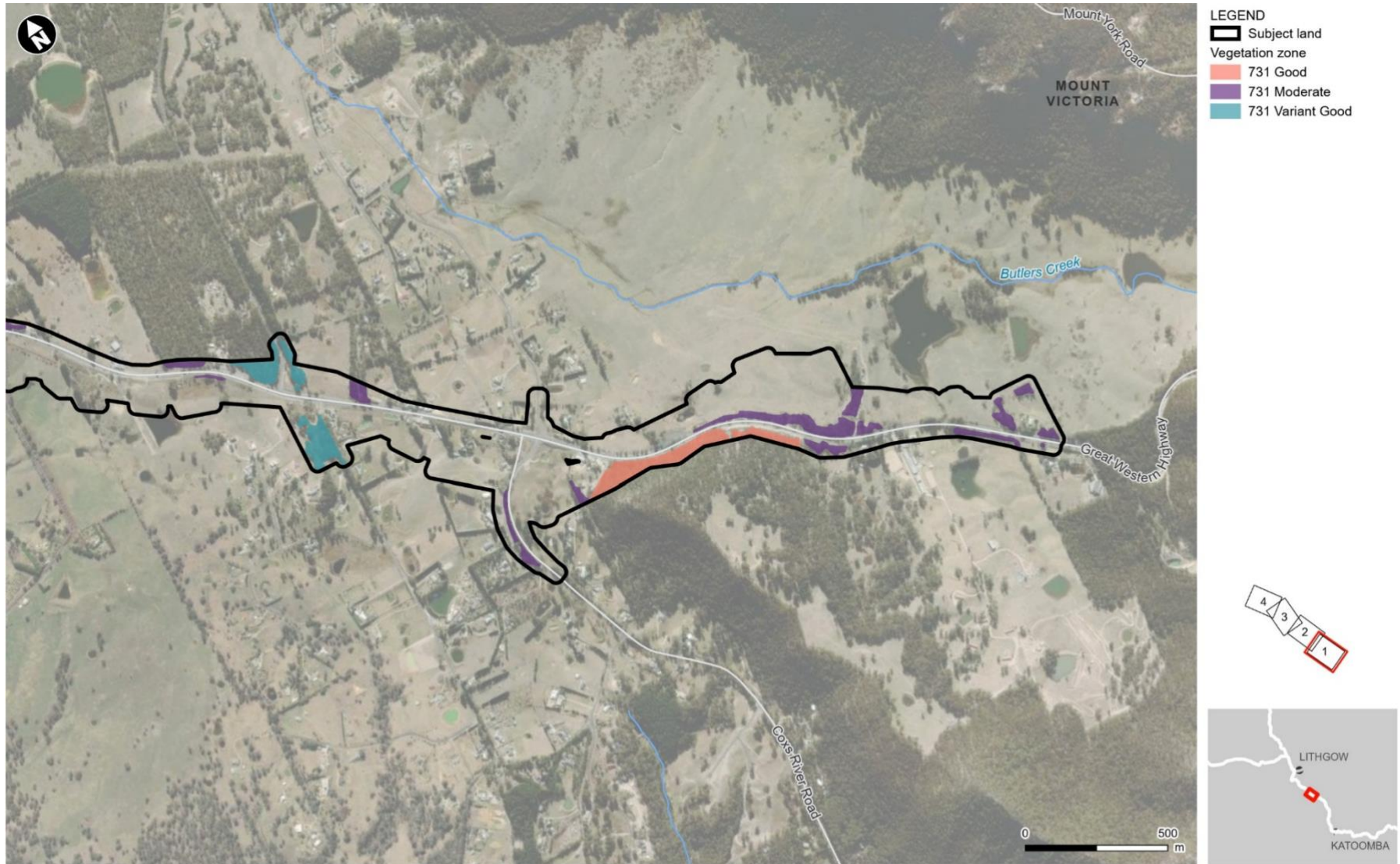
One vegetation zone was established for PCT 1330 (moderate) following plot sampling, bringing the total number of vegetation zones on the subject land to 13. A description of this vegetation zone is included below. Descriptions for all other vegetation zones on the subject land is included in Section 3.3.3 of the BDAR.

The vegetation zones and vegetation integrity scores (as determined using the BAM calculator) for each PCT are listed in Table 2-3.

Table 2-3 Vegetation zones in the subject land

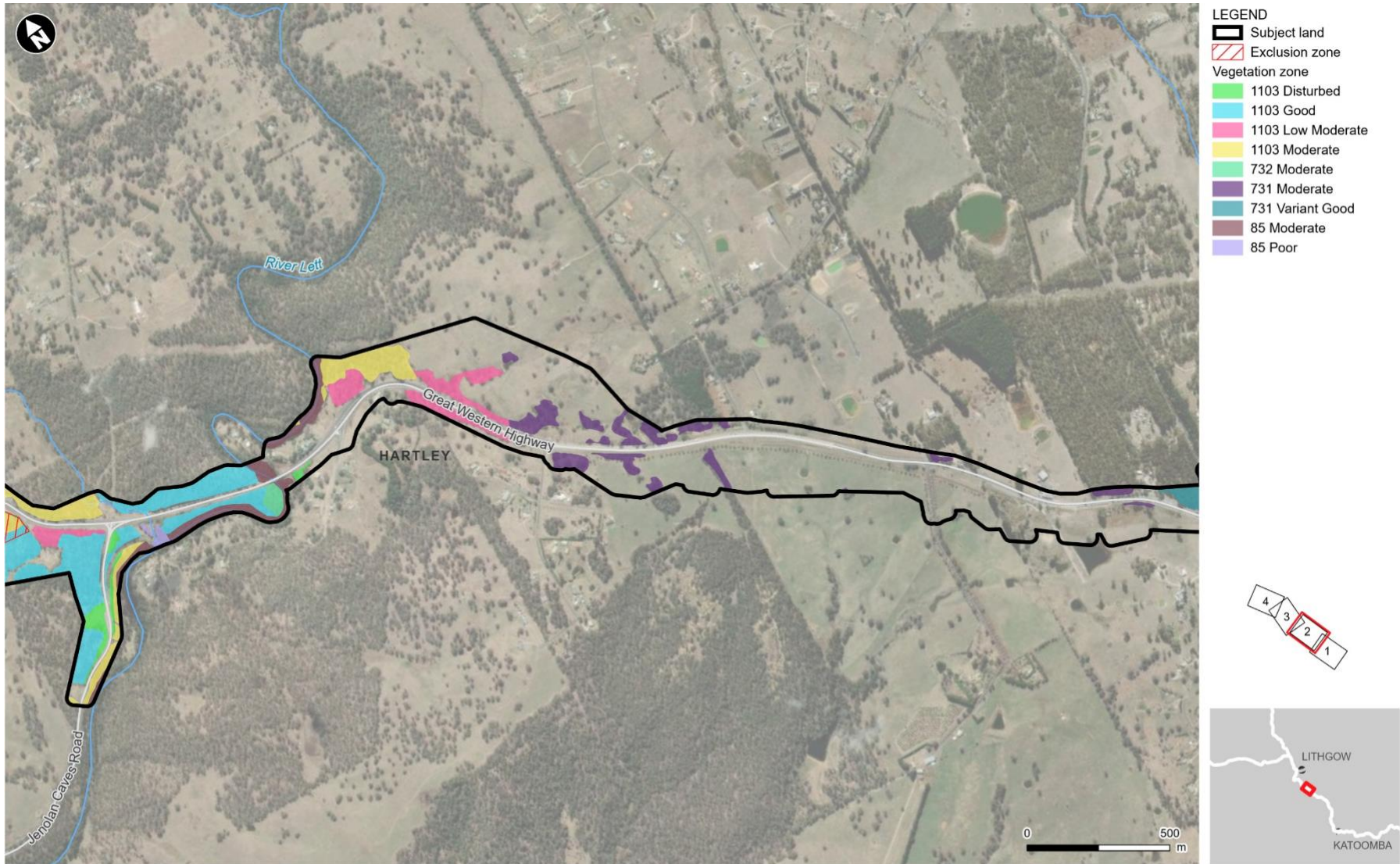
Plant community type (PCT)	Vegetation zone	Vegetation integrity score	Area within subject land (ha)
Bathurst Subregion / South Eastern Highlands Bioregion			
River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion	85 (moderate)	78.4	3.95
(85)	85 (disturbed)	34.6	0.35
Broad-leaved Peppermint - Ribbon Gum grassy open forest in the north east of the South Eastern Highlands Bioregion (732)	732 (moderate)	64.2	4.98
Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains; Sydney Basin Bioregion (963)	963 (good)	81.4	1.92
Ribbon Gum - Yellow Box grassy woodland on	1103 (disturbed) Tablelands Basalt Forest TEC	9.9	1.32

Plant community type (PCT)	Vegetation zone	Vegetation integrity score	Area within subject land (ha)
undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion (1103)	1103 (disturbed) Box Gum Woodland TEC	3.6	0.52
	1103 (good) Tablelands Basalt Forest TEC	79.8	8.04
	1103 (good) Box Gum Woodland TEC	68.6	5.00
	1103 (low-moderate) Tablelands Basalt Forest TEC	43.4	3.97
	1103 (low-moderate) Box Gum Woodland TEC	33.2	0.82
	1103 (moderate) Tablelands Basalt Forest TEC	70.9	6.31
	1103 (moderate) Box Gum Woodland TEC	66.8	1.26
Burraborang subregion / Sydney Basin Bioregion			
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (731)	731 (good)	72.1	12.44
	731 (moderate)	67.2	12.09
	731 (variant – good)	83.7	3.08
Silvertop Ash - Narrow-leaved Peppermint open forest on ridges of the eastern tableland, South Eastern Highlands Bioregion and South East Corner Bioregion (1155)	1155 (moderate)	63.2	10.45
Yellow Box – Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)	1330 (moderate)	67.7	1.90
Total (Bathurst Subregion / South Eastern Highlands Bioregion)			38.45
Total (Burraborang subregion / Sydney Basin Bioregion)			39.96
Total (all bioregions)			78.41



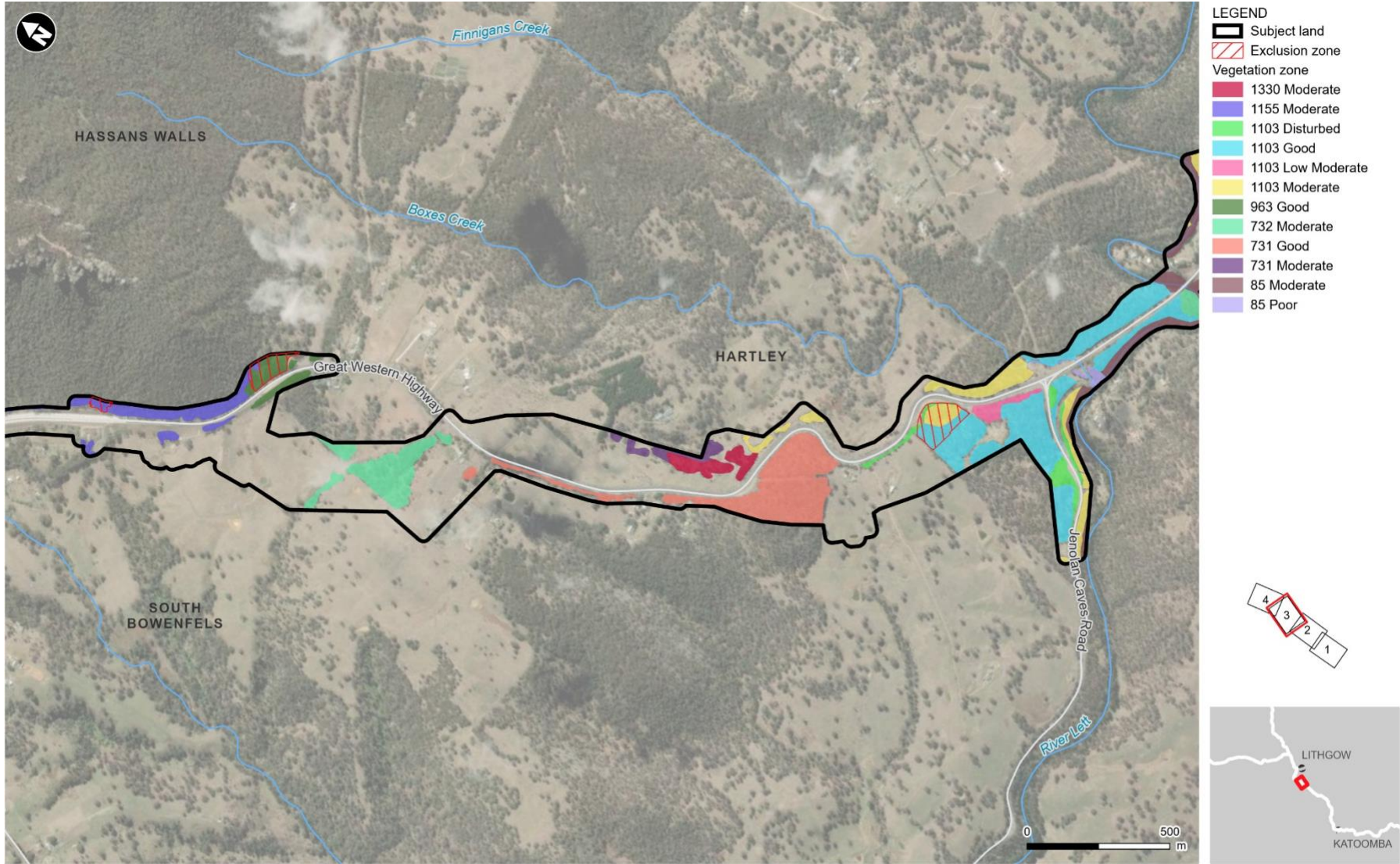
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Figure 2-2 Plant community types recorded in the subject land (1 of 4)



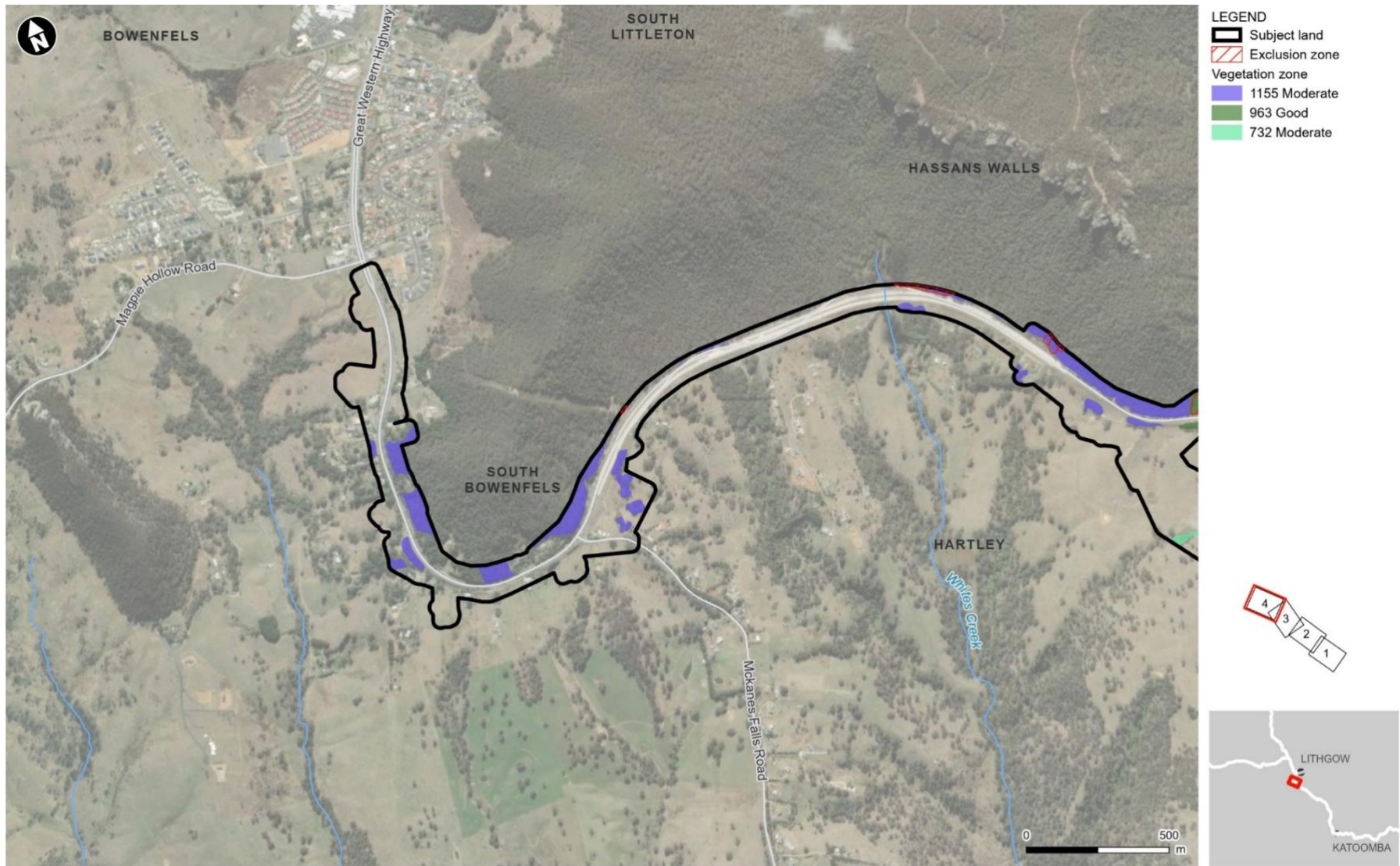
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Figure 2-2 Plant community types recorded in the subject land (2 of 4)



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Figure 2-2 Plant community types recorded in the subject land (3 of 4)



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Figure 2-2 Plant community types within the subject land (4 of 4)

Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion

Vegetation formation: Grassy Woodlands

Vegetation class: Southern Tableland Grassy Woodlands

PCT: 1330

Conservation status: BC Act – Critically Endangered, EPBC Act – Critically Endangered

Estimate of percent cleared: 94 percent

Extent in the subject land: 1.90 hectares

Table 2-4 Vegetation integrity scores for PCT 1330

Vegetation zone	Plots completed	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score
1330 (moderate)	1	76.1	76	53.7	67.7

Table 2-5 Flora species recorded within PCT 1330

Growth form	Typical species
Trees	<i>Eucalyptus blakelyi</i> , <i>Eucalyptus bridgesiana</i> , <i>Eucalyptus melliodora</i> , <i>Eucalyptus viminalis</i> , <i>Eucalyptus macrorhyncha</i> .
Shrubs	<i>Acacia dealbata</i>
Grass and grass like	<i>Themeda triandra</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i> .
Forb	<i>Hydrocotyle laxiflora</i> , <i>Einadia hastata</i> , <i>Geranium solanderi</i> , <i>Rumex brownii</i> , <i>Solanum prinophyllum</i> , <i>Acaena novae-zelandiae</i> , <i>Oxalis perennans</i> , <i>Veronica plebeia</i> .
Fern	<i>Cheilanthes sieberi</i> .
Other	<i>Clematis aristate</i> , <i>Desmodium varians</i> , <i>Glycine tabacina</i> .
Exotics	<i>Anthoxanthum odoratum</i> , <i>Eragrostis curvula</i> , <i>Rubus anglocandicans</i> , <i>Setaria parviflora</i> , <i>Conyza bonariensis</i> .

Description: Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (PCT 1330) is described as a woodland with a sparse shrub layer and a dense grassy understorey occurring on loamy soils derived predominantly from fine-grained sedimentary or acid-volcanic substrates. It is found on undulating country on the tablelands between Hartley and Braidwood and is likely to extend west. PCT 1330 usually occurs about 600 metres to 900 metres above mean sea level (amsl) and receives 650 – 900 millimetres annual precipitation. It is distributed almost exclusively on freehold land and is subject to continuing small-scale clearing, grazing and weed invasion (DPIE (EES), 2022).

The characteristic canopy species of this PCT include *Eucalyptus blakelyi* (Blakely’s Red Gum), *Eucalyptus bridgesiana* (Apple Box), *Eucalyptus melliodora* (Yellow Box), *Eucalyptus dives* (Broad-leaved Peppermint) and *Acacia dealbata* (Silver Wattle). The ground layer is dominated by grass and forb species including *Cymbopogon refractus* (Barbed Wire Grass), *Themeda triandra* (Kangaroo Grass), *Microlaena stipoides*

var. *stipoides* (Weeping Grass), *Echinopogon ovatus* (Hedgehog Grass), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat Rush), *Dichondra repens* (Kidney Weed) and *Rumex brownii* (Swamp Dock) (DPIE (EES), 2022)

PCT 1330 on the subject land occurs in one condition and represents a single vegetation zone: 1330 (moderate) (Plate 2-1). Vegetation zone 1330 (moderate) is present as two closely located patches, covering 1.90 hectares and occurs at an elevation between 810 and 850 amsl. The patch of 1330 (moderate) on the subject land has a canopy dominated with Blakely's Red Gum with a scattering of other tree species including Apple Box, Board-leaved Peppermint and Yellow Box. The shrubs stratum is largely absent with sparsely occurring Silver Wattle. The ground stratum is diverse with a mixture of native grasses, forbs and ferns including Weeping Grass, *Wahlenbergia gracilis* (Sprawling Bluebell), *Hydrocotyle laxiflora* (Stinking Pennywort), *Carex inversa* (Knob Sedge), and *Dichelachne micrantha* (Short-hair Plume Grass).

Exotic species are present within the assemblages of 1330 (moderate). The exotic pasture grass *Anthoxanthum odoratum* (Sweet Vernal Grass) displays a high cover in some areas, while *Eragrostis curvula* (African lovegrass), *Rubus anglocandicans* (Blackberry), *Ehrharta erecta* (Panic Veldt Grass), *Conyza bonariensis* (Fleabane) and *Setaria parviflora* (Marsh Bristle Grass) are also frequently occurring.



Plate 2-1 PCT 1330 (moderate) within the subject land (Q33)

2.2.3 Threatened ecological communities

Section 4.4 of the BDAR identifies two threatened ecological communities (TECs) as occurring within the subject land, based on the associations listed with PCT 1103 in the BioNet Vegetation Database:

- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregion (hereafter referred to as Tableland Basalt Forest) – listed as Endangered under the BC Act
- 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 (hereafter referred to as White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland) – listed as Critically Endangered under the BC Act and EPBC Act.

Further investigation of vegetation on the subject land following submission of the BDAR has identified additional areas of both TECs.

One patch of vegetation north-west of the highway crossing at River Lett was reclassified from vegetation zone 732 (moderate) to 1103 (good) following analysis of plot monitoring results paired with site observations on the dominance of *Eucalyptus melliodora* (Yellow Box). Where *Eucalyptus melliodora* (Yellow Box) is not the dominant / co-dominant canopy species in occurrences of PCT 1103 the Tableland Basalt Forest TEC is present. Justification for identifying PCT 1103 as the TEC is included in Table 3-19, Section 3.4 of the BDAR. The total area of Tableland Basalt Forest on the subject land has increased to 19.02 hectares.

One patch of native vegetation located centrally within the subject land, north-west of the Jenolan Caves Road and Great Western Highway junction, was identified as PCT 1330. This PCT is listed as associated with the TEC White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland. Comparison of attributes of PCT 1330 on the subject land (including elevation, rainfall, vegetation characteristics) with relevant paragraphs of the BC Act Final Determination for White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland is presented in Table 2-6.

Table 2-6 Comparison of PCT 1330 in the subject land with relevant paragraphs of the BC Act Final Determination for White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland

Extract from Final Determination	Comparison with areas of PCT 1330 in the subject land
<p>1. White Box Yellow Box Blakely’s Red Gum Grassy Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170 metres to c. 1200 m, on the northern tablelands (Beadle, 1981). The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Bioregions are defined in Thackway and Cresswell (1995).</p>	<p>The subject land is located on the tablelands west of the Blue Mountains. The mean annual rainfall at Lithgow (Birdwood Street) (weather station 063224) is 861.8 mm (BoM, 2022). The altitude of the subject land ranges from 700 to 950 metres. The subject land is located at the boundary of the Sydney Basin and South Eastern Highlands bioregions.</p>
<p>2. White Box Yellow Box Blakely’s Red Gum Grassy Woodland includes those woodlands where the characteristic tree species include one or more of the following species in varying proportions and combinations - <i>Eucalyptus albens</i> (White Box), <i>Eucalyptus melliodora</i> (Yellow Box) or <i>Eucalyptus</i></p>	<p><i>blakelyi</i> (Blakely’s Red Gum) was the dominant tree within the two patches of PCT 1330 north-west of the junction between the existing Great Western Highway and Jenolan Caves Road. The ground layer of PCT 1330 is characterised by grasses and herbaceous species.</p>

Extract from Final Determination	Comparison with areas of PCT 1330 in the subject land
<p><i>blakelyi</i> (Blakely's Red Gum). Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing or thinning and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common.</p>	
<p>3. White Box Yellow Box Blakely's Red Gum Grassy Woodland is characterised by the following assemblage of species. [96 species listed]</p>	<p>Of the 96 species listed, a total of 30 (31%) were recorded in the subject land, with 22 (23%) recorded in areas mapped as PCT 1330.</p>

The subject land is at the eastern edge of the central tablelands and the annual mean rainfall in this area is above that specified in the Final Determination. However, given the dominance of *Eucalyptus blakelyi* and the grassy woodland structure of PCT 1330, this PCT likely meets the BC Act criteria for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

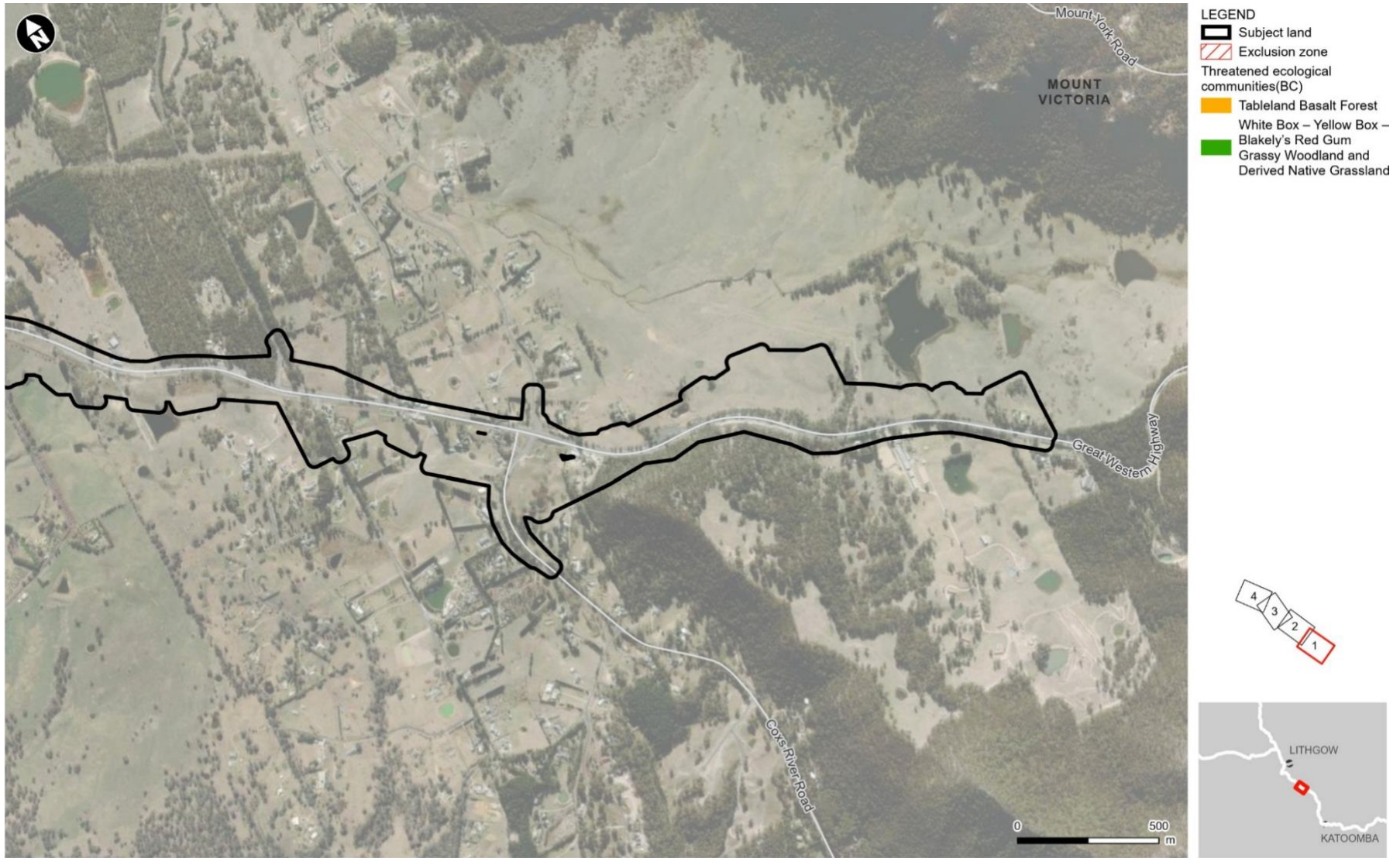
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland on the subject land includes patches of PCT 1103 and PCT 1330. The addition of 1.90 hectares of PCT 1330 which qualifies for listing as White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland has increased the total occurrence of this critically endangered TEC on the subject land to 9.5 hectares.

In order to determine whether the patch of PCT 1330 within the subject land meets the criteria for the EPBC Act listed TEC, a comparison of plot data (Q33) with the flowchart in the EPBC Act policy statement was undertaken. The results of the comparison are shown below in Table 2-7.

Table 2-7 Comparison of vegetation plots in PCT 1330 with EPBC flowchart criteria for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland

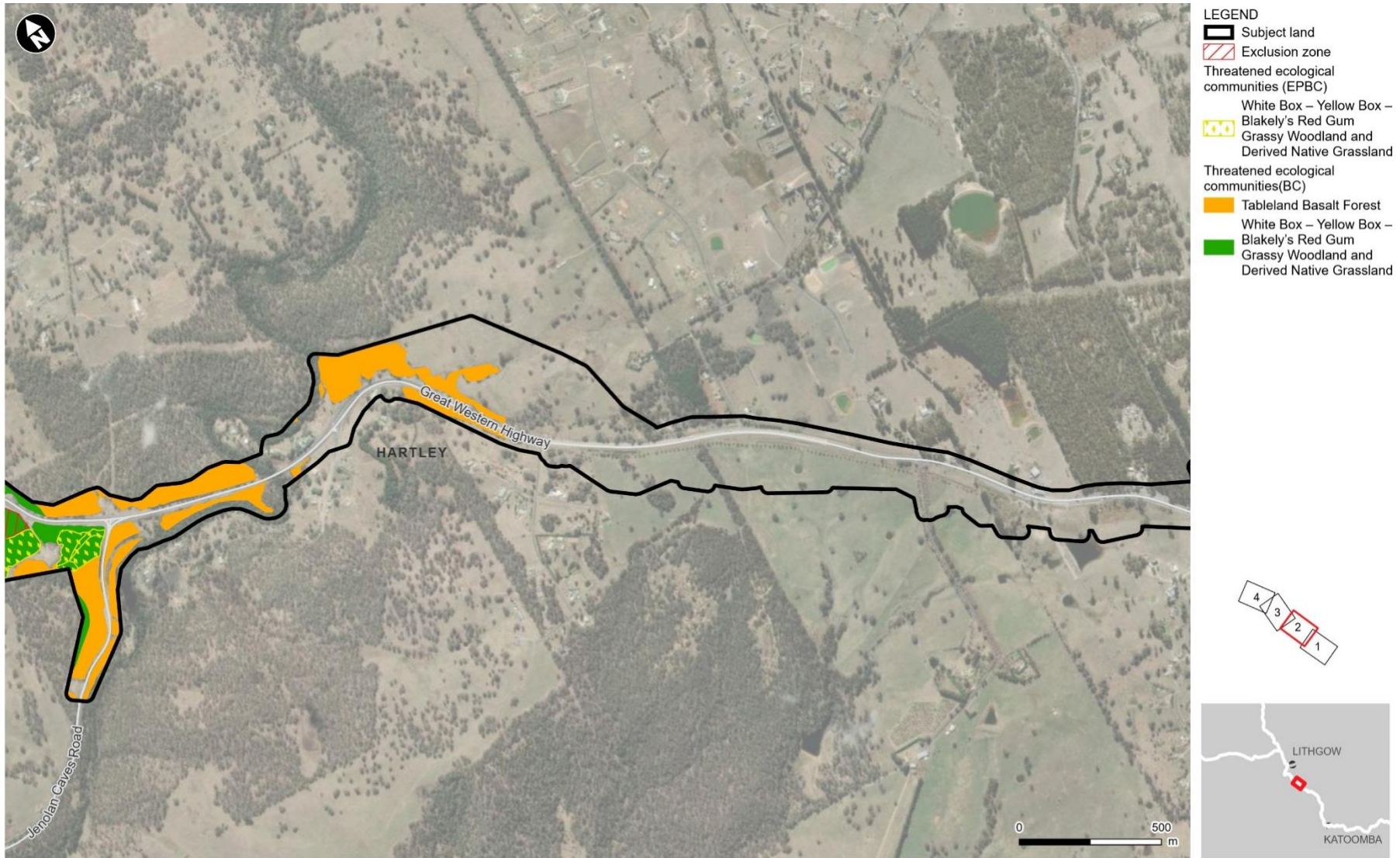
EPBC flowchart criteria	Q33
Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum (or Western Grey Box or Coastal Grey Box in the Nandewar Bioregion)?	Yes
Does the patch have a predominantly native understorey?	Yes
Is the patch 0.1 hectares or greater in size?	Yes
There are 12 or more native understorey species present (excluding grasses).	Yes
There must be at least one important species.	Yes
Is this the community?	Yes

Based on the analysis of plot data and field observations, 0.30 hectares of PCT 1330 qualifies as White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands as defined under the EPBC Act. Patches of PCT 1103 and PCT 1330 on the subject land qualify for listing as the EPBC listed community. The addition of 0.3 hectares of White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands brings the total area of this EPBC listed community on the subject land to 4.51 hectares (Figure 2-1).



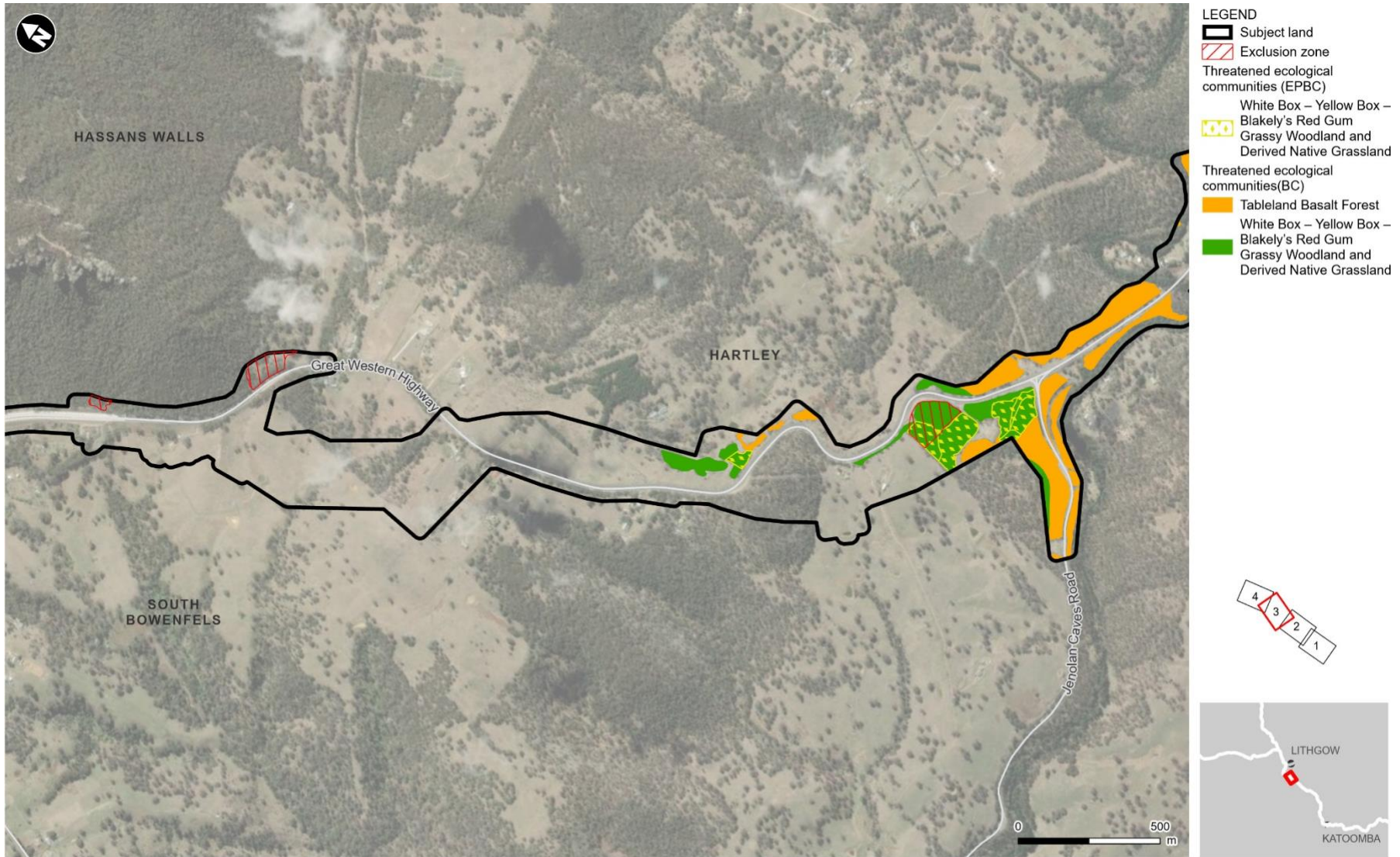
Date: 11/02/2022 Path: C:\Users\eh59186\ARCADIS\Australia GIS - Projects\NSW\GWHA_Current\B_Maps\Ecology\Addendum\GWHA_Eco_Surveys_ARI_V1.aprx
 Created by: EH
 QA by: BG

Figure 2-1 Threatened ecological communities within the study area (1 of 4)



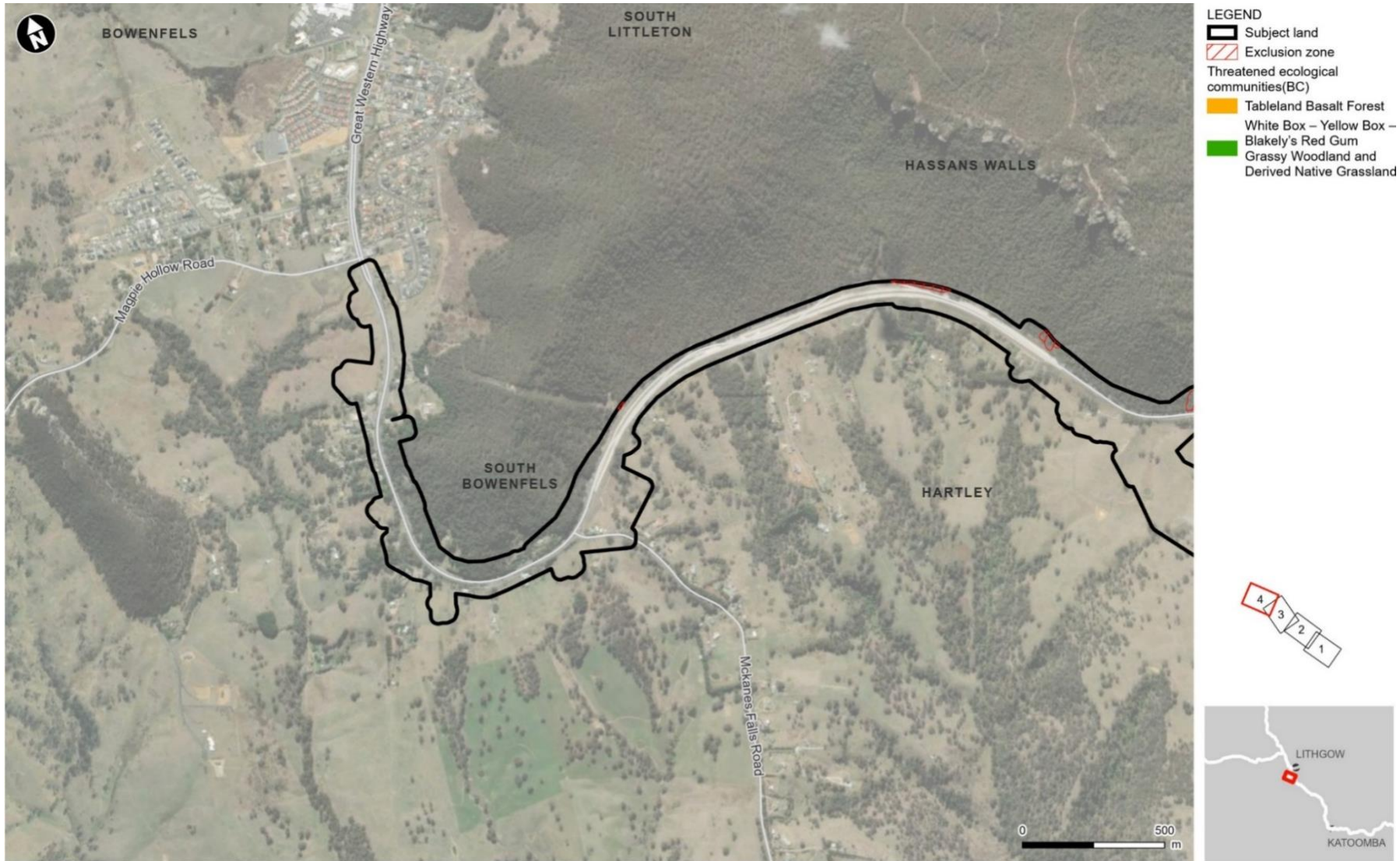
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 QA by: BG

Figure 2-3 Threatened ecological communities within the study area (Page 2 of 4)



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 QA by: BG

Figure 2-3 Threatened ecological communities within the study area (Page 3 of 4)



Date: 11/02/2022 Path: C:\Users\sh5r186\ARCADIS\Australia GIS - Projects\NSW\GWHA_Current\B_Maps\Ecology\Addendum\GWHA_Eco_Survey\AHL_v1.aprx
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Figure 2-3 Threatened ecological communities within the study area (Page 4 of 4)

3. Threatened species

3.1 Methodology

Targeted surveys on the subject land for threatened species and locally significant fauna were conducted over 14 days between October 2021 and March 2022. Weather conditions on the dates of survey is summarised Table 3-1.

Table 3-1 Weather data including maximum temperature, rainfall, and wind on survey dates at weather stations closest to the survey site, Mount Boyce AWS (063292) and Lithgow (Cooerwull) (063226) (BoM, 2022)

Date	Max temp (C°)	Rain (millimetres)	Wind	Max wind gust (Kilometres per hour)	Weather station
05.10.2021	11.4	0	SW	80	Mount Boyce AWS {station 063292}
05.10.2021	11.8	0.4			Lithgow (Cooerwull) {station 063226}
06.10.2021	17.7	0	WSW	50	Mount Boyce AWS {station 063292}
06.10.2021	17.9	0.4			Lithgow (Cooerwull) {station 063226}
17.11.2021	17.7	0	E	26	Mount Boyce AWS {station 063292}
17.11.2021	18.0	0			Lithgow (Cooerwull) {station 063226}
18.11.2021	21.8	0	WSW	41	Mount Boyce AWS {station 063292}
18.11.2021	21.9	0			Lithgow (Cooerwull) {station 063226}
07.12.2021	21.2	1.8	WSW	50	Mount Boyce AWS {station 063292}
07.12.2021	22.2	2.2			Lithgow (Cooerwull) {station 063226}
08.12.2021	15.6	2.4	ESE	44	Mount Boyce AWS {station 063292}
08.12.2021	19.3	6.8			Lithgow (Cooerwull) {station 063226}
09.12.2021	19.2	18.2	SSW	28	Mount Boyce AWS {station 063292}
09.12.2021	19.4	8.4			Lithgow (Cooerwull) {station 063226}
20.12.2021	25.9	1.4	W	46	Mount Boyce AWS {station 063292}
20.12.2021	26.5	2.8			Lithgow (Cooerwull) {station 063226}
21.12.2021	28.9	0	WSW	46	Mount Boyce AWS {station 063292}
21.12.2021	29.3	0.1			Lithgow (Cooerwull) {station 063226}
22.12.2021	28.9	0	W	33	Mount Boyce AWS {station 063292}
22.12.2021	27.6	0			Lithgow (Cooerwull) {station 063226}
23.12.2021	25.0	3.2	SE	37	Mount Boyce AWS {station 063292}
23.12.2021	24.7	35.2			Lithgow (Cooerwull) {station 063226}

Date	Max temp (C°)	Rain (millimetres)	Wind	Max wind gust (Kilometres per hour)	Weather station
24.01.2022	21.1	6.0	E	20	Mount Boyce AWS {station 063292}
24.01.2022	21.8	0.4			Lithgow (Cooerwull) {station 063226}
25.01.2022	23.3	1.4	E	20	Mount Boyce AWS {station 063292}
25.01.2022	25.3	0			Lithgow (Cooerwull) {station 063226}
31.03.2022	15.8	5.0	SE	44	Mount Boyce AWS {station 063292}
31.03.2022	16.1	1.0			Lithgow (Cooerwull) {station 063226}

3.1.1 Threatened flora

Targeted surveys for threatened flora were conducted during spring 2021 and summer 2021/2022, led by Principal Ecologist Jane Rodd and Senior Ecologist Nathan Banks. Threatened flora species identified as having a moderate or higher likelihood of occurring within the subject land in the BDAR were surveyed for using methodologies described in Section 5.3.1 of the BDAR (Arcadis, 2021). Targeted surveys were prioritised for areas identified as moderate and high quality habitat.

The identification of PCT 1330 on the subject land during recent surveys triggered the need to conduct targeted surveys for the candidate threatened flora species *Persoonia glaucescens* (Mittagong Geebung) which was not previously returned by BAMC during the initial BDAR surveys.

Persoonia marginata (Clandulla Geebung) was previously listed as a target species in the BDAR, however the species is not a candidate species for any PCT in either subregion, nor is it moderate or high likelihood of occurrence and as such there is no requirement for it to be surveyed.

A summary of the survey effort and dates of targeted surveys for terrestrial flora species is included in Table 3-2 and mapped in Figure 2-1.

Table 3-2 Targeted threatened flora survey details

Species	Recommended survey timing	Associated PCTs and area in subject land	Minimum survey requirements	Survey completed
<i>Acacia flocktoniae</i>	July – September	1155 – 10.45 ha	Parallel field traverses.	17/11/2021
			For a medium shrub in dense vegetation the recommended maximum distance between field traverses is 10 m, in open vegetation it is 20 m.	18/11/2021
<i>Asterolasia buxifolia</i>	September – November	1103 – 27.25 ha	Parallel field traverses.	17/11/2021
			For a small shrub in dense vegetation the recommended maximum distance between field traverses is 10 m, in open vegetation it is 15 m.	18/11/2021
<i>Baloskion longipes</i> Dense Cord-rush	Year-round	963 – 1.92 ha 1155 – 10.45 ha	Parallel field traverses.	17/11/2021
			For a forb in dense vegetation the recommended maximum distance between field traverses is 5 m, in open vegetation it is 10 m.	18/11/2021
				20/12/2021
				21/12/2021
				24/01/2021
<i>Boronia deanei</i>	October – November	963 – 1.92 ha	Parallel field traverses.	17/11/2021
			For a small shrub in dense vegetation the recommended maximum distance between field traverses is 10 m, in open vegetation it is 15 m.	18/11/2021
			Survey: Use flowers to locate and identify. Survey Oct – Nov when most distinguishable.	20/12/2021

Species	Recommended survey timing	Associated PCTs and area in subject land	Minimum survey requirements	Survey completed
				21/12/2021
				24/01/2022
				24/01/2022
				25/01/2022
<i>Eucalyptus pulverulenta</i>	Year-round	731 – 27.61 ha	Parallel field traverses.	17/11/2021
Silver-leafed gum		732 – 4.98 ha	For a tree in dense vegetation the recommended maximum distance between field traverses is 20 m, in open vegetation it is 40 m.	18/11/2021
				20/12/2021
				21/12/2021
				24/01/2022
				25/01/2022
<i>Kunzea cabbagei</i>	October – November	1155 – 10.45 ha	Parallel field traverses.	
Cabbage Kunzea			For a forb in dense vegetation the recommended maximum distance between field traverses is 5 m, in open vegetation it is 10 m.	17/11/2021
			Survey: Use fertile material to identify. Survey Oct - Nov.	18/11/2021
			Seedbank persistence: Seedbank persistence assumed based on similar species.	
<i>Persoonia glaucescens</i>	January – March	1330 – 1.90 ha	Parallel field traverses.	24/01/2021
				25/01/2021

Species	Recommended survey timing	Associated PCTs and area in subject land	Minimum survey requirements	Survey completed
Mittagong Geebung			For a medium shrub in dense vegetation the recommended maximum distance between field traverses is 10 m, in open vegetation it is 20 m. Survey: Use flowers to locate and identify.	
<i>Swainsona sericea</i>	September – November	1103 – 27.25 ha	Parallel field traverses. For a forb in dense vegetation the recommended maximum distance between field traverses is 5 m, in open vegetation it is 10 m.	17/11/2021
Silky Swainson-pea		1330 – 1.90 ha	Survey: Survey months differ based on location. Survey Oct - Nov on Monaro. Survey Sep - Oct in the Riverina.	18/11/2021
<i>Thesium australe</i>	November – February	732 – 4.98 ha	Parallel field traverses.	17/11/2021
Austral Toadflax			For a forb in dense vegetation the recommended maximum distance between field traverses is 5 m, in open vegetation it is 10 m.	18/11/2021
			Survey: Species can be easily overlooked when understorey height exceeds 30cm. When this is the case close inspection surveys (searching between grass tussocks) may be necessary to conclusively determine absence of this species.	20/12/2021
				21/12/2021
				24/01/2022
				25/01/2022
<i>Veronica blakelyi</i>	December – February	731 – 27.61 ha	Parallel field traverses.	20/12/2021
		732 – 4.98 ha	For a small shrub in dense vegetation the recommended maximum distance between field traverses is 10 m, in open vegetation it is 15 m.	21/12/2021
		963 – 1.92 ha	Survey: Use flowers to identify, as easily confused with <i>Veronica perfoliata</i> . Typically flowers over summer but will sporadically flower at other times of the year.	24/01/2022
				25/01/2022

3.1.2 Threatened fauna

Targeted surveys for threatened species were undertaken by Arcadis ecologists between October 2021 and January 2022. Targeted fauna surveys aimed to address the survey requirements outlined in Section 5.3.2 in the BDAR (Arcadis, 2021) and the Threatened Biodiversity Data Collection (TBDC) (DPIE (EES), 2021a). Surveys were undertaken on 5 and 6 October, and between 7 December 2021 and 28 January 2022. Weather conditions on date of survey are outlined in Table 3-1.

Gang-gang Cockatoo

Gang-gang Cockatoos are listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) and are a dual credit species, with breeding habitat associated with species credits. Impacts of the proposal to foraging habitat for the species have been previously assessed however due to seasonal constraints, presence of breeding habitat for Gang-gang Cockatoo and subsequent impacts of the proposal to the species could not be fully assessed until October 2021 (Table 3-3). Spring and summer targeted surveys aimed to determine if the subject land is being used by this species for breeding. Surveys were conducted on 5 and 6 October and 7, 8, 9, and 20 December 2021, in areas previously identified as containing large hollow-bearing trees within the subject land. Surveys involved minimum 20-minute walking transects in the early morning or late afternoon, detecting the species by visual observation, calls and/or indirect evidence. Any suitable hollows were also inspected for signs of occupation. As per the recommendations in the TBDC, experienced ecologists searched for signs of breeding including the presence of (a) a lone adult male or (b) an occupied nest.

Gang-gang Cockatoo was gazetted Endangered on the EPBC Act on 2 March 2022, following submission of the BDAR. There are no assessment guidelines for the species as yet. Species impacts and mitigation as outlined in the BDAR and this report meet the assessment requirements of the strategic assessment for Transport activities being assessed under Division 5.1 of the EP&A Act. Opportunistic identification of Gang-gang Cockatoos were also recorded when traversing the subject land. All observations were recorded using an Arc Collector enabled iPad.

Table 3-3 Targeted survey details for detection of Breeding Gang-gang Cockatoo

Minimum survey requirements	Survey methods	Survey effort	Seasonal requirements (DPIE (EES) 2021)	Survey timing	Adequacy against guidelines
Surveying for lone adult males from October to January or identifying potential nest sites (eucalypts with hollows at least nine metres above ground with hollow diameter 10 cm+) (DPIE (EES), 2021b).	Diurnal bird survey: Area search	Six days of area searches of minimum 20-minute transects in suitable habitat (PCTs 85, 731, 732, 963, 1103 and 1155) focusing on areas with mapped hollow bearing trees within the subject land.	October – January	Diurnal area search and inspection of identified breeding habitat: 5.10.2021 6.10.2021	Breeding: Adequate
Inspection of potential breeding habitat identified within the subject land during habitat assessments (ie hollow-bearing trees >9 m, hollow >9-10 cm) during	Stag watch / inspection of hollows suitable for breeding	Suitable hollows inspected for breeding sings.		7.12.2021 8.12.2021 9.12.2021 20.12.2021	

Minimum survey requirements	Survey methods	Survey effort	Seasonal requirements (DPIE (EES) 2021)	Survey timing	Adequacy against guidelines
breeding season (October – January).					

Booroolong Frog

Booroolong Frog are listed as endangered under the BC Act and EPBC Act. Surveys for Booroolong Frog followed the recommended survey guidelines outlined in ‘NSW Survey Guide for Threatened Frogs: A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method’ (DPIE, 2020a). This included both aural and visual surveys.

More than twelve hours of nocturnal spotlighting surveys were conducted over four nights on 7, 8, 20 and 21 December 2021, fulfilling minimum survey requirements for the species (Table 3-4). Three sites with rocky habitat identified as suitable for Booroolong Frog were surveyed on a minimum of two separate survey dates. Spotlights were used to detect eyeshine and any frog calls were also recorded. The ecologists walked at a slow pace following the river edge to complete transects a minimum of 200 metres, stopping frequently to listen for frog calls. All frog species encountered were recorded. Weather conditions varied across survey dates, including between periods of rainfall and on sunny and clear days. Weather conditions for each survey date are identified in Table 3-1. Survey effort and location of transects are shown in Figure 3-1.

Table 3-4 Targeted Booroolong Frog survey details

Minimum survey requirements	Survey methods	Survey effort	Seasonal requirements (DPIE (EES) 2021)	Survey timing	Adequacy against guidelines
Aural-visual surveys are completed as transects running along the edge of suitable stream breeding habitat. These frogs are highly detectable using spotlight surveys along rocky sections of stream.	Targeted spotlighting searches	Spotlighting: Four nights along the River Lett where it intersects the subject land. Minimum 500 metres transects for 2 hours per night.	October – December	Spotlighting: 7.12.2021 8.12.2021 20.12.2021 21.12.2021	General detection: Adequate
Total effort for a 500 metre transect is 480 survey minutes. A total of four repeat surveys should be conducted (DPIE, 2020a).					

Threatened microbat species

Manmade structures within the subject land with potential microbat roosting habitat were inspected consistent with the methodology outlined in Section 5.3.2 of the BDAR. Culverts and bridges were inspected with a spotlight, focusing on gaps where bats could roost.

Two passive Anabat Swift recorders were also deployed from 7 December to 20 December 2021 at culverts identified as having or likely to have bats roosting: Culvert 2 and Culvert 3 (Table 5-7 of the BDAR (Arcadis, 2021)) (Figure 3-1). The passive Anabats were set to record bat activity from dusk to dawn. Both

Anabat Swift recorders documented seven nights of data, however due to unfavourable weather conditions of heavy rainfall on three nights, the four nights with the best weather conditions were analysed for each of the recorders. Dates analysed for bat detections were 7, 11, 12 and 13 December 2021. Deployment locations of the passive Anabats at the culverts are shown in Plate 3-1.

In addition to the above, active bat monitoring was undertaken using the Wildlife Acoustics Echo Meter Touch 2 devices connected to IOS devices. Large-eared Pied Bat were targeted through active monitoring undertaken at various manmade structures in the subject land for thirty minutes after dusk. This was conducted for four nights on 7, 8, 20 December 2021 and 24 January 2022. Calls frequencies were identified with the use of the 'Bat calls of NSW - region-based guide to the echolocation calls of Microchiropteran bats' (DEC, 2004). Locations of active and passive Anabats within the subject land are shown in Figure 3-1.



Plate 3-1 Locations of passive Anabat Swift records in the subject land – Culvert 2 (top) and Culvert 3 (bottom)

3.1.3 Locally significant fauna

Platypus

The Platypus is known to inhabit the River Lett within the vicinity of the subject land. Platypus are crepuscular (active at night, dusk and dawn). Targeted surveys for Platypus included watch surveys and habitat assessments. Platypus watch surveys involved quietly observing the water for Platypus activity for one hour from dusk from the river edge. The following areas within the subject land were surveyed:

- Sections of the River Lett with recently reported Platypus sightings within or in close proximity to the subject land, and
- Areas within the subject land with deep, slow-moving pools with abundant riparian vegetation that were considered likely for a burrow to occur.

A total of nine platypus watches were conducted at eight locations at dusk across five nights. The location of platypus watches are shown in Figure 3-1.

Platypus habitat assessments were conducted to assess likelihood of burrow occurrence. As burrows can be notoriously difficult to locate (Serena, 1998), searches for burrows on the river’s edge were accompanied by the assessment of the banks at 20-30m intervals within about 800 metres up and downstream of the proposed bridge at River Lett. Habitat was categorized as high, medium, and low quality based on the habitat attributes outlined in Table 3-5. To supplement the active searches, two remote cameras were deployed on the banks of the River Lett from 23 December 2021 to 1 January 2022 to detect activity of Platypus within the subject land.

Table 3-5 Platypus habitat assessment criteria

Habitat feature	Habitat quality		
	Low	Medium	High
Water flow	Fast	Moderate	Slow
Water depth estimate	<30cm	>30cm and <60cm	>60cm
Bank sediment	Rock or sand dominant	Mixed	Clay dominant
Riparian vegetation	Minimally vegetated	Moderately vegetated	Trees present and/or highly vegetated
Burrow visible	No burrow visible	No burrow visible	Burrow present

3.1.4 Limitations

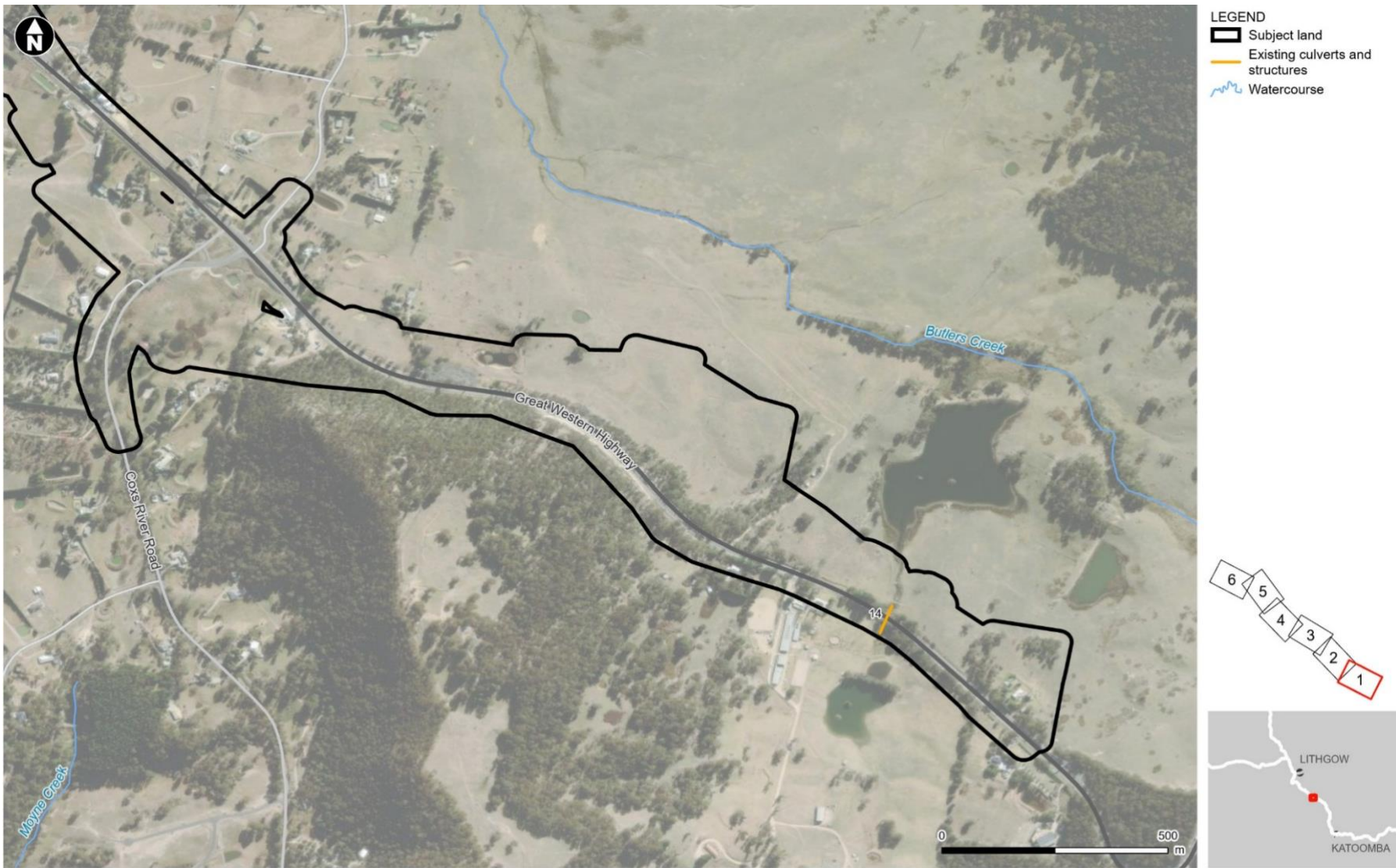
Targeted surveys for threatened fauna and flora species were unable to be completed for several properties due to access restrictions by landholders. Property lots not surveyed included:

- Lot 1 / 587763; Lot 2,3,4 DP1130441- 2200 Great Western Highway, Little Hartley NSW 2790
- Lot 10 DP1134053 'Fernhill' 3109 Great Western Highway, South Bowenfels NSW 2790
- Lot 154 DP1122453 "Misty View" 3055 Great Western Highway, Hartley NSW 2790

Native vegetation on these properties has been considered habitat of threatened species credit species which have been identified on the subject land. Associated plant community types of Greater Glider, Squirrel Glider, Purple Copper Butterfly and Large-eared Pied Bat which have been mapped on these properties have been included in species polygons and offset accordingly. Threatened flora species credit species have been assessed as 'not present' within these properties. A recommendation to conduct targeted surveys for threatened flora and fauna, following acquisition of the properties, to determine presence/absence and the scale of impacts is included in Section 5. The results of findings will determine if additional offsetting is required.

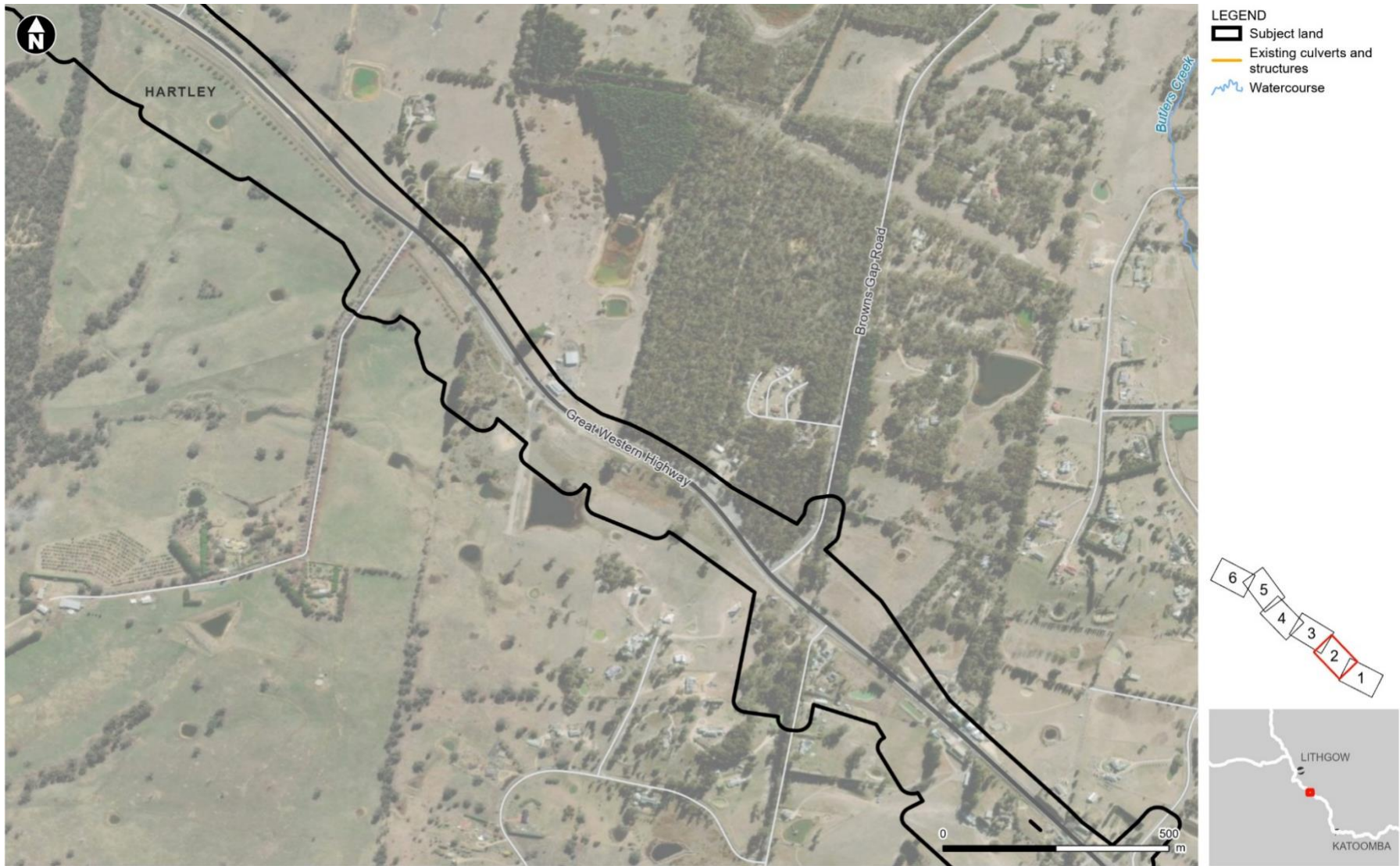
Platypus have complex habitat needs with multiple burrows used throughout their home-range. These burrows are either used intermittently, moving between multiple burrows within their home range, or for breeding where young are contained. Detection of Platypus burrow entrances is difficult as they are often concealed by riparian vegetation, undercut banks and woody debris, or can be located below the water line

(Thomas et al., 2018). Breeding burrows also have a 'plug' of soil and vegetation, used to prevent water from entering that may drown young puggle (juvenile platypus). Consequently, this survey focused on habitat assessment to identify likelihood of burrow occurrence.



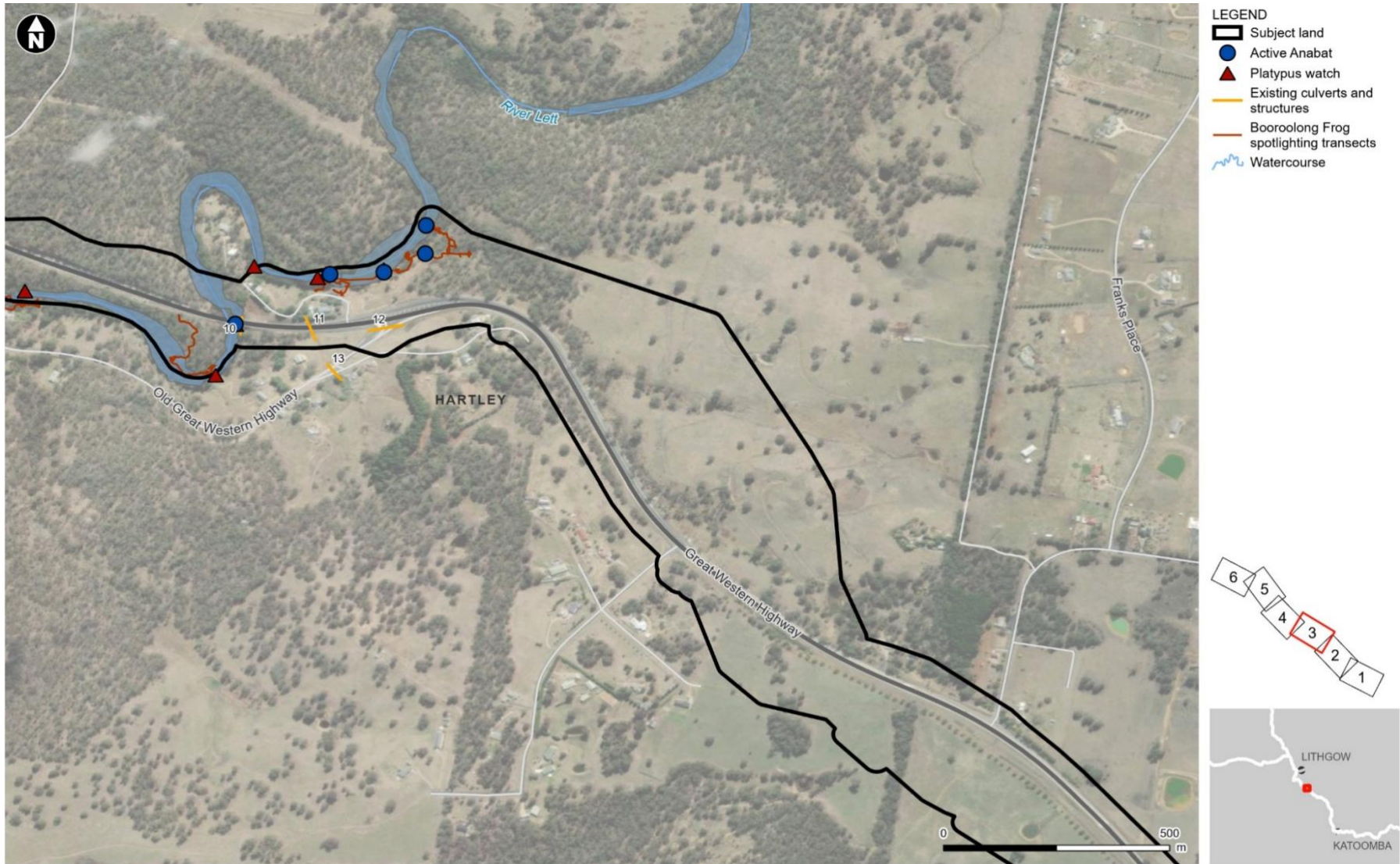
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Figure 3-1 Fauna survey effort within the subject land (1 of 6)



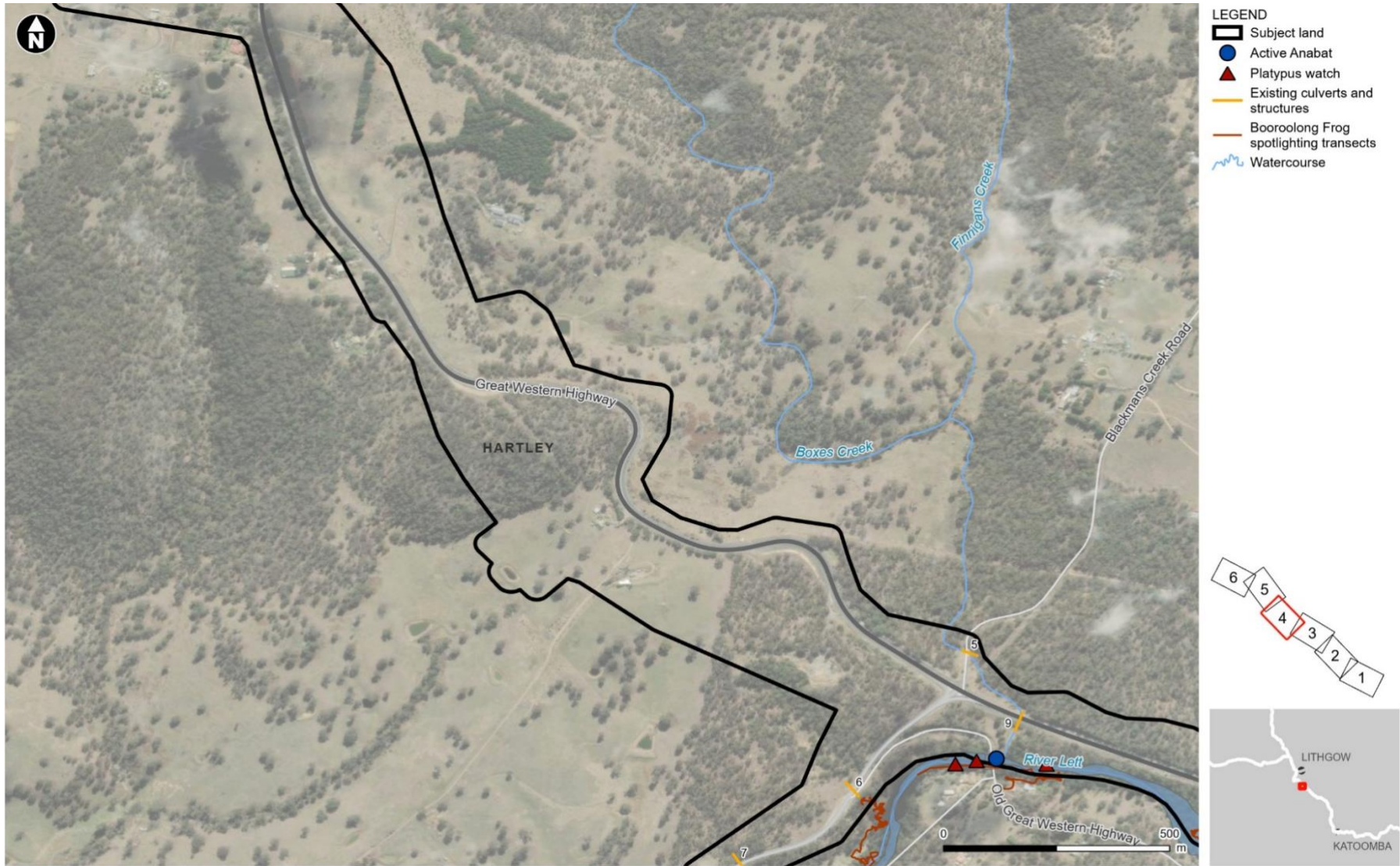
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Figure 3-1 Fauna survey effort within the subject land (2 of 6)



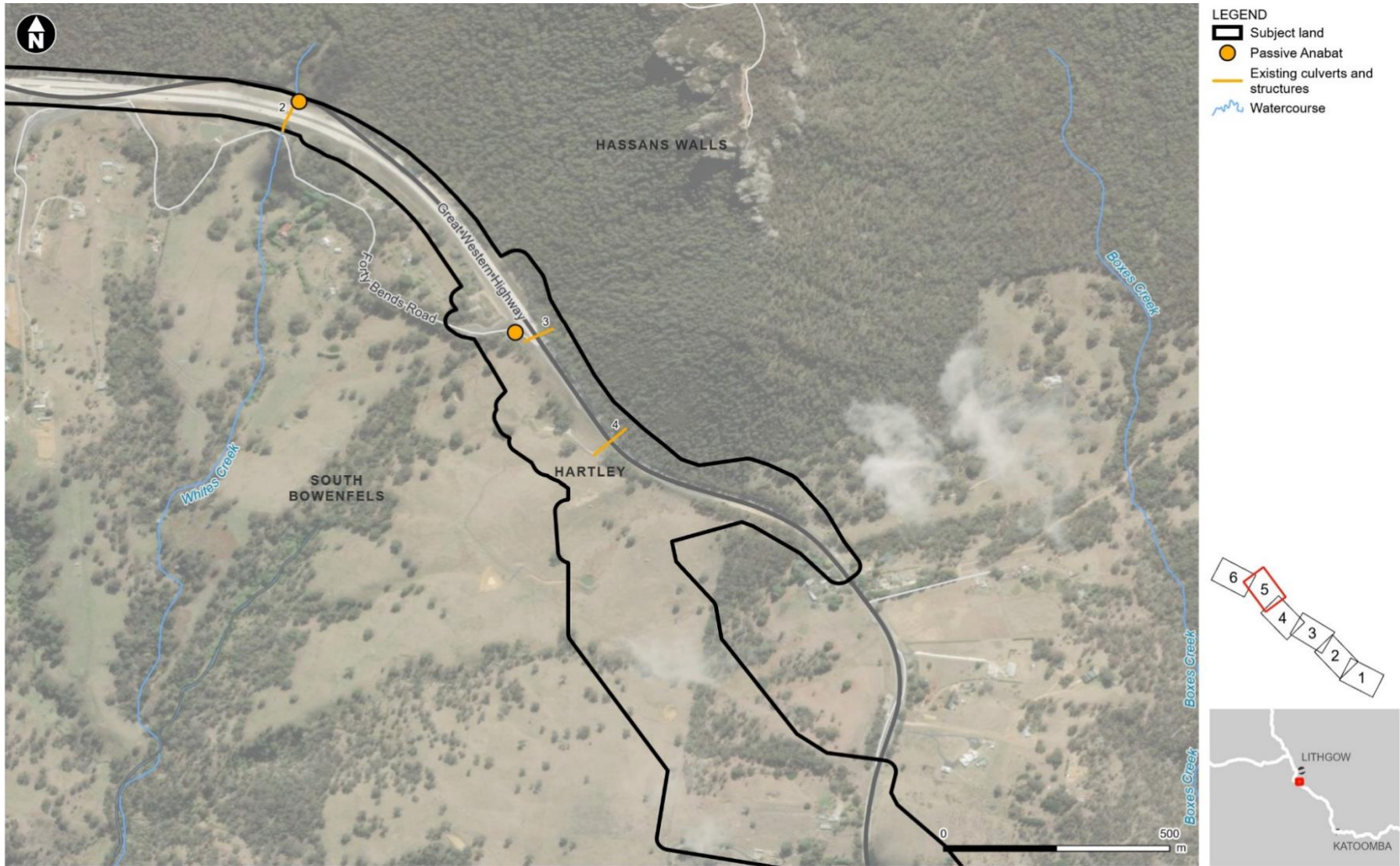
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Figure 3-1 Fauna survey effort within the subject land (3 of 6)



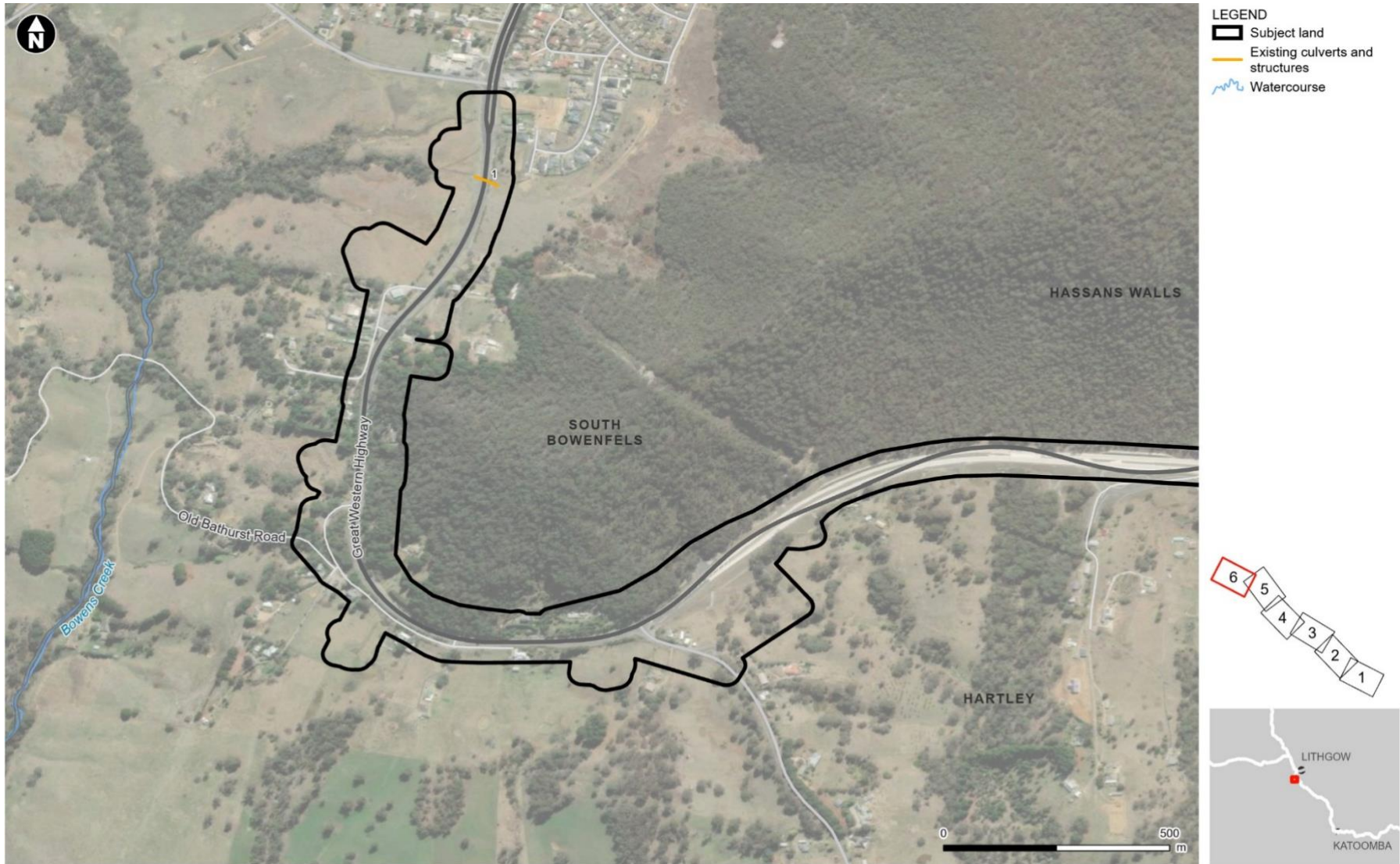
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Figure 3-1 Fauna survey effort within the subject land (4 of 6)



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Figure 3-1 Fauna survey effort within the subject land (5 of 6)



Date: 11/02/2022 Path: C:\Users\en59168\ARCADIS\Australia GIS - Projects\NSW\GWHPA_Current\B_Maps\Ecology\Addendum\GWH_Eco_surveys_A4L_V1.sprx
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Figure 3-1 Fauna survey effort within the subject land (6 of 6)

3.2 Results

3.2.1 Threatened flora

No threatened flora species were detected within the subject land during targeted surveys. A summary of targeted survey results is included in Table 3-6.

Table 3-6 Targeted threatened flora species credit species survey results

Species	Presence (species credits)
<i>Acacia flocktoniae</i> Flockton Wattle	Not present (surveyed)
<i>Asterolasia buxifolia</i>	Not present (surveyed)
<i>Baloskion longipes</i> Dense Cord-rush	Not present (surveyed)
<i>Boronia deanei</i> Deane's Boronia	Not present (surveyed)
<i>Eucalyptus pulverulenta</i> Silver-leafed Gum	Not present (surveyed)
<i>Kunzea cabbagei</i> Cabbage Kunzea	Not present (surveyed)
<i>Persoonia glaucescens</i> Mittagong Geebung	Not present (surveyed)
<i>Swainsona sericea</i> Silky Swainson-pea	Not present (surveyed)
<i>Thesium austral</i> Austral Toadflax	Not present (surveyed)
<i>Veronica blakelyi</i>	Not present (surveyed)

3.2.2 Threatened fauna

The result of targeted surveys for threatened and locally significant fauna are discussed below. Updates to species polygons, which have occurred due to changes in vegetation mapping and identification of habitat features during recent surveys, have been included in Figure 3-5. The species polygon for Greater Glider has not changed whereas those of Large-eared Pied Bat, Purple Copper Butterfly and Squirrel Glider have been updated.

Gang-gang Cockatoo

Gang-gang Cockatoos were recorded flying overhead in the subject land near the Jenolan Caves Road intersection on 9 and 22 December 2021, as well as feeding in trees in Hartley Nature Reserve outside the subject land on 21 December 2021. No signs of breeding activities were observed within the subject land. Gang-gang Cockatoos were mostly observed in small flocks of 5-6 birds.

The Gang-gang Cockatoos at Hartley Nature Reserve appeared to be feeding in River Oak (*Casuarina cunninghamiana*) immediately above the River Lett. Both males and females were observed, including a bonded male and female pair. As per the TBDC survey guidelines for this species no (a) lone adult males were detected on the subject land and (b) occupied nest were also not detected. Therefore, no species polygon for breeding habitat has been established for Gang-gang Cockatoo on the subject land.

Booroolong Frog

Booroolong Frogs were not detected at the site during targeted spotlighting surveys, visually or aurally. Frog activity was high during surveys on 7 and 8 December 2021, with five other frog species identified including Common Eastern Froglet (*Crinia signifera*), Eastern Banjo Frog (*Limnodynastes dumerilii*) Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Peron's Tree Frog (*Litoria peronii*) and Green Stream Frog (*Litoria phyllochroa*) (Plate 3-2).



Plate 3-2 Frog species detected during targeted Booroolong Frog surveys. From left to right: Eastern Banjo Frog, Green Stream Frog and Peron's Tree Frog

Threatened microbat species

Fifteen species of microbats were detected on the Anabat Swift detectors. This included three threatened species, Large Bent-winged Bat (*Miniopterus orianae oceanensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Figure 3-2). One additional bat species was recorded in the River Lett under the main highway bridge using active monitoring devices. This species was the Greater Broad-nosed Bat (*Scoteanax rueppellii*), listed as Vulnerable under the BC Act. Three individual bats of two species were observed roosting in Culvert 3. Two are likely *Nyctophilus* sp. and one unknown species.

Two hundred and thirty-nine passes of Large Bent-winged Bat were recorded, of which 221 occurred at Culvert 2, and 18 at Culvert 3 (Figure 3-4). Both culverts showed majority of passes from Large Bent-

winged Bat early in the evening and again on sunrise. The timing and quantity of passes indicates that the species is almost certainly roosting at Culvert 2 and may potentially be roosting in Culvert 3 (Figure 3-3). The species was detected during the breeding season when the species is typically inhabiting maternity caves. It is likely Culvert 2 is inhabited by young males or juveniles and roosting occurs all times of the year in the culvert.

Thirteen Large-eared Pied Bat passes were detected in total at the two culverts. The species was detected at Culvert 2 shortly after sunset and again on sunrise, indicating that the species could be roosting and/or breeding in the culvert. Five passes occurred at Culvert 3 at approximately midnight on a single night. This indicates there is a much lower potential for roosting at Culvert 3. Approximately 15 individuals of two different species were observed at Culvert 2. Active Anabat surveys did not detect the presence of Large-eared Pied Bat at this culvert.

Eastern False Pipistrelle was recorded a total of five times, with three passes at Culvert 3 and two passes at Culvert 2. As Eastern False Pipistrelle is known to roost in tree hollows it is unlikely the species is using either structure for roosting habitat, with records more likely due to the species passing by the culverts whilst foraging.

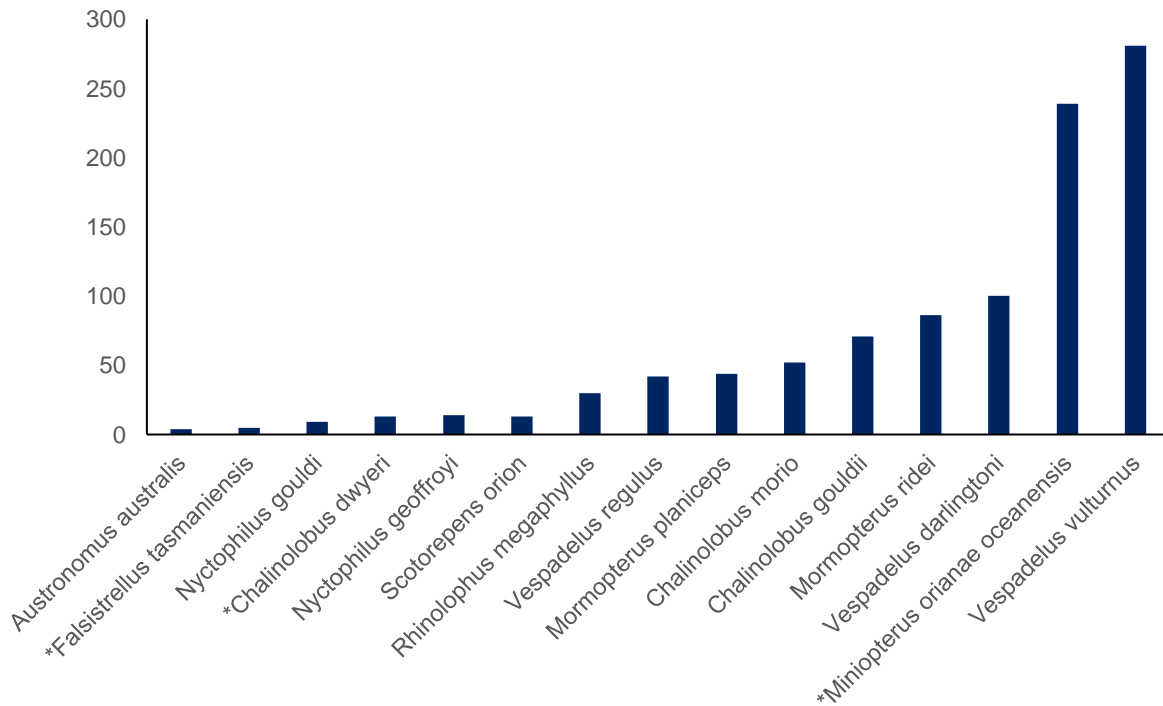


Figure 3-2 Total detections of microbats from Anabat Swift recorders at two culverts on the Great Western Highway. *Threatened species. One additional bat was also detected using active monitoring devices - NSW threatened Greater Broad-nosed Bat, *Scoteanax rueppellii*

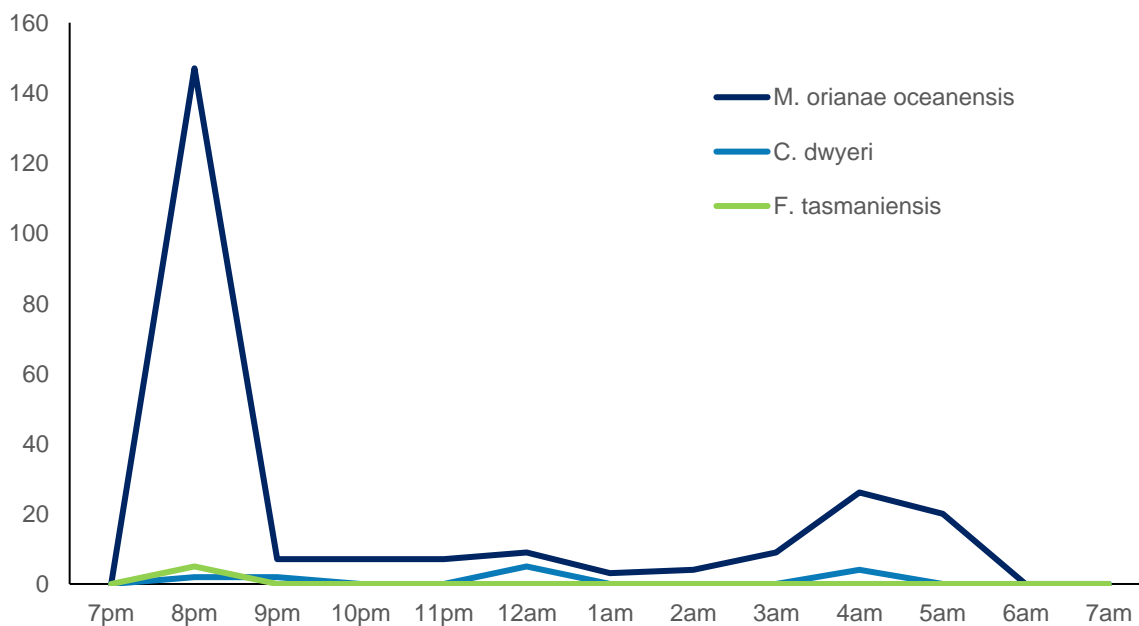


Figure 3-3 Timing of calls by threatened bat species detected on Anabat. *M. orianae oceanensis* (n=283), *C. dwyeri* (n=14), *F. tasmaniensis* (n=5). Sunset at approximately 8.06pm, sunrise at approximately 5:42am.

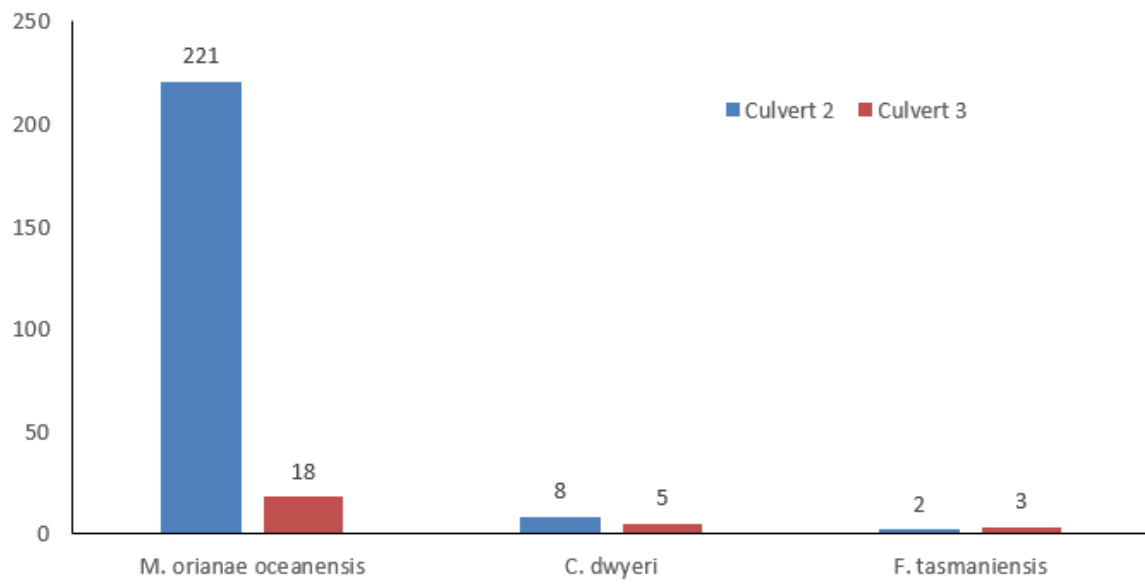
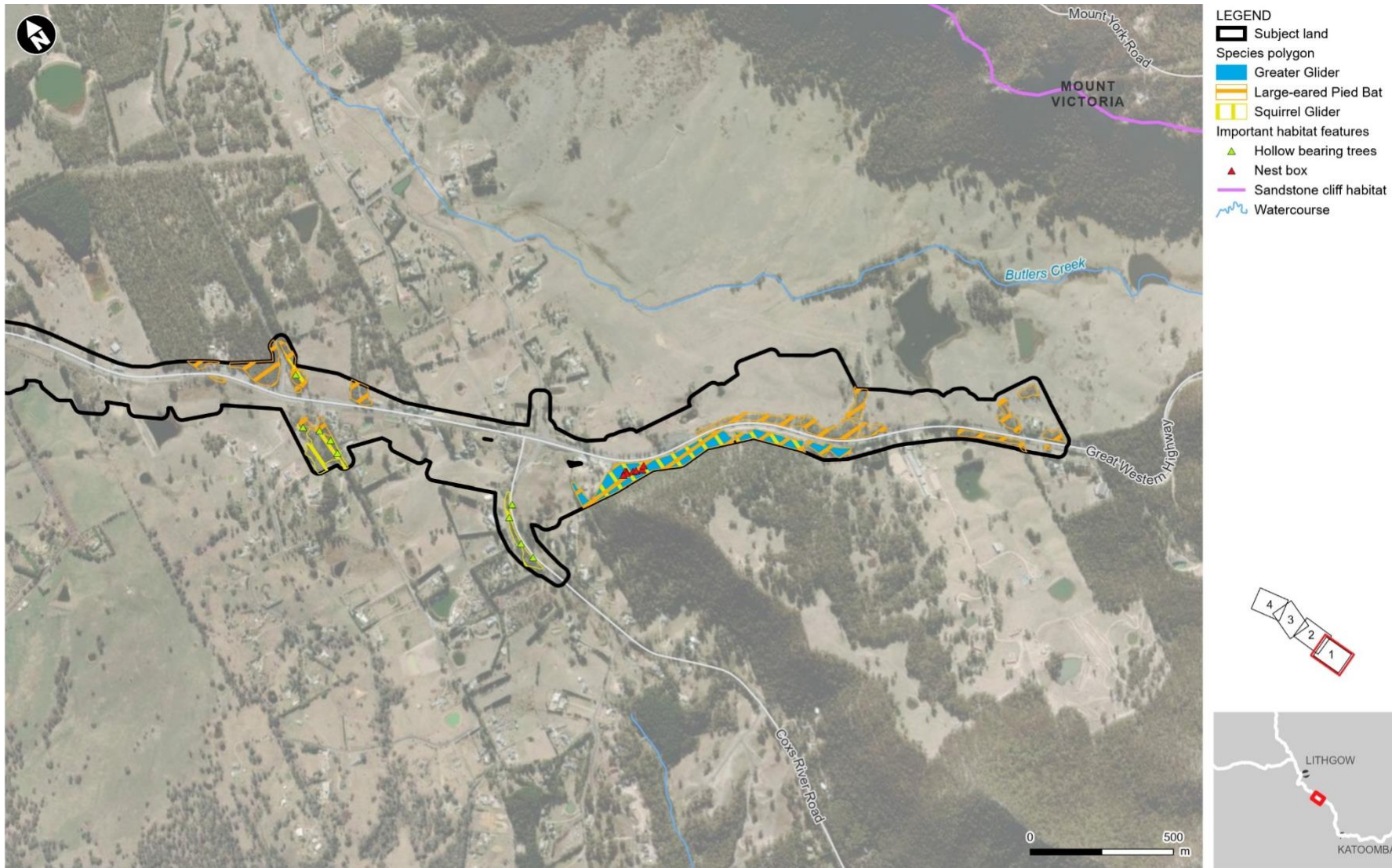
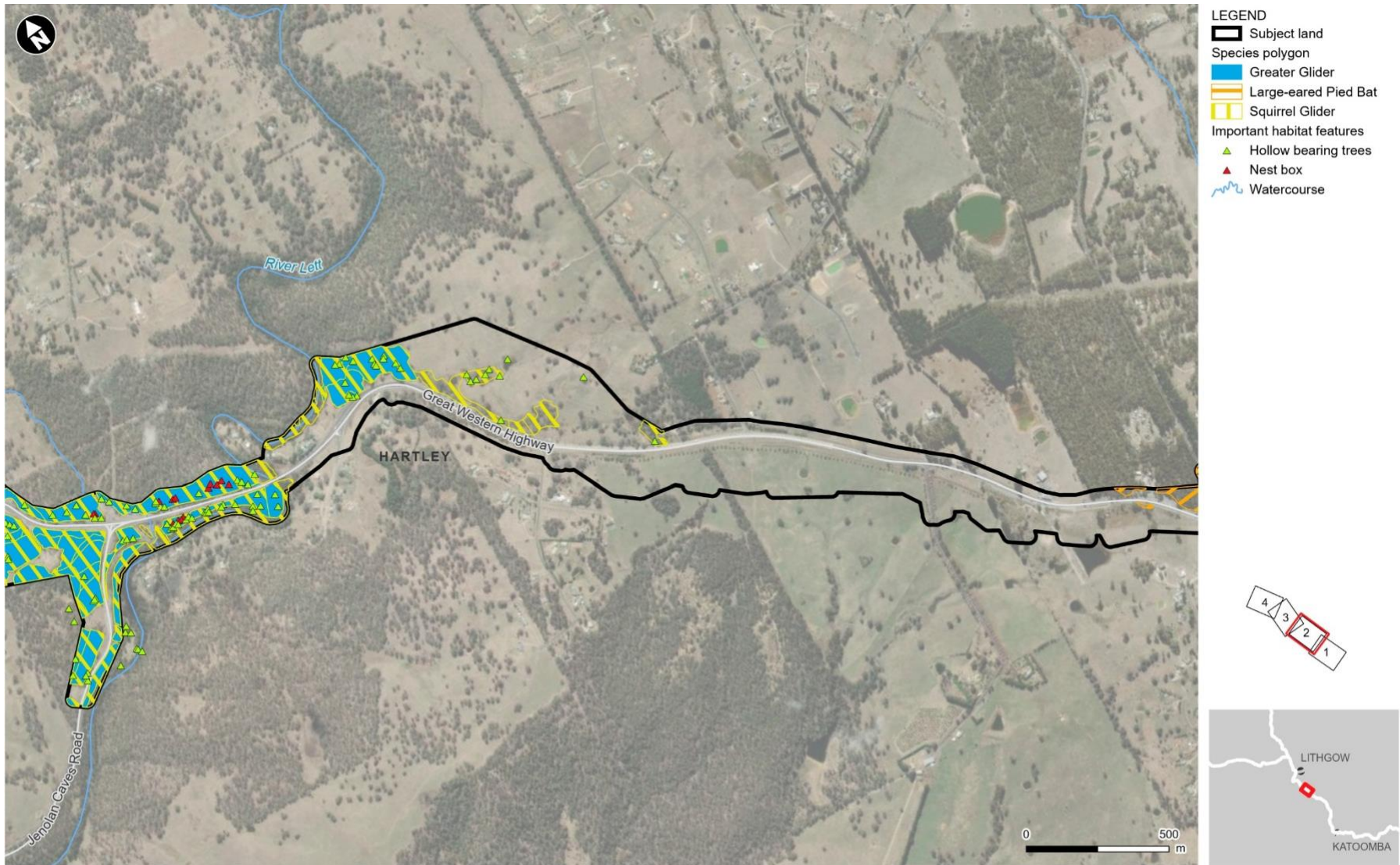


Figure 3-4 Location of threatened bat calls detected on Anabat Swift recorders at each culvert. *M. orianae oceanensis* (n=283), *C. dwyeri* (n=14), *F. tasmaniensis* (n=5).



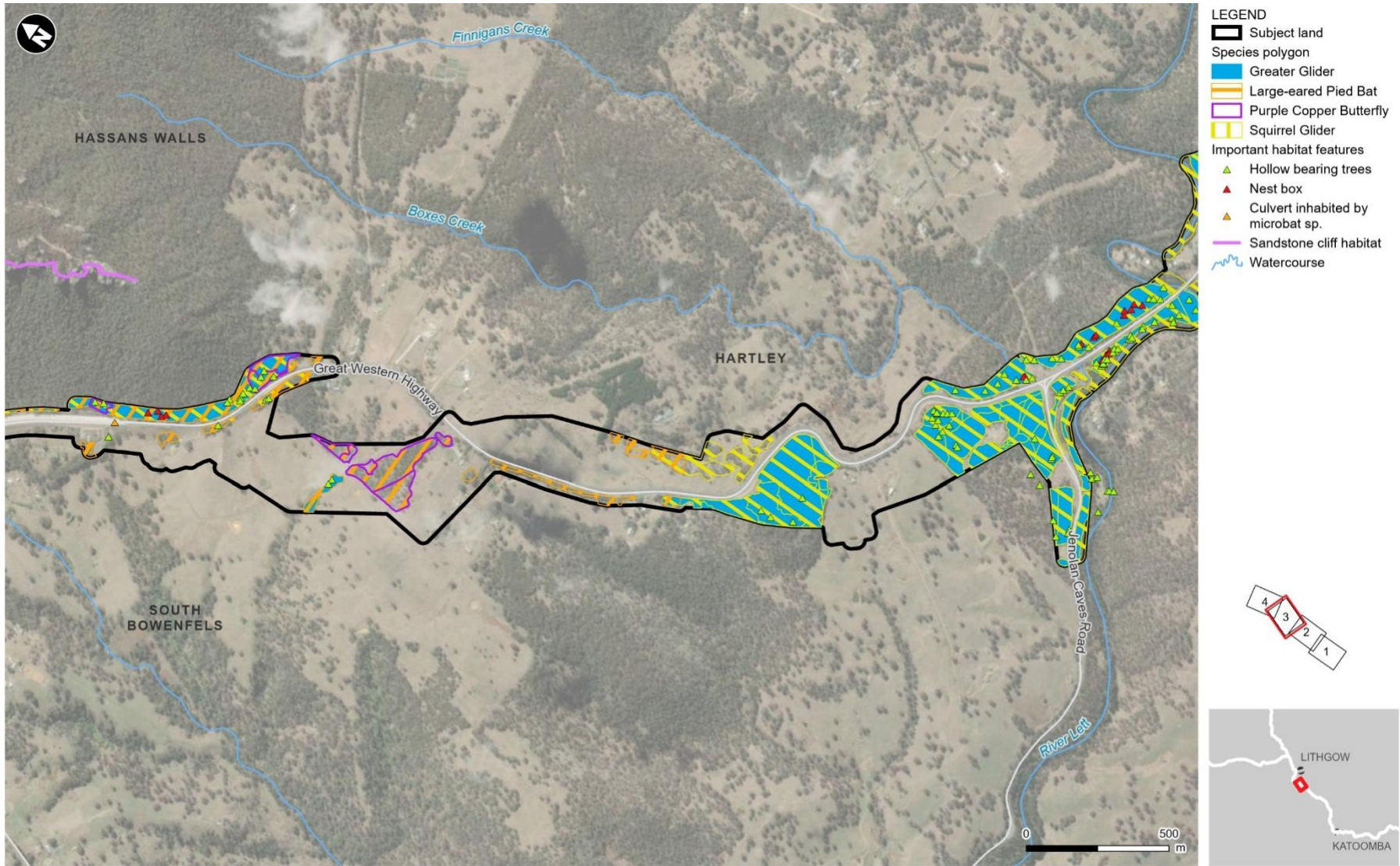
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Figure 3-5. Threatened fauna species polygons on the subject land (1 of 4)



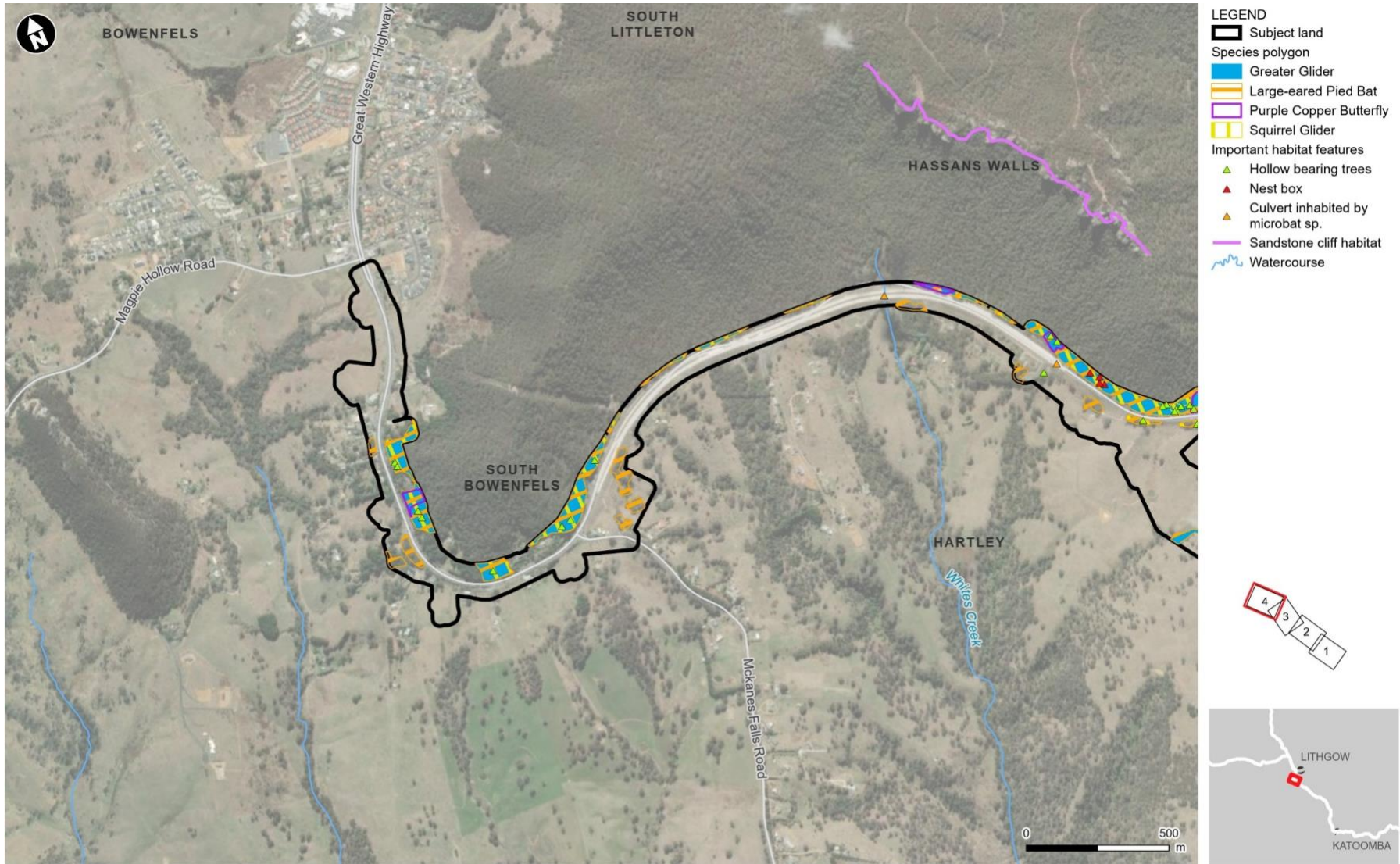
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Figure 3 5. Threatened fauna species polygons on the subject land (2 of 4)



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Figure 3 5. Threatened fauna species polygons on the subject land (3 of 4)



Date: 8/03/2022 Path: C:\Users\eh59180\ARCADIS\Australia GIS - Projects\NSW\GWHA_Current\B_Maps\Ecology\Addendum\GWHA_Eco_Surveys_A4L_V1.aprx
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Figure 3 5. Threatened fauna species polygons on the subject land (4 of 4)

3.2.3 Locally significant fauna

Platypus

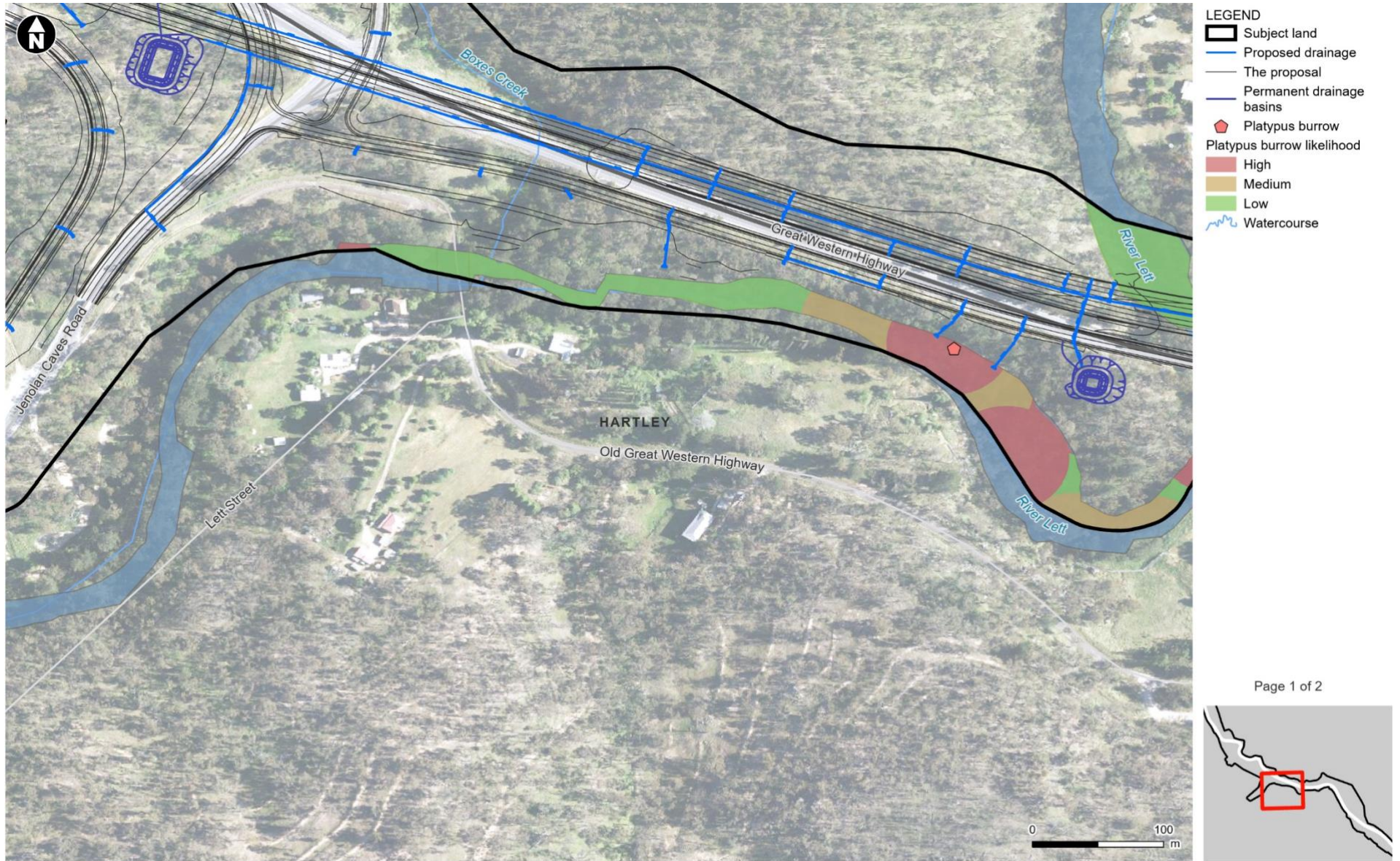
Platypus were observed at two sites on the River Lett in Hartley during targeted dusk surveys (Plate 3-3). Sightings occurred on separate survey dates, at sites approximately 250 metres apart. Water-rat (*Hydromys chrysogaster*) was also observed at both sites where Platypus were located.

Results of the Platypus habitat assessment identified ten (31.2%) sections of the River Lett as high quality, eight (43.7%) sections as medium quality, and eight (25%) sections as low quality potential habitat (Figure 3-6).

Both remote cameras failed to detect any Platypus activity on the River Lett within the subject land. One camera was deployed underneath the construction footprint of the bridge crossing the River Lett, and the second was facing a burrow that was located in a side pool off the river during habitat assessments. Due to poor weather conditions following camera deployment, the second camera did not collect any data past the first day, so occupancy status of the burrow was unable to be determined.

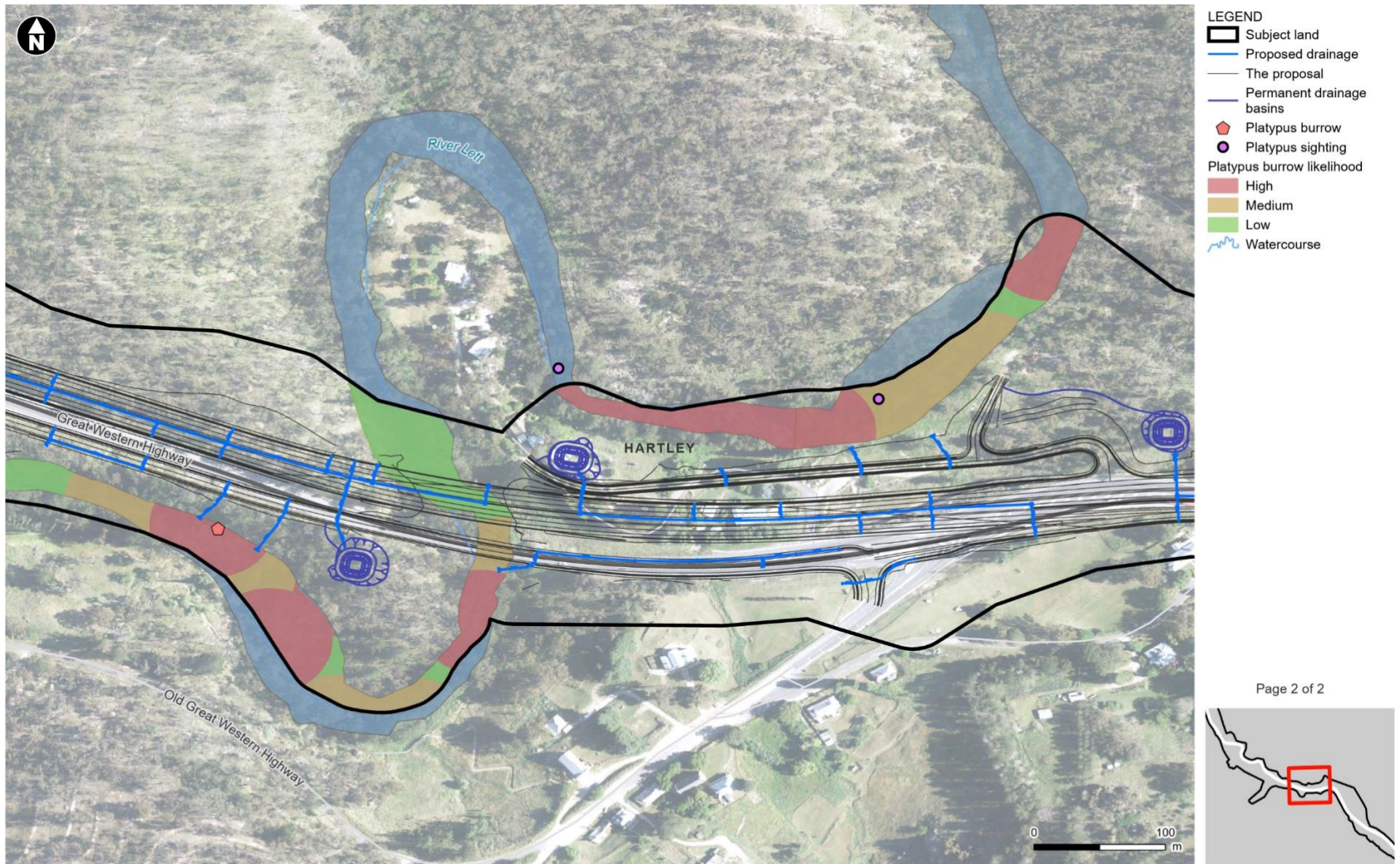


Plate 3-3 Platypus observed near the River Lett, Little Hartley



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Figure 3-6 Platypus survey results (1 of 2)



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Figure 3-5 Platypus survey results (2 of 2)

4. Impacts

4.1 Removal of native vegetation and habitat

4.1.1 Direct impacts on native vegetation and habitat

Clearing of native vegetation on the subject land to facilitate the proposal is discussed in Section 7.1.1 of the BDAR. The updated areas of clearing to vegetation zones, following additional surveys, has been summarised in Table 4-1. It is assumed that all vegetation within the subject land would be removed, except for areas located within exclusion zones. The total area of native vegetation to be cleared for the proposal is 75.09 hectares which is an decrease of 0.1 hectares from 75.19 hectares assessed in the BDAR.

Table 4-1 Direct impacts to native vegetation

Plant community type (PCT)	Vegetation zone	Area within subject land (ha) – BDAR	Area within subject land (ha) – Current	Area within exclusion zones (ha)	Area to be impacted (ha)	Change (loss) in vegetation integrity score
Bathurst Subregion / South Eastern Highlands Bioregion						
River Oak forest and woodland wetland of the NSW South	85 (moderate)	3.95	3.95	0	3.95	78.4
Western Slopes and South Eastern Highlands Bioregion (85)	85 (disturbed)	0.35	0.35	0	0.35	34.6
Broad-leaved Peppermint – Ribbon Gum grassy open forest in the north east of the South Eastern Highlands Bioregion (732)	732 (moderate)	6.42	4.98	0	4.98	64.2
Sydney Peppermint – Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains;	963 (good)	2.34	1.92	1.04	0.88	81.4

Plant community type (PCT)	Vegetation zone	Area within subject land (ha) – BDAR	Area within subject land (ha) – Current	Area within exclusion zones (ha)	Area to be impacted (ha)	Change (loss) in vegetation integrity score
Sydney Basin Bioregion (963)*						
Ribbon Gum – Yellow Box grassy woodland on undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion (1103)	1103 (disturbed) Tablelands Basalt Forest TEC	1.85	1.85	0.14	1.32	9.9
	1103 (disturbed) Box Gum Woodland TEC				0.38	3.6
	1103 (good) Tablelands Basalt Forest TEC	11.62	13.04	0.90	8.04	79.8
	1103 (good) Box Gum Woodland TEC				4.10	68.6
	1103 (low-moderate) Tablelands Basalt Forest TEC	4.79	4.79	0	3.97	43.4
	1103 (low-moderate) Box Gum Woodland TEC				0.82	33.2
	1103 (moderate) Tablelands Basalt Forest TEC	6.94	7.57	0.74	6.31	70.9
	1103 (moderate) Box Gum Woodland TEC				0.52	66.8
Burrarorang subregion / Sydney Basin Bioregion						
–Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills,	731 (good)	12.44	12.44	0	12.44	72.1
	731 (moderate)	14.61	12.09	0	12.09	67.2
	731 (variant – good)	3.08	3.08	0	3.08	83.7

Plant community type (PCT)	Vegetation zone	Area within subject land (ha) – BDAR	Area within subject land (ha) – Current	Area within exclusion zones (ha)	Area to be impacted (ha)	Change (loss) in vegetation integrity score
South Eastern Highlands Bioregion (731)						
Silvertop Ash - Narrow-leaved Peppermint open forest on ridges of the eastern tableland, South Eastern Highlands Bioregion and South East Corner Bioregion (1155)	1155 (moderate)	10.24	10.45	0.49	9.96	63.2
Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion 1330)	1330 (moderate) Box Gum Woodland TEC	0	1.90	0	1.90	67.7

The 75.09 hectares of native vegetation to be cleared for the proposal includes 27.36 hectares of vegetation that meets the criteria for a TEC under the BC Act and 3.90 hectares under the EPBC Act. These areas are listed in Table 4-2.

Table 4-2 Direct impacts to threatened ecological communities

Threatened ecological community (TEC)	Vegetation zone	Area within subject land (ha)	Area within exclusion zones (ha)
BC Act listed communities			
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregion (Endangered)	1103 (good)	8.04	0
	1103 (moderate)	6.31	0
	1103 (low-moderate)	3.97	0
	1103 (disturbed)	1.32	0
	Total	19.64	0
White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland in the NSW	1330 (moderate)	1.90	0
	1103 (good)	5.00	0.90

Threatened ecological community (TEC)	Vegetation zone	Area within subject land (ha)	Area within exclusion zones (ha)
North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (Critically Endangered)	1103 (moderate)	1.26	0.74
	1103 (low-moderate)	0.82	0
	1103 (disturbed)	0.52	0.14
	Total	9.50	1.78
EPBC Act listed communities			
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered)	1330 (moderate)	0.30	0
	1103 (good)	4.21	0.61
	Total	4.51	0.61

4.2 Impacts to threatened species

4.2.1 Threatened flora

A total of 75.09 hectares of native vegetation will be removed by the proposal. This native vegetation comprises PCTs 1103, 732, 731, 963, 1155 and 1330 which are considered potential habitat of locally occurring threatened flora species. No individuals of threatened flora species assessed as having a moderate or higher likelihood of occurrence were detected during targeted surveys. Subsequently there will be no direct impacts to threatened flora species from the proposal. There is however the potential for threatened flora species to exist within the seed bank on the subject land. Pre-clearing surveys would be undertaken to check for threatened flora species and an unexpected finds procedure would be following in the event of encountering an unexpected threatened flora species as per Section 9.1 of the BDAR.

4.2.2 Threatened fauna

Gang-gang Cockatoo

Gang-gang Cockatoo has been assumed to use the subject land for dispersal and foraging habitat as per the BDAR (Arcadis, 2021), and subsequent impacts of the proposal have been assessed (Section 8.1 of BDAR). Results of the current surveys support the assessment that the area is used as foraging habitat, however, do not suggest breeding is occurring within the subject land nor that the proposal will significantly impact breeding habitat for the species in the area.

Multiple observations of the species around the River Lett in Little Hartley may indicate that the species breeds in suitable tree hollows in the surrounding areas. The observation of multiple adults feeding in the River Oak, *Casuarina cunninghamiana*, along the river could suggest that this tree species is an important foraging resource.

The field surveys failed to detect any Gang-gang Cockatoo tree hollow nests in the project area. However, a reduction of tree hollows in the area is likely to place greater impact on all hollow nesting species in the project area which includes Gang-gang Cockatoo. See BDAR (Arcadis, 2021) for further information.

No species credits are required for the Gang-gang Cockatoo.

Booroolong Frog

Surveys in the River Lett failed to detect any Booroolong Frogs. While the species has been recorded in the wider area historically (>20 years ago), it is possible that the site has changed significantly since these records. There was substantial weed growth along the banks of the river, which has been associated with major declines in the Booroolong Frog populations (Hansen and Crosby, 2016). The site also contains dense tree cover which has been known to be unsuitable for Booroolong Frog, instead preferring open exposed to extended period of direct sunlight which aid in their thermoregulation requirements (Hunter and Smith, 2013).

Chytrid Fungus has been responsible for worldwide declines of amphibians (Berger et al., 1998) and it is not known if the site may contain this pathogen. While Booroolong Frogs were not found in the project area, it is possible that populations exist further downstream. To ensure these populations are not impacted, construction activities should use hygiene measures to wash down vehicles, equipment and footwear when entering the riparian zone. Furthermore, the introduction of foreign soil and water should also be avoided to prevent the spread of Chytrid.

No species credits are required for the Booroolong Frog.

Threatened microbat species

Large Bent-winged Bat

The BDAR identified potential impacts to this species as a result of noise and vibration, human disturbance and potential culvert extension works at Culvert 3. Culvert extension works are no longer required and direct impacts to the species roosting habitat would not occur.

Survey results suggests the species is roosting in Culvert 2 during all times of the year, and if roosting in Culvert 3, only in small numbers. Indirect impacts to the species could occur at Culvert 3 and are likely at Culvert 2 given the high chance of a roost. Conducting works during the overwinter period would not avoid impacts to the species but would not affect breeding habitat.

Impacts to the species are otherwise consistent with those assessed in the BDAR.

No species credits are required for the Large Bent-winged Bat.

Large-eared Pied Bat

The subject land was found to contain potential breeding habitat for the Large-eared Pied Bat in Culverts 2 and 3. Breeding has not been confirmed at the culverts and targeted surveys would be undertaken at culvert 2 and 3 to confirm presence of breeding bats during the next breeding season. Should breeding bats occur, indirect impacts could occur at the culverts from noise and vibration and increased disturbance from human activity, as assessed in Section 8.1.5 of the BDAR. In the event breeding is detected, mitigation measures would be developed to avoid impacts to breeding individuals such as construction scheduling to avoid works near both culverts during the breeding season (November to January - inclusive).

A species polygon was established for this species in the BDAR to include all habitat on the subject land (aligned with PCTs listed within the Threatened Biodiversity Data Collection) that is within two kilometres of caves, scarps, cliffs, rock overhangs, culverts and disused mines (potential breeding habitat). The species polygon has been amended to include all habitat within two kilometres of the culverts in addition to areas previously identified (Figure 3-5).

Other microbat species

Impacts to the Eastern False Pipistrelle and Greater Broad-nosed Bat are possible from indirect noise and vibration during construction at either the culverts or River Lett Bridge. No direct impacts would occur and indirect impacts are largely consistent with those described in the BDAR. Mitigation measures outlined in the BDAR are sufficient to address potential impacts. Both species are ecosystem credit species and no additional offsets are required to address impacts.

Mitigation measures outlined in the BDAR and in Table 5-1 are considered adequate to mitigate impacts to other microbat species that are not threatened species.

4.2.3 Locally significant fauna

Platypus

Platypus have the potential to be indirectly impacted by a reduction in water quality from earthworks in the vicinity of River Lett. Increasing water turbidity and spills would have adverse impacts on foraging habitat quality and food sources including aquatic invertebrates. Erosion and sedimentation control measures and spill management measures are outlined in Section 7.2 of the REF to manage water turbidity and spills. Additional mitigation measures have been included to further minimise potential water quality impacts.

Direct impacts to Platypus burrows are possible from construction of drainage outlets along the River Lett and the River Lett bridge construction. Burrow destruction can potentially cause death to individuals with or without young. Figure 3-6 maps drainage channels within areas of high and medium likelihood of burrows and close to a known burrow. The drainage design would be altered to minimise potential for impact to a burrow and additional mitigation has been included to this affect in Table 5-1.

Bridge construction would result in direct removal of vegetation and soil along banks. The bridge would be constructed in an area mapped as low potential habitat and as such, impacts to burrows are unlikely. Avoidance of earth works for bridge construction in the breeding season (October to March) would further reduce potential to impact the species.

Compaction by heavy vehicles/machinery and damage to burrows from disturbance of bank vegetation could impact burrow stability. A no-go zone would be established on the River Lett, within retained habitat to minimized potential for impacts.

Other potential impacts to Platypus include indirect impacts from noise and artificial lighting, shading, litter accumulations in River Lett and hydrological alterations to the River Lett. Shading impacts would be over a relatively small area and hydrological changes are expected to be minor as stated in Section 6.1.3 of the BDAR. Additional mitigation measures have been included in Table 5-1 to minimise other impacts.

4.3 Serious and irreversible impacts

One additional threatened entity has been identified by the BAM credit calculator as being at risk of a serious and irreversible impacts (SAIL) from the proposal. Large-eared Pied Bat listed as Vulnerable under the BC Act is a potential SAIL for breeding habitat impacts only. A SAIL assessment for the species has been undertaken in Table 4-3.

TEC SAIL assessments have been updated in Table 4-4 and Table 4-5 to account for minor changes in impact areas. The SAIL assessments remain largely consistent with those in Section 8.2 of the BDAR.

Table 4-3 SAII Assessment – Large-eared Pied Bat

SAII assessment requirement	Assessment
<p>1 The assessor is required to provide further information in the BDAR or BCAR for any species at risk of an SAII, including the action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR.</p>	<p>Direct impacts to the species breeding habitat would not occur. The presence of breeding individuals would be confirmed through survey during the next breeding season. Indirect impacts are possible if breeding individuals are detected during survey though these would be avoided through mitigation measures such as scheduling works in the vicinity of potential breeding habitat outside of the breeding season (refer to Table 5 1). Other measures would be implemented to minimise potential impacts if the species is found present (refer to Section 9 of the BDAR) and include:</p> <ul style="list-style-type: none"> • Undertaking works at night when bats are likely to have left the roost • Light minimisation measures • Restricting access to culverts with roosting bats • Adaptive management and monitoring
<p>2 The assessor must consult the TBDC and/or other sources to report on the current population of the species including:</p> <p>a. evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:</p> <ul style="list-style-type: none"> i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites 	<p>a.</p> <ul style="list-style-type: none"> i. N/A ii. In 2013, the population of Large-eared Pied Bat is predicted to have experienced a 30% decline in population size and number of mature individuals over the three years prior due to historic and continued loss of habitat (Woinarski et al 2014). In addition, at least 30% of the species area of occupancy burnt during wildfires in 2019-2020 further impacting this species. NSW has been predicted to include more than 50% of the Large-eared Pied Bat population in Australia. There is little data for the species in the last few years however a search on the NSW Bionet shows that only 19 observations were recorded in 2021 down from a mean decade number of 124 records.

SAll assessment requirement**Assessment**

- b. evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:
- i. an estimate of the species' current population size in NSW, and
 - ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and
 - iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations

- c. evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:
- i. extent of occurrence
 - ii. area of occupancy
 - iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and
 - iv. whether the species' population is likely to undergo extreme fluctuations

- b.
- i. Expert estimates of the species total population have ranged between 10,000 (Pennay & Thompson 2008) and 20,000 individuals (Woinarski et al. 2014). Reporting rates in NSW also show that this species accounts for less than 1% of all bats reported within its range (Pennay 2011). At least 30% of the area of occupancy burnt during wildfires in 2019-2020 alone and the species decline is projected to be continuing. NSW has been predicted to include more than 50% of the species. Taking into account that there has been continued decline since estimates occurred and large bushfires, it is estimated that there are fewer than 5,000 - 10,000 individuals remaining. This is a conservative estimate. Accuracy is difficult given limited recent data available on species population size.
 - ii. From substantial impact to the species distribution through fire and continued tree removal, the population in NSW is likely to have declined by more than 30% since 2019.
 - iii. The number of mature individuals would be significantly lower. The total number of individuals in any of the scattered subpopulations is estimated to be less than 1,000 (Woinarski et al. 2014).
- c.
- i. The Large-eared Pied Bat has a large extent of occurrence (EOO) of <20,000km². It is found from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands.
 - ii. The area of occupancy is much less at 1,508 km² (Woinarski et al. 2014).
 - iii. The Large-eared Pied Bat is at risk across its range and no specific threat-defined locations.
 - iv. There is no evidence that this species will undergo extreme fluctuations.

SAII assessment requirement	Assessment
<p>d. evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:</p> <ul style="list-style-type: none"> i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus). 	<p>d.</p> <ul style="list-style-type: none"> i. The known reproductive characteristics would not limit the ability of the Large-eared Pied Bat to occupy new habitat. However, as stated below, the availability of caves or crevices in cliffs for maternal roost sites would be required. ii. The Large-eared Pied Bat roosts in caves and crevices in cliffs. A biodiversity stewardship site would be required to provide these requirements for breeding. iii. N/A
<p>3 Where the TBDC indicates data is 'unknown' or 'data deficient' for a species for a criterion listed in Subsection 9.1.2(2.), the assessor must record this in the BDAR or BCAR.</p>	<p>The TBDC does not indicate data is 'unknown' or 'data deficient' for this species for any of the listed criteria.</p>
<p>4 In relation to the impacts from the proposal on the species at risk of an SAI, the assessor must include data and information on:</p> <ul style="list-style-type: none"> a. the impact on the species' population (Principles 1 and 2) presented by: <ul style="list-style-type: none"> i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and 	<p>a.</p> <ul style="list-style-type: none"> i. Fourteen Large-eared Pied Bat passes were recorded near two culverts within the subject land during eight nights of survey which is indicative of a very small number of individuals being present. The species was not recorded during surveys in other locations across the subject land. It is likely that an additional 5-10 individuals (BioNet shows 9 records within 10km) use the subject land for foraging due to nearby roosting habitat in escarpments of Hassans Walls and other nearby areas where the species has been recorded. Based on the available data, it is estimated that the number of individuals that utilise the subject land could range

SAIL assessment requirement	Assessment
<ul style="list-style-type: none"> ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal 	<ul style="list-style-type: none"> from one to ten. Based on a 5,000-10,000 population size, the bats in the subject land would represent <0.2% of the current NSW population at most. ii. N/A iii. The area of habitat to be impacted is 27.59ha. The number of the number of individuals that utilise the subject land could range from one to ten.
<p>b. impact on geographic range (Principles 1 and 3) presented by:</p> <ul style="list-style-type: none"> i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions 	<p>b.</p> <ul style="list-style-type: none"> i. The area of the species' geographic range to be impacted would be 27.59ha which equals 0.1% of the area of occupancy within NSW. ii. Indirect impacts to potential roosting habitat from noise and vibration may occur if the species is roosting in the culvert. Foraging resources will also be removed. It is not anticipated that all of the subpopulation would be impacted. iii. An estimate of the area required to support the persisting subpopulation is unable to be calculated. However, a recent study (Williams and Thompson 2018) of Large-eared Pied Bats in the Blue Mountains shows that this species forages for food at an average distance of 700m from their roosting habitat and up to 2.5km has been recorded. There are ample areas of intact native vegetation within the locality that are within these distances of the subject land that are suitable for foraging and contain rocky features likely suitable for breeding and are therefore likely to support the persisting subpopulation. <p>The proposal would result in potential edge effects which are anticipated to be minor for all biodiversity as noted in Section 8.1.3 of the BDAR which is also expected for this species. Indirect noise and vibration impacts are discussed in Sections 4.2.2 of the Biodiversity Addendum Report and Section 8.1.5 of the BDAR and would be managed in accordance with mitigation measures outlined in both reports.</p>

SAll assessment requirement	Assessment
<p>(increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.</p>	
<p>5 The assessor may also provide new information that can be used to demonstrate that the principle identifying the species as at risk of an SAll, is inaccurate</p>	<p>N/A</p>

Table 4-4 SAI assessment - Tableland Basalt Forest

SAI assessment requirement	Assessment
<p>1 The assessor is required to provide further information in the BDAR or BCAR regarding the impacts on each TEC at risk of an SAI. This must include the action and measures taken to avoid the direct and indirect impact on the TEC at risk of an SAI. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR and BCAR.</p>	<p>Avoidance and minimisation of biodiversity impacts are documented in Chapter 5 of this report. Impacts to TECs and highly cleared PCTs were avoided as far as possible during options assessment, with the selected option having the second least amount of TEC impacted (SKM, 2009).</p>
<p>2 The assessor must consult the TBDC and/or other sources to report on the current status of the TEC including:</p> <p>a. evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW AND the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)</p>	<p>Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions is listed as endangered under the BC Act.</p> <p>The current geographic extent of this TEC in NSW is not precisely known. The TEC incorporates multiple PCTs, with a total of 18 PCTs listed as associated vegetation types in the TBDC; some of these PCTs only partially meet the criteria for the TEC.</p> <p>The Final Determination for Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (NSW TSSC, 2011) states that the total remaining area of the TEC is estimated to be less than 15 000 ha, and represents approximately 5-20% of its projected occurrence at the time of European settlement.</p> <p>There is no information available in the TBDC on the estimated reduction in geographic extent of the TEC since 1970.</p>
<p>a. extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by:</p> <p>i. change in community structure</p> <p>ii. change in species composition</p> <p>iii. disruption of ecological processes</p> <p>iv. invasion and establishment of exotic species</p> <p>v. degradation of habitat, and</p>	<p>Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions has been and continues to be subject to a range of threatening processes resulting in degradation and decline in biotic processes (NSW TSSC, 2011), including:</p> <ul style="list-style-type: none"> • extensive clearing, resulting in fragmentation and loss of ecological connectivity • moderate to heavy grazing by livestock and rabbits, resulting in changes to ecosystem structure and composition, compaction and erosion of topsoil, invasion of the community by exotic plant species

SAIL assessment requirement	Assessment
vi. fragmentation of habitat	
b. evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the TEC's geographic range in NSW according to the: <ul style="list-style-type: none"> i. extent of occurrence ii. area of occupancy, and iii. number of threat-defined locations 	<p>The Final Determination for Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (NSW TSSC, 2011) states that the geographic distribution of the TEC is highly restricted.</p> <p>The estimated extent of occurrence is 21,841 km² and the estimated area of occurrence is >112 km² (advice from the BAM support team, provided via email 16 September 2021). There is no information on the number of threat-defined locations for this TEC.</p>
c. d. evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).	There is no evidence that the TEC is unlikely to respond to management.
3 Where the TBDC indicates data is 'unknown' or 'data deficient' for a TEC for a criterion listed in Subsection 9.1.1(2.), the assessor must record this in the BDAR or BCAR.	The TBDC does not indicate data is 'unknown' or 'data deficient' for this TEC for any of the listed criteria.
4 In relation to the impacts from the proposal on the TEC at risk of an SAIL, the assessor must include data and information on: <ul style="list-style-type: none"> a. the impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal: <ul style="list-style-type: none"> i. in hectares, and ii. as a percentage of the current geographic extent of the TEC in NSW. <p>Data and information should include direct impacts (i.e. from clearing) and indirect impacts where partial loss of the TEC is likely as a result of the proposal. The assessor should consider for example, changes to fire regime (frequency, severity), hydrology, pollutants, species interactions (increased</p>	<p>The proposal would result in direct impacts to 19.02 hectares of Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions.</p> <p>The current geographic extent of this TEC in NSW is not precisely known. The TEC incorporates multiple PCTs, with a total of 18 PCTs listed as associated vegetation types in the TBDC; some of these PCTs only partially meet the criteria for the TEC.</p> <p>The Final Determination for Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (NSW TSSC, 2011) states that the total remaining area of the TEC is estimated to be less than 15 000 hectares. This number is likely to be lower at the date of the current report (2022). The removal of 19.02 hectares represents a loss of at least 0.13% of the current extent of the TEC in NSW.</p>

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Assessment

competition, changes to pollinators or dispersal), fragmentation, increased edge effects and disease, pathogens and parasites, which are likely to contribute to the loss of flora and/or fauna species characteristic of the TEC

b. the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by:

i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 metres of the development footprint or equivalent area for other types of proposals

ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:

- distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and
- estimated maximum dispersal distance for native flora species characteristic of the TEC, and

iii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.

- other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development

Removal of 19.02 hectares of Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions from the subject land will leave one adjoining patch of TEC about 68 hectares in area to the south of the subject land, and another adjoining patch of about 69 hectares to the north of the subject land.

The TEC is currently fragmented by the existing highway. The existing gap between patches of the TEC currently ranges from about 27m to 45m; this will increase to 170m to 232m following completion of the proposal.

The maximum dispersal distance for native flora species characteristic of the TEC varies depending on the species, and this is not known for all species.

According to Booth (2017), eucalypt pollen regularly travels distances of over one kilometre, although most is distributed within 200 m. Seed is dispersed by dropping from the canopy, and the seeds of most eucalypt species fall within a distance roughly equivalent to the height of the tree (Booth, 2017).

Grasses tend to disperse seed through adhesion, where the seed attaches to animal fur; other species such as those in the Asteraceae may have wind-dispersed seeds.

In general, pollination of some species may be possible between highly fragmented patches, but seed dispersal is less likely.

The areas of the TEC identified in the subject land are in variable condition and occur within four different vegetation zones. The vegetation integrity scores for each zone, and their composition, structure and function condition scores, are listed below.

SAll assessment requirement	Assessment				
	Vegetation zone	Composition	Structure	Function	Vegetation integrity score
	1103 (good)	82	71.4	87	79.8
	1103 (moderate)	46.4	84.8	90.7	70.9
	1103 (low-moderate)	26.4	33.5	91.9	43.4
	1103 (disturbed)	27.5	3.9	9.2	9.9
The assessor may also provide new information that demonstrates that the principle identifying that the TEC is at risk of an SAll is not accurate.	NA				

Table 4-5 SAII assessment - White Box Yellow Box Blakely's Red Gum Woodland

SAII assessment requirement	Assessment
<p>1 The assessor is required to provide further information in the BDAR or BCAR regarding the impacts on each TEC at risk of an SAII. This must include the action and measures taken to avoid the direct and indirect impact on the TEC at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR and BCAR.</p>	<p>Avoidance and minimisation of biodiversity impacts are documented in Section 7 of this report. Impacts to TECs and highly cleared PCTs were avoided as far as possible during options assessment, with the selected option having the second least amount of TEC impacted (SKM, 2009).</p> <p>In order to minimise impacts on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, a 1.78 hectares patch of the TEC is being retained within the subject land in an exclusion zone.</p>
<p>2 The assessor must consult the TBDC and/or other sources to report on the current status of the TEC including:</p> <p>a. evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW AND the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)</p>	<p>White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as critically endangered under the BC Act and the EPBC Act.</p> <p>The current geographic extent of this TEC in NSW is not precisely known. The TEC incorporates multiple PCTs, with a total of 66 PCTs listed as associated vegetation types in the TBDC; some of these PCTs only partially meet the criteria for the TEC.</p> <p>The Commonwealth listing advice and conservation advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (TSSC, 2006) identified a total of 250,729 hectares of the TEC in NSW, compared with the estimated pre-1750 extent of 3,717,366 ha, which represents a reduction of 93%.</p> <p>There is no information available in the TBDC on the estimated reduction in geographic extent of the TEC since 1970.</p>
<p>b. extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by:</p> <p>i. change in community structure</p> <p>ii. change in species composition</p> <p>iii. disruption of ecological processes</p>	<p>White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland has been and continues to be subject to a range of threatening processes resulting in degradation and decline in biotic processes (NSW TSSC, 2020), including:</p> <ul style="list-style-type: none"> • extensive and ongoing clearing, mostly for agriculture • widespread grazing of domestic stock, resulting in changes to ecosystem structure and composition, soil erosion, invasion of the community by exotic plant species • dryland salinity, resulting in eucalypt dieback, death of understorey species and invasion of exotic species

SAIL assessment requirement		Assessment
<ul style="list-style-type: none"> iv. invasion and establishment of exotic species v. degradation of habitat, and vi. fragmentation of habitat 	<ul style="list-style-type: none"> • elevated soil nitrogen, resulting in weed invasion and conversion from native to exotic pasture 	
<ul style="list-style-type: none"> c. evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the TEC's geographic range in NSW according to the: <ul style="list-style-type: none"> i. extent of occurrence ii. area of occupancy, and iii. number of threat-defined locations 	<p>The Final Determination for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (NSW TSSC, 2020) states that the geographic distribution of the TEC is not restricted.</p> <p>The estimated extent of occurrence of the TEC is 702,800 km² and the estimated area of occupancy is 151,100 km² (NSW TSSC, 2020).</p> <p>There is no publicly available information on the number of threat-defined locations for this TEC.</p>	
<ul style="list-style-type: none"> d. evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation). 	<p>There is no evidence that the TEC is unlikely to respond to management; the National Recovery Plan for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DECCW, 2010) includes a list of management practices essential to the maintenance and/or improvement of the TEC.</p>	
<p>3 Where the TBDC indicates data is 'unknown' or 'data deficient' for a TEC for a criterion listed in Subsection 9.1.1(2.), the assessor must record this in the BDAR or BCAR.</p>	<p>The TBDC does not indicate data is 'unknown' or 'data deficient' for this TEC for any of the listed criteria.</p>	
<p>4 In relation to the impacts from the proposal on the TEC at risk of an SAIL, the assessor must include data and information on:</p> <ul style="list-style-type: none"> a. the impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal: <ul style="list-style-type: none"> i. in hectares, and ii. as a percentage of the current geographic extent of the TEC in NSW. 	<p>The proposal would result in direct impacts to 7.72 hectares of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.</p> <p>The current geographic extent of this TEC in NSW is not precisely known. The TEC incorporates multiple PCTs, with a total of 66 PCTs listed as associated vegetation types in the TBDC; some of these PCTs only partially meet the criteria for the TEC.</p> <p>Threatened Species Scientific Committee, (2006) identified a total of 250,729 hectares of the TEC in NSW. This number is likely to be lower at the date of the current report (2022). The removal of 7.72 hectares represents a loss of at least 0.003% of the current extent of the TEC in NSW.</p>	

SAll assessment requirement

Assessment

Data and information should include direct impacts (i.e. from clearing) and indirect impacts where partial loss of the TEC is likely as a result of the proposal. The assessor should consider for example, changes to fire regime (frequency, severity), hydrology, pollutants, species interactions (increased competition, changes to pollinators or dispersal), fragmentation, increased edge effects and disease, pathogens and parasites, which are likely to contribute to the loss of flora and/or fauna species characteristic of the TEC

b. the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by:

i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500m of the development footprint or equivalent area for other types of proposals

ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:

- distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and
- estimated maximum dispersal distance for native flora species characteristic of the TEC, and

iii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.

Removal of 7.72 hectares of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland from the subject land will leave one patch of TEC about 7.5 hectares in area and three smaller patches of 0.7 hectares to 1.5 hectares to the south-west of the subject land, another two patches of about 0.9 hectares each to the north-east of the subject land, and another 1.78 hectare patch within an exclusion zone in the subject land. Another large patch of the TEC, of at least 30 hectares in area, is located to the south-east of the intersection of Jenolan Caves Road and the existing highway.

The TEC is currently fragmented by the existing highway. The existing gap between patches of the TEC ranges from about 26m to 56m; this will increase to 65 metres to 140 metres following completion of the proposal.

The maximum dispersal distance for native flora species characteristic of the TEC varies depending on the species, and this is not known for all species.

According to Booth (2017), eucalypt pollen regularly travels distances of over 1 kilometres, although most is distributed within 200m. Seed is dispersed by dropping from the canopy, and the seeds of most eucalypt species fall within a distance roughly equivalent to the height of the tree (Booth, 2017).

Grasses tend to disperse seed through adhesion, where the seed attaches to animal fur; other species such as those in the Asteraceae may have wind-dispersed seeds.

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- other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development

In general, pollination is likely to be possible between fragmented patches, but seed dispersal is less likely.

The areas of the TEC identified in the subject land are in variable condition and occur within four different vegetation zones. The vegetation integrity scores for each zone, and their composition, structure and function condition scores, are listed below.

Vegetation zone	Composition	Structure	Function	Vegetation integrity score
1330 (moderate)	76.1	76	53.7	67.7
1103 (good)	76.7	81.5	51.5	68.6
1103 (moderate)	68.2	70.2	62.3	66.8
1103 (low-moderate)	21.2	32.7	53.1	33.2
1103 (disturbed)	11	0.1	30.2	3.6

The assessor may also provide new information that demonstrates that the principle identifying that the TEC is at risk of an SAIL is not accurate.

N/A

5. Mitigation measures

Additional mitigation measures are identified in Table 5-1 relevant to this assessment.

Table 5-1 Mitigation measures

Target species	Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impact anticipated	Responsibility
Gang-gang cockatoo	Loss of hollow bearing trees	Artificial hollow construction would include hollows suitable for Gang-gang Cockatoos.	Post-construction phase	Medium	None	Transport, ecologist
Booroolong Frog	Introduction of Chytrid Fungus	Hygiene measures to prevent the spread of chytrid would be implemented in accordance with <i>Hygiene guidelines: Protocols to protect priority biodiversity areas in NSW from Phytophthora cinnamomi, myrtle rust, amphibian chytrid fungus and invasive plants</i> (DPIE, 2020b).	Construction phase	Medium	None	Construction contractor
Microbats	Indirect impacts to <i>C. dwyeri</i>	Targeted survey will be undertaken during breeding season for <i>C. dwyeri</i> prior to construction. If found to be breeding at culvert 2 and 3, appropriate management measures would be implemented, such as scheduling works outside the November to January during breeding season.	Construction phase	High	None	Construction contractor, ecologist

Target species	Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impact anticipated	Responsibility
Platypus	Burrow disturbance/destruction	<p>Thorough searches for platypus burrows would be conducted by a suitably experienced ecologist prior to construction to confirm the location of any burrows within the construction footprint and determine if any of these burrows are breeding burrows.</p> <p>Based on the findings of these surveys, suitable management measures would be developed. These may include:</p> <ul style="list-style-type: none"> • Locating drainage channels to avoid areas of medium and high quality Platypus habitat • Establishing a no-go zone at retained areas of the River Lett banks during construction • Restricting earth works for bridge construction to outside the Platypus breeding season (October to March). 	Design Phase	Medium	Changes to design may be required	Engineer, ecologist

Target species	Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impact anticipated	Responsibility
Purple Copper Butterfly	Loss of individuals from habitat removal in unassessed areas	<p>Following acquisition of the following properties targeted surveys for Purple Copper Butterfly in areas of suitable habitat should be conducted:</p> <ul style="list-style-type: none"> Lot 10 DP1134053 'Fernhill' 3109 Great Western Highway, South Bowenfels NSW 2790 Lot 154 DP1122453 "Misty View" 3055 Great Western Highway, Hartley NSW 2790 <p>Surveys should be conducted during detectable periods (DPIE (EES), 2021a).</p>	Pre-construction	High	None	Transport

6. Offsetting

6.1 Ecosystem credits

The ecosystem credits required to offset the direct impacts of the proposal, as determined using the BAM credit calculator, are listed in Table 6-1. A total of 2,474 ecosystem credits are required to offset the direct impacts of the proposal, a decrease of 54 credits from the 2,528 ecosystem credits required in the BDAR. Changes to vegetation integrity scores and vegetation zone areas across the subject land has resulted in different ecosystem credit totals.

Table 6-1 Ecosystem credits – direct impacts

Plant community type (PCT)	Vegetation zone code	Area to be impacted (ha)	Ecosystem credits required
Bathurst Subregion / South Eastern Highlands Bioregion			
River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion (85)	85 (moderate)	3.95	155
	85 (disturbed)	0.35	6
Broad-leaved Peppermint - Ribbon Gum grassy open forest in the north east of the South Eastern Highlands Bioregion (732)	732 (moderate)*	4.98	140
Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains; Sydney Basin Bioregion (963)	963 (good)*	0.88	27
Ribbon Gum - Yellow Box grassy woodland on undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion (1103) Tablelands Basalt Forest TEC	1103 (disturbed)	1.32	0
	1103 (good)	8.04	321
	1103 (low-moderate)	3.97	86
	1103 (moderate)	6.31	224
Ribbon Gum - Yellow Box grassy woodland on undulating terrain of the eastern tablelands; South Eastern Highlands Bioregion (1103) Box Gum Woodland TEC	1103 (disturbed)	0.38	0
	1103 (good)	4.10	176
	1103 (low-moderate)	0.82	17
	1103 (moderate)	0.52	22
Burrangorang subregion / Sydney Basin Bioregion			
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion (731)	731 (good)	12.44	449
	731 (variant – good)	3.08	129
	731 (moderate)	12.08	406

Plant community type (PCT)	Vegetation zone code	Area to be impacted (ha)	Ecosystem credits required
Silvertop Ash - Narrow-leaved Peppermint open forest on ridges of the eastern tableland, South Eastern Highlands Bioregion and South East Corner Bioregion (1155)	1155 (moderate)	9.96	236
Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)	1330 (moderate)	1.90	80
Total (Bathurst Subregion / South Eastern Highlands Bioregion)		35.62	1,174
Total (Burratorang subregion / Sydney Basin Bioregion)		39.47	1,300
Total (all bioregions)		75.09	2,474

*Although some or all areas of this PCT in the subject land are within the Sydney Basin Bioregion, the BAM calculator does not allow selection of this PCT within the bioregion; therefore the PCT has been included in the calculator for the South Eastern Highlands bioregion.

6.2 Species credits

The species credits required to offset the impacts of the proposal, as determined using the BAM credit calculator, are listed in Table 6-2. There have been minor increases in credit requirements for two species. Large-eared Pied Bat credits increased due to an inclusion of additional habitat within the two kilometres of the two culverts that contain potential roosting bats. Squirrel Glider credits slightly increased due to patches of PCT 732 being re-mapped to PCT 1103, associated habitat of this species. Greater Glider credits decreased following ground-truthing of native vegetation previously identified as suitable habitat.

Table 6-2 Species credits

Species	Loss of habitat (ha)		Total loss of habitat (ha)	Total species credits required
	Bathurst Subregion / South Eastern Highlands Bioregion	Burratorang subregion / Sydney Basin Bioregion		
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	5.28	22.45	27.73	1,408 (193 additional)
<i>Paralucia spinifera</i> Purple Copper Butterfly	3.97	0.33	4.30	137 (no change)
<i>Petauroides volans</i> Greater Glider	19.41	19.53	38.94	1,356 (128 less)
<i>Petaurus norfolcensis</i> Squirrel Glider	25.50	25.73	51.23	1,788 (1 additional)

*Some areas of habitat in the subject land located within the Sydney Basin Bioregion have been included in the BAM calculator for the South Eastern Highlands, due to associated PCTs.

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Appendix A - Recorded Fauna

Common name	Scientific name	Observation type	Status	
			BC Act	EPBC Act
BIRDS				
Australian Magpie	<i>Gymnorhina tibicen</i>	O	-	-
Australian Raven	<i>Corvus coronoides</i>	O, W	-	-
Australian Wood Duck	<i>Chenonetta jubata</i>	O, W	-	-
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	O, W	-	-
Brown Thornbill	<i>Acanthiza pusilla</i>	O	-	-
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	O	-	-
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	O, W	-	-
Common Blackbird	<i>Turdus merula</i>	W	-	-
Common Myna	<i>Acridotheres tristis</i>	O	-	-
Crimson Rosella	<i>Platycercus elegans</i>	O, W	-	-
Dollarbird	<i>Eurystomus orientalis</i>	O	-	-
Eastern Rosella	<i>Platycercus eximius</i>	O	-	-
Eastern Yellow Robin	<i>Eopsaltria australis</i>	O	-	-
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	W	-	-
Galah	<i>Eolophus roseicapilla</i>	O	-	-
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	O, W	V	-

Common name	Scientific name	Observation type	Status	
			BC Act	EPBC Act
Grey Butcherbird	<i>Cracticus torquatus</i>	O	-	-
Grey Fantail	<i>Rhipidura albiscapa</i>	O	-	-
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	O	-	-
House Sparrow	<i>Passer domesticus</i>	O	-	-
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	O	-	-
Little Corella	<i>Cacatua sanguinea</i>	O	-	-
Nankeen Kestrel	<i>Falco cenchroides</i>	O	-	-
Noisy Friarbird	<i>Philemon corniculatus</i>	O	-	-
Noisy Myna	<i>Manorina melanocephala</i>	O	-	-
Pied Currawong	<i>Strepera graculina</i>	O	-	-
Red Wattlebird	<i>Anthochaera carunculata</i>	O	-	-
Rufous Whistler	<i>Pachycephala rufiventris</i>	O	-	-
Sacred Kingfisher	<i>Todiramphus sanctus</i>	W	-	-
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	O	-	-
Spotted Pardalote	<i>Pardalotus punctatus</i>	O	-	-
Striated Thornbill	<i>Acanthiza lineata</i>	O	-	-
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	O	-	-
Superb Fairywren	<i>Malurus cyaneus</i>	W	-	-
Wedge-tailed Eagle	<i>Aquila audax</i>	W	-	-

Common name	Scientific name	Observation type	Status	
			BC Act	EPBC Act
Welcome Swallow	<i>Hirundo neoxena</i>	O	-	-
White-browed Scrubwren	<i>Sericornis frontalis</i>	W	-	-
White-throated Treecreeper	<i>Cormobates leucophaea</i>	O	-	-
White-winged Chough	<i>Corcorax melanorhamphos</i>	O	-	-
White-naped Honeyeater	<i>Melithreptus lunatus</i>	H		
Willie Wagtail	<i>Rhipidura leucophrys</i>	W	-	-
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	O	-	-
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	O	-	-
Yellow-tailed Black Cockatoo	<i>Calyptorhynchus funereus</i>	O, W	-	-
MAMMALS				
Agile Antechinus	<i>Antechinus agilis</i>	Q	-	-
Bare-nosed Wombat	<i>Vombatus ursinus</i>	F, P, Q, O	-	-
Black Rat*	<i>Rattus rattus</i>	Q	-	-
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	O	-	-
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	O	-	-
House Mouse*	<i>Mus musculus</i>	O	-	-
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	U	V	-
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O	-	-
European Rabbit*	<i>Oryctolagus cuniculus</i>	O, F	-	-

Common name	Scientific name	Observation type	Status	
			BC Act	EPBC Act
European Red Fox*	<i>Vulpes vulpes</i>	F	-	-
Feral Cat*	<i>Felis catus</i>	O	-	-
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	U	V	-
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	U	V	-
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	U	V	V
Platypus	<i>Ornithorhynchus anatinus</i>	O, F	-	-
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	F	-	-
Sugar Glider	<i>Petaurus breviceps</i>	O	-	-
Swamp Wallaby	<i>Wallabia bicolor</i>	O	-	-
Unidentified microbat	-	O, U	-	-
-	<i>Petaurus sp.</i>	O	-	-
AMPHIBIANS				
Common Eastern Froglet	<i>Crinia signifera</i>	W	-	-
Eastern Banjo Frog	<i>Limnodynastes dumerillii</i>	O, W	-	-
Green Stream Frog	<i>Litoria phyllochroa</i>	O, W	-	-
Peron's Tree Frog	<i>Litoria peroni</i>	O	-	-
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	W	-	-
REPTILES				
Eastern Long-necked Turtle	<i>Chelodina longicollis</i>	O	-	-

Common name	Scientific name	Observation type	Status	
			BC Act	EPBC Act
Eastern Water Dragon	<i>Physignathus lesueurii</i>	O, Q	-	-
Eastern Water Skink	<i>Eulamprus quoyii</i>	O, Q	-	-
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	O	-	-

Observation type: O = Observed, Q = Camera trap, W = Heard call, U = Ultrasonic recording, P = Scat, F = Burrow/Den

Appendix B - Recorded flora

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair			0.5							
Amygdalaceae	<i>Prunus spp.</i>		*				0.1					
Anthericaceae	<i>Thysanotus juncifolius</i>			0.1								
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Autumn-lily		0.1						0.1		
Apiaceae	<i>Conium maculatum</i>	Hemlock	*				0.1					
Apiaceae	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort		0.3	0.1	0.1	2	0.5	0.2	1		
Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	*						0.1			
Asteraceae	<i>Cassinia aculeata</i>	Dolly Bush					0.5			0.1		
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting								0.1		
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	*	0.1		0.1	0.1	0.1				
Asteraceae	<i>Conyza bonariensis</i>	Flaxleaf Fleabane	*					0.2	0.5	0.1		
Asteraceae	<i>Conyza sumatrensis</i>	Tall fleabane	*	0.5	0.1	1					0.1	0.1

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Asteraceae	<i>Euchiton involucratus</i>	Star Cudweed						0.1				
Asteraceae	<i>Euchiton sphaericus</i>	Star Cudweed							0.2	0.1		
Asteraceae	<i>Gamochaeta</i> spp.		*	0.1	0.1							
Asteraceae	<i>Hypochaeris radicata</i>	Catsear	*	0.2		0.2	0.2	0.2		0.1	0.5	1
Asteraceae	<i>Ozothamnus diosmifolius</i>	White Dogwood						0.1		0.1		
Asteraceae	<i>Senecio hispidulus</i>	Hill Fireweed			0.1		0.1					
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	*	0.5								
Asteraceae	<i>Senecio quadridentatus</i>	Cotton Fireweed				0.1	0.2		0.1			0.1
Asteraceae	<i>Sonchus asper</i>	Prickly Sowthistle	*			0.1	0.1					
Asteraceae	<i>Sonchus oleraceus</i>	Common Sowthistle	*				0.1		0.1			
Asteraceae	<i>Vittadinia cuneata</i>	A Fuzzweed									0.1	
Asteraceae	<i>Xerochrysum viscosum</i>	Sticky Everlasting		0.1						2		
Boraginaceae	<i>Cynoglossum australe</i>						0.5	0.1	0.2	0.2		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Boraginaceae	<i>Echium plantagineum</i>	Patterson's Curse	*			0.1		0.1				
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	*						0.1			
Boraginaceae	<i>Myosotis</i> spp.					0.1						
Brassicaceae	<i>Brassica</i> spp.	Brassica	*			0.1						
Campanulaceae	<i>Wahlenbergia communis</i>	Tufted Bluebell		0.2								
Campanulaceae	<i>Wahlenbergia gracilentia</i>	Annual Bluebell								0.1		
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell							0.1			
Campanulaceae	<i>Wahlenbergia</i> spp.	Bluebell					0.2				0.1	0.1
Caprifoliaceae	<i>Lonicera japonica</i>	Japanese Honeysuckle	*		0.1							
Caryophyllaceae	<i>Stellaria pungens</i>	Prickly Starwort					0.1	0.2				
Casuarinaceae	<i>Casuarina cunninghamiana</i>	River Oak			20							
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush						0.5	1	0.2		
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort						0.1	0.1	0.1		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Clusiaceae	<i>Hypericum perforatum</i>	St. Johns Wort	*	5	0.1	0.1	0.5	0.1	0.3	0.1	1	0.1
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed		0.5	0.1			7.5	0.1			0.1
Cyperaceae	<i>Carex gaudichaudiana</i>					0.1						
Cyperaceae	<i>Carex inversa</i>	Knob Sedge						0.1	0.1			
Cyperaceae	<i>Carex</i> spp.				0.2	0.1						
Cyperaceae	<i>Cyperus</i> spp.								0.1			
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken		3	0.2							5
Dilleniaceae	<i>Hibbertia obtusifolia</i>	Hoary Guinea Flower		0.1						0.5		
Euphorbiaceae	<i>Micrantheum</i> spp.				5							
Fabaceae (Faboideae)	<i>Bossiaea buxifolia</i>			0.2						0.1		
Fabaceae (Faboideae)	<i>Cytisus scoparius</i>	Scotch Broom										0.1
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil		0.2			0.1	0.1	0.1	0.1		
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	Twining glycine			0.1		0.1	0.1		0.1		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	Variable Glycine							0.1			
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla								0.1		
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian Indigo								0.1		
Fabaceae (Faboideae)	<i>Medicago sativa</i>	Lucerne	*			0.1						
Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover	*			0.1						
Fabaceae (Faboideae)	<i>Vicia sativa</i>	Common vetch	*			0.1	0.1					
Fabaceae (Mimosoideae)	<i>Acacia dealbata</i>	Silver Wattle		20	0.5	5	1		1		1	
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	Hickory Wattle										2
Fabaceae (Mimosoideae)	<i>Acacia floribunda</i>	White Sally Wattle									0.1	
Fabaceae (Mimosoideae)	<i>Acacia melanoxylon</i>	Blackwood						1				
Fabaceae (Mimosoideae)	<i>Acacia spp.</i>	Wattle			0.2							
Gentianaceae	<i>Centaureum erythraea</i>	Common Centaury	*	0.1								

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Gentianaceae	<i>Centaurium tenuiflorum</i>	Branched Centaury, Slender centaury	*				0.1					
Geraniaceae	<i>Geranium solanderi</i>	Native Geranium		0.1	0.1	1	1	0.1	1		0.1	0.1
Goodeniaceae	<i>Goodenia hederacea</i>	Ivy Goodenia						0.1		0.2		
Haloragaceae	<i>Gonocarpus teucroides</i>	Germander Raspwort		0.2								
Iridaceae	<i>Romulea rosea</i>		*	0.1								
Juncaceae	<i>Juncus</i> spp.	A Rush				0.1						
Juncaceae	<i>Juncus usitatus</i>								0.1			
Lamiaceae	<i>Ajuga australis</i>	Austral Bugle						0.1	0.1	0.1		
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Matt-rush								3		
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Matt-rush						0.2	1			
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush		5	50			0.5	0.1	5		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Lomandraceae	<i>Lomandra multiflora</i>	Many-flowered Mat-rush		1	0.2		0.1					
Malaceae	<i>Cotoneaster glaucophyllus</i>		*						0.1			
Myrtaceae	<i>Calytrix tetragona</i>	Common Fringe-myrtle			0.1							
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum							20			
Myrtaceae	<i>Eucalyptus bridgesiana</i>	Apple Box							5	4		
Myrtaceae	<i>Eucalyptus macrorhyncha</i>	Red Stringybark						5		7.5		
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box							0.5	1	0.1	
Myrtaceae	<i>Eucalyptus viminalis</i>	Ribbon Gum		10	1	20	15	10				25
Myrtaceae	<i>Eucalyptus sp.</i>										0.4	
Myrtaceae	<i>Leptospermum spp.</i>	Tea-tree			2							
Oleaceae	<i>Ligustrum sinense</i>	Small-leaved Privet	*		25							0.1
Oxalidaceae	<i>Oxalis exilis</i>			0.1		0.1			0.1			

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Oxalidaceae	<i>Oxalis perennans</i>						0.1	0.2	0.1	0.1		
Phormiaceae	<i>Dianella longifolia</i>	Blueberry Lily		0.1	0.1		0.1					
Phormiaceae	<i>Dianella revoluta</i>	Blueberry Lily					2		0.1			
Phormiaceae	<i>Stypandra glauca</i>	Nodding Blue Lily								10		
Phyllanthaceae	<i>Poranthera microphylla</i>	Small Poranthera					0.1	0.1	0.1	0.1		
Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed	*					0.1				
Pittosporaceae	<i>Billardiera scandens</i>	Hairy Apple Berry								0.1		
Pittosporaceae	<i>Bursaria spinosa</i>	Native Blackthorn		1			0.1					
Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	*	0.1		0.2					0.1	
Plantaginaceae	<i>Veronica plebeia</i>	Trailing Speedwell		0.1	0.1		0.1	0.1	0.2	0.5		
Poaceae	<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass	*	25	5	15	40	10	10	2		
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass								5		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Poaceae	<i>Austrostipa rudis</i>			0.2				15	0.2	15		
Poaceae	<i>Bothriochloa macra</i>	Red Grass						1				
Poaceae	<i>Briza maxima</i>	Quaking Grass	*					0.1				
Poaceae	<i>Bromus catharticus</i>	Praire Grass	*			2						
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass							1			
Poaceae	<i>Dactylis glomerata</i>	Cocksfoot	*			25						0.1
Poaceae	<i>Dichelachne micrantha</i>	Shorthair Plumegrass		0.2				0.2	0.2	2		
Poaceae	<i>Dichelachne</i> spp.	A Plumegrass							1			
Poaceae	<i>Digitaria</i> spp.	A Finger Grass							0.1			
Poaceae	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass						0.2	0.5	0.5		0.1
Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	*						1			
Poaceae	<i>Elymus scaber</i>	Common Wheatgrass				0.2	5					

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Poaceae	<i>Entolasia stricta</i>	Wiry Panic			0.1							
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass						1		1		
Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	*	1	0.2	30	0.5		7		60	
Poaceae	<i>Holcus lanatus</i>	Yorkshire Fog	*			0.5			1			
Poaceae	<i>Lachnagrostis filiformis</i>			0.1								
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass		5	20	0.2	10	20	30	12		90
Poaceae	<i>Nassella trichotoma</i>	Serrated Tussock	*	0.5	5	0.2			0.2			
Poaceae	<i>Panicum simile</i>	Two-colour Panic							0.1			
Poaceae	<i>Paspalum dilatatum</i>	Paspalum	*					0.1	0.2			
Poaceae	<i>Phalaris aquatica</i>	Phalaris	*			2						
Poaceae	<i>Poa sieberiana</i>	Snowgrass		0.2								
Poaceae	<i>Rytidosperma racemosum</i>	Wallaby Grass					10					
Poaceae	<i>Rytidosperma racemosum var. racemosum</i>	Wallaby Grass							2			

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Poaceae	<i>Rytidosperma spp.</i>			0.2								
Poaceae	<i>Setaria parviflora</i>		*					0.1	1			
Poaceae	<i>Sorghum leiocladum</i>	Wild Sorghum		0.2								
Poaceae	<i>Sporobolus africanus</i>	Parramatta Grass	*					0.2	0.2			
Poaceae	<i>Themeda triandra</i>			5				2	2	5	0.1	2
Polygonaceae	<i>Acetosella vulgaris</i>	Sheep Sorrel	*			2	0.1					
Polygonaceae	<i>Rumex acetosella</i>		*					0.1	1			
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock				0.1			0.5			
Primulaceae	<i>Lysimachia arvensis</i>	Scarlet Pimpernel	*			0.1						
Proteaceae	<i>Grevillea sp.</i>											2
Proteaceae	<i>Lomatia myricoides</i>	River Lomatia			10							
Proteaceae	<i>Persoonia linearis</i>	Narrow-leaved Geebung					0.1			2		
Pteridaceae	<i>Cheilanthes sieberi</i>	Rock Fern		0.1				0.1	0.2	0.5		

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Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard					0.1	0.1	0.1			
Rosaceae	<i>Acaena novae-zelandiae</i>	Bidgee-widgee		0.1		0.1		0.1	0.2			
Rosaceae	<i>Acaena ovina</i>	Acaena					0.2					
Rosaceae	<i>Rosa rubiginosa</i>	Sweet Briar	*					0.2	0.2			
Rosaceae	<i>Rubus anglocandicans</i>	Blackberry	*		0.2	10	0.2	0.2	5		3	1
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry						0.1		0.1		
Rosaceae	<i>Sanguisorba minor</i>	Salad Burnet									0.1	0.1
Rubiaceae	<i>Opercularia aspera</i>	Coarse Stinkweed								0.1		
Santalaceae	<i>Exocarpos cupressiformis</i>	Cherry Ballart								0.5		
Scrophulariaceae	<i>Verbascum spp.</i>		*			0.2						
Solanaceae	<i>Anthocercis scabrella</i>							0.1				
Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	*					0.1			0.1	
Solanaceae	<i>Solanum prinophyllum</i>	Forest Nightshade						0.2	0.5	0.5		

Family	Scientific name	Common name	Exotic	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36
Solanaceae	<i>Solanum spp.</i>			0.1		0.1	0.1					
Verbenaceae	<i>Verbena bonariensis</i>	Purpletop	*			0.2	0.1	0.1	0.2	0.1	0.1	