



LWB1-B3 MODIFICATION ECOLOGICAL ASSESSMENT

FINAL

October 2015



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Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Austar Coal Mine Pty Ltd

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Table of Contents

1.0	Introduction	1
1.1	Proposed Modification	1
1.2	Modification Area	1
1.3	Objectives of this Ecological Assessment	4
2.0	Methods	5
2.1	Ecological Database Searches	5
2.2	Literature Review	5
2.2.1	Floristic Species List of Duckworth Property (Elliot 2014)	5
2.2.2	Austar Stage 2 Subsidence Management Plan – Appendix 1 Ecological Assessment (Umwelt 2007)	5
2.2.3	Austar Ecological Assessment, Stage 3 Mine Area (Longwalls A6 to A17) and Surface Infrastructure Site (Umwelt 2008)	6
2.2.4	Ecological Assessment for Austar Proposed Stage 3 Modification (Umwelt 2011a)	7
2.2.5	Stage 2 and Stage 3 Ecological Monitoring (Umwelt 2009, Umwelt 2010, Umwelt 2011b, Umwelt 2013, Umwelt 2014a, Umwelt 2014b)	8
2.2.6	Longwall Panels A1 and A2 Flora and Fauna Assessment, Austar Coal Mine (ERM 2006)	8
2.2.7	Vegetation of Werakata National Park, Hunter Valley, New South Wales. Cunninghamia 8(3): 331-347 (Bell 2004)	9
2.2.8	Vertebrate Fauna of Werakata National Park (DEC 2005)	9
2.2.9	Vegetation of the Cessnock-Kurri Kurri Region, Cessnock LGA, New South Wales: Survey, Classification & Mapping (Bell and Driscoll 2008)	11
2.3	Flora and Vegetation Community Surveys	11
2.3.1	Flora Surveys	12
2.3.2	Plot-based Surveys	16
2.3.3	Rapid Assessments	17
2.3.4	Meander Transect Surveys	17
2.3.5	Plant Identification and Nomenclature Standards	18
2.3.6	Vegetation Mapping	18
2.4	Fauna Surveys	18
2.4.1	Diurnal Bird Surveys	20
2.4.2	Herpetofauna Searches	20
2.4.3	Anabat Echolocation Surveys	20
2.4.4	Spotlighting	21
2.4.5	Nocturnal Call Playback	21
2.4.6	Signs of Presence Searches	22
2.4.7	SEPP 44 Surveys	22

2.4.8	Habitat Assessment	23
2.5	Aquatic Surveys	23
2.5.1	Aquatic Mammal Surveys	25
2.5.2	Aquatic Habitat Assessment	25
2.5.3	Groundwater Dependent Ecosystems	27
3.0	Results	28
3.1	Flora Species and Vegetation Communities	28
3.1.1	Threatened Species, Endangered Populations and Regionally Significant Plants	28
3.1.2	Vegetation Communities	29
3.1.3	Threatened Ecological Communities	37
3.2	Fauna Results	39
3.2.1	Fauna Species Recorded	39
3.2.2	Habitat Assessment	43
3.2.3	SEPP 44 Koala Habitat Assessment Results	44
3.3	Connectivity	44
3.4	Critical Habitat	45
3.5	Aquatic Results	45
3.6	Groundwater Dependent Ecosystems	47
4.0	Impact Assessment	49
4.1	Potential Impacts of the Proposed Modification	49
4.2	Impact on Biodiversity Values	50
4.3	Impact on Threatened Species and Communities	50
4.3.1	Threatened Species	50
4.3.2	Endangered Populations	51
4.3.3	Endangered Ecological Communities	51
4.3.4	Threatened Aquatic Species and Ecosystems	51
4.4	Matters of National Environmental Significance	51
4.5	Groundwater Dependent Ecosystems	53
4.6	Key Threatening Processes	53
4.6.1	Threatened Species Conservation Act 1995 Listed KTPs	53
4.6.2	Environment Protection and Biodiversity Conservation Act 1999 Listed KTPs	54
4.6.3	Fisheries Management Act Listed KTPs	55
5.0	Mitigation and Management	56
5.1	Ecological Monitoring	56
6.0	References	58

Figures

Figure 1.1	Locality Plan	2
Figure 1.2	Proposed LWB1-B3 Modification	3
Figure 2.1	Flora Survey Methods	13
Figure 2.2	Fauna Survey Methods	19
Figure 2.3	Aquatic Survey Methods	24
Figure 3.1	Vegetation Communities and Threatened Species Records	30

Plates

Plate 1	Photo of Riparian Swamp Oak Open Forest	31
Plate 2	Riparian Cabbage Gum Open Forest	32
Plate 3	Spotted Gum – Ironbark Forest	33
Plate 4	Photo of Melaleuca Shrubland with Emergent Eucalypts	34
Plate 5	Grassland	35
Plate 6	Wet Soak Area	36
Plate 7	Aquatic Habitat provided by the LWB1-B3 Modification Area	45
Plate 8	Low Quality Aquatic Habitat provided by the LWB1-B3 Modification Area	46

Tables

Table 2.1	Extent and Adequacy of Flora Surveys Undertaken in the LWB1-B3 Modification Area	14
Table 2.2	Modified Braun-Blanquet Crown Cover-abundance Scale	16
Table 2.3	Species of Eucalypt listed in Schedule 2 of SEPP 44	22
Table 3.1	Locally Significant Flora Species	29
Table 3.2	Vegetation Communities within the LWB1-B3 Modification Area	29
Table 3.3	Threatened Fauna Species with Potential to occur in the LWB1-B3 Modification Area	42

Appendices

Appendix A	Threatened Species, Endangered Populations and Threatened Ecological Communities with Potential to Occur
Appendix B	Flora Species List
Appendix C	Fauna Species List
Appendix D	Aquatic Survey Results
Appendix E	Seven Part Test of Significance under the Environmental Planning and Assessment Act 1979
Appendix F	Assessments of Significance under the Environment Protection and Biodiversity Conservation Act 1999

1.0 Introduction

Austar Coal Mine Pty Ltd (Austar), a subsidiary of Yancoal Australia Limited (Yancoal) operates the Austar Coal Mine, an underground coal mine located approximately 10 kilometres south of Cessnock in the Lower Hunter Valley in NSW (refer to **Figure 1.1**). The Austar Coal Mine incorporates the former Ellalong, Southland and Bellbird South Collieries and includes coal extraction, handling, processing and rail and road transport facilities.

Extensive longwall mining has been undertaken within the Austar Coal Mine in accordance with a number of approvals. Mining within the Stage 1 and Stage 2 area was approved by the Minister for Urban Affairs and Planning under DA 29/95, while mining of the Stage 3 area was approved by the Minister for Planning under Project Approval 08_0111.

1.1 Proposed Modification

Austar proposes to modify development consent DA 29/95 (the Bellbird South Consent) to permit the transfer and processing of coal from three additional longwall (LW) panels, LWB1-B3, via the existing Bellbird South mains (refer to **Figure 1.2**). The proposed modification, referred to as the LWB1-B3 Modification, seeks to amend the Bellbird South Consent to:

- extend the development consent area to cover the three longwall panels;
- extend the life of the Bellbird South Consent by a further 5 years to provide sufficient time for LWB1-B3 to be completed; and
- include a new Extraction Plan condition to cover the LWB1-B3 workings, consistent with contemporary Extraction Plan requirements.

LWB1-B3 are located in an area with a depth of cover of approximately 480 to 555 metres. The proposed modification will provide access to approximately 4.5 million tonnes of ROM coal and will provide sufficient throughput for the Austar Coal Mine to maintain business continuity in the medium term.

No other changes to the approved mining operations or existing surface facilities are proposed as part of the modification.

1.2 Modification Area

The ecological impacts of the proposed LWB1-B3 Modification have been assessed within the predicted 20 millimetre subsidence contour for LWB1-B3. The 20 millimetre subsidence contour represents the vertical limit of subsidence and is referred to throughout this report as the LWB1-B3 Modification Area (refer to **Figure 1.2**).

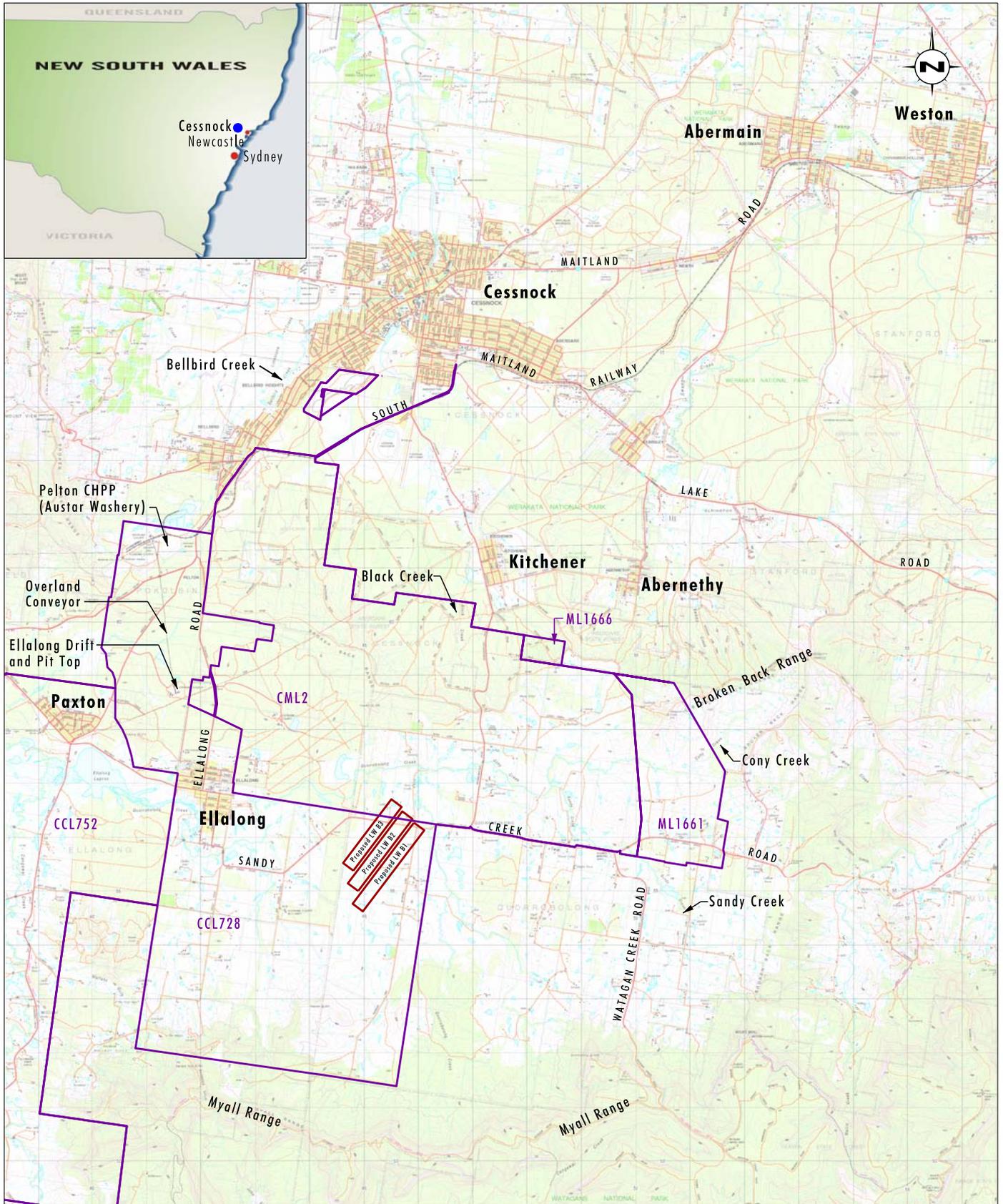


Image Source: LPI NSW (2009)
 Data Source: Aустar Coal Mine (2015)

Legend

- Proposed LWB1-B3 Longwall Panels
- Mining Lease Boundary

FIGURE 1.1
Locality Plan

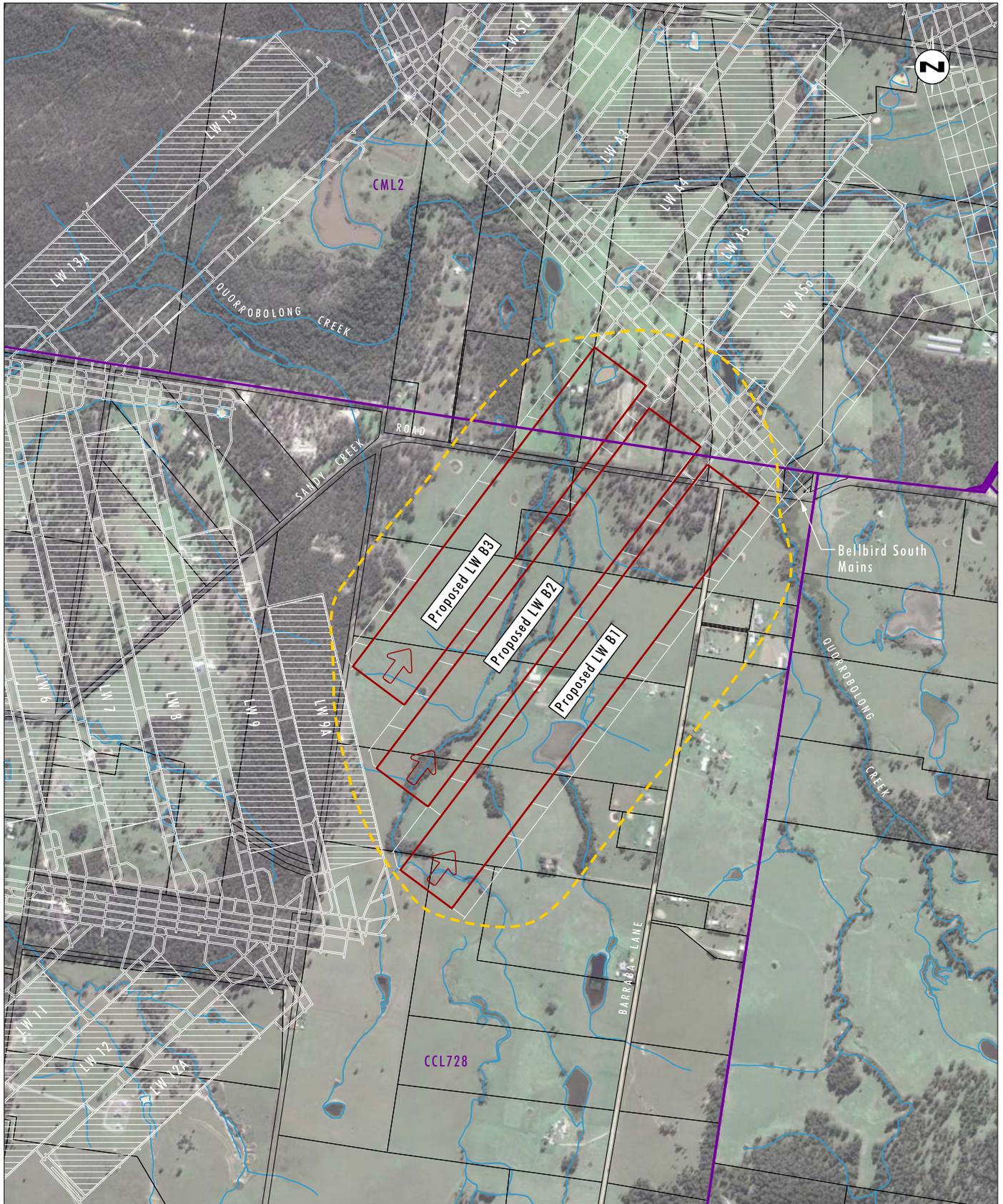


Image Source: Google Earth (2014)
 Data Source: Austar Coal Mine (2015)

0 0.25 0.5 1.0 km
 1:20 000

Legend

- ▭ Proposed LWB1-B3 Longwall Panels
- ▭ LWB1-B3 Modification Area
- ▭ Completed Underground Workings
- ▭ Mining Lease Boundary
- ➔ Direction of Mining
- Drainage Line
- Cadastral Boundary

File Name (A4): R07/3542_033.dgn
 20151014 11.13

FIGURE 1.2

Proposed LWB1-B3 Modification

1.3 Objectives of this Ecological Assessment

The objectives of this ecological assessment are to:

- record the flora and fauna species diversity, vegetation communities and fauna habitats occurring within the LWB1-B3 Modification Area
- identify any threatened species, migratory species, endangered populations or threatened ecological communities (TECs) (or their habitats), listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), and the NSW *Fisheries Management Act 1995* (FM Act)
- assess the potential impacts of the proposed modification on threatened species, migratory species, endangered populations and TECs in accordance with the requirements of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the EPBC Act
- address the requirements of the State Environmental Planning Policy 44 – Koala Habitat (SEPP 44)
- propose reasonable measures (where required) to mitigate impacts associated with the proposed modification.

2.0 Methods

2.1 Ecological Database Searches

In order to identify potential threatened species, migratory species, endangered populations and TECs with the potential to occur in the LWB1-B3 Modification Area, a search of relevant ecological databases was completed during May 2015. These database sources comprised:

- a 10 kilometre radius search from the centre of the LWB1-B3 Modification Area of the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (May 2015)
- a 10 kilometre radius search from the centre of the LWB1-B3 Modification Area of the Department of the Environment (DotE) Protected Matters Database (May 2015)
- a local government area search of the Department of Primary Industries (Fishing and Aquaculture) Threatened and Protected Species Records Viewer (May 2015).

Records from these database searches were combined with records derived through literature reviews and professional opinion to identify the range of potentially occurring threatened species, migratory species, endangered populations and TECs for the area. The results of the database searches are compiled in **Appendix A**.

Current lists of threatened species and key threatening processes were sourced from the OEH, DotE and the Department of Primary Industries websites.

2.2 Literature Review

A review of relevant and available literature was undertaken in order to gain a greater understanding of the ecological values of the LWB1-B3 Modification Area and its locality. Documents reviewed included previous ecological studies relating to sites in proximity to the LWB1-B3 Modification Area, regional vegetation mapping, relevant papers in scientific journals and threatened species information resources such as the OEH internet resources. A full list of references cited within this report is provided in **Section 6**.

A summary of the ecological findings of the key literature is provided in the following section.

2.2.1 Floristic Species List of Duckworth Property (Elliot 2014)

Although not a formal report, local horticulturalist and native plant specialist Max Elliot compiled a flora species list of the Duckworth property on behalf of the landholder. As access to this property was limited during the time of survey, this species list was utilised to inform floristic composition and to inform vegetation community mapping for this area.

2.2.2 Austar Stage 2 Subsidence Management Plan – Appendix 1 Ecological Assessment (Umwelt 2007)

Umwelt prepared an ecological assessment for the mining of three longwalls (A3-A5) within the Stage 2 area located within 1 kilometre of the current LWB1-B3 Modification Area (Umwelt 2007). Field surveys for this project were undertaken to identify threatened species, migratory species, endangered populations and TECs occurring or with potential to occur in the Stage 2 area, as well as to map the vegetation communities present and to describe the fauna habitats.

Two TSC Act listed endangered ecological communities (EECs) were recorded in the Stage 2 area, being the River Flat Eucalypt Forest and the Lower Hunter Spotted Gum – Ironbark Forest. Two threatened fauna species were recorded: the grey-crowned babbler (*Pomatostomus temporalis temporalis*) and the speckled warbler (*Chthonicola sagittata*). Two EPBC Act listed migratory species were also recorded: the great egret (*Ardea alba*) and the white-bellied sea-eagle (*Haliaeetus leucogaster*). A number of other threatened flora and fauna species were found to have potential to occur in the Stage 2 area; however none were identified during targeted surveys.

Analysis of changes to surface terrain, creek bed profiles and surface and groundwater regimes as a result of the predicted and upper bound subsidence for Stage 2 indicated that:

- there would be no significant changes to catchment boundaries
- there would be no significant change to channel alignment or bank stability
- there would be no significant change to in channel or out of channel ponding
- groundwater availability to riparian vegetation would not be likely to substantially change as a result of mining.

To ensure the continued protection of significant ecological values of the Stage 2 area, regular monitoring of the predicted subsidence area was recommended to identify unforeseen impacts of the underground mining, and to enable appropriate mitigation measures to be implemented to ameliorate these impacts. The monitoring program was specifically targeted towards identifying changes to River-flat Eucalypt Forest EEC.

2.2.3 Austar Ecological Assessment, Stage 3 Mine Area (Longwalls A6 to A17) and Surface Infrastructure Site (Umwelt 2008)

The Stage 3 project documented in Umwelt (2008) involved two components, the first being the addition of 12 longwall panels (expanding from Stage 2), and the second being the development of associated surface infrastructure. This project is located less than 3 kilometres from the LWB1-B3 Modification Area. A detailed ecological survey and assessment was undertaken by Umwelt to identify the impacts of the proposed longwall mining and surface infrastructure developments on any ecological values and to integrate into the development any measures to avoid or minimise these impacts.

Extensive multi-season ecological surveys were conducted, a summary of the methods employed is provided in Section 3.1 of this document.

The following threatened species, endangered populations and TECs were recorded:

- heath wrinklewort (*Rutidosis heterogama*)
- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)
- Lower Hunter Spotted Gum – Ironbark Forest EEC
- River-flat Eucalypt Forest EEC
- Hunter Lowland Red Gum Forest EEC
- Quorrobolong Scribbly Gum Woodland EEC

- gang-gang cockatoo (*Callocephalon fimbriatum*)
- grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- speckled warbler (*Chthonicola sagittata*)
- powerful owl (*Ninox strenua*)
- squirrel glider (*Petaurus norfolcensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)
- large-footed myotis (*Myotis macropus*)
- eastern freetail-bat (*Mormopterus norfolcensis*).

The construction of the Surface Infrastructure Site (SIS) required the clearing of an 8-10 hectare area of vegetation which included habitat for two EECs and a number of threatened species. A 17 hectare parcel of land nearby to the SIS, and with similar ecological characteristics to the SIS, was nominated as a biodiversity offset for the SIS development. In addition to the biodiversity offsets, a detailed tree-clearing procedure was developed to minimise the impacts on any hollow-bearing fauna during the construction of the SIS facilities.

Based on the subsidence predictions and modelling, it was determined that the Stage 3 project would not have a significant impact on any threatened species, migratory species, endangered populations or TECs.

2.2.4 Ecological Assessment for Austar Proposed Stage 3 Modification (Umwelt 2011a)

The subject of this ecological assessment was the reorientation of the approved Stage 3 longwall panel alignment. This project was located within 3 kilometres of the LWB1-B3 Modification Area.

Although much of the area had already been subject to ecological survey as part of Umwelt (2008), additional surveys were undertaken by Umwelt to examine previously un-surveyed vegetation to identify threatened species and delineate/clarify existing vegetation mapping.

This project identified:

- eight vegetation communities, of which two (River-flat Eucalypt Forest EEC and Lower Hunter Spotted Gum – Ironbark Forest EEC) were TECs
- three threatened flora species, being heath wrinklewort (*Rutidosis heterogama*), small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and netted bottle-brush (*Callistemon linearifolius*)
- four further threatened flora species with potential to occur, being Bynoes wattle (*Acacia bynoeana*), leafless tongue orchid (*Cryptostylis hunteriana*), Illawarra greenhood (*Pterostylis gibbosa*) and Groves paperbark (*Melaleuca groveana*)

- twelve threatened fauna species: gang-gang cockatoo (*Callocephalon fimbriatum*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), speckled warbler (*Chthonicola sagittata*), powerful owl (*Ninox strenua*), squirrel glider (*Petaurus norfolkensis*), little bentwing-bat (*Miniopterus australis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), southern myotis (*Myotis macropus*) and eastern freetail-bat (*Mormopterus norfolkensis*)
- 18 additional threatened fauna species with potential to occur.

Based on the subsidence predictions and modelling, it was determined that the revised Stage 3 longwall panel alignment would not have a significant impact on any threatened species, migratory species, endangered populations or TECs.

2.2.5 Stage 2 and Stage 3 Ecological Monitoring (Umwelt 2009, Umwelt 2010, Umwelt 2011b, Umwelt 2013, Umwelt 2014a, Umwelt 2014b)

Austar established an ecological monitoring program for the Stage 2 and Stage 3 areas in order to detect any impacts that may be associated with the longwall mining on the ecological values identified. Monitoring has been undertaken on a biannual basis at both Stage 2 and Stage 3 monitoring sites.

Monitoring of Stage 2 areas commenced in 2008 and is focused on monitoring riparian vegetation, particularly River-flat Eucalypt Forest EEC. There are six Stage 2 monitoring sites and monitoring consists of a combination of vegetation plot monitoring, condition assessment and photo monitoring.

Monitoring of Stage 3 areas commenced in 2012 and is focused on monitoring values of Lower Hunter Spotted Gum Ironbark Forest EEC, heath wrinklewort (*Rutidosia heterogama*), small flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and netted bottle brush (*Callistemon linearifolius*). There are nine Stage 3 monitoring sites at which a combination of vegetation plot monitoring, condition assessment, habitat assessment, targeted threatened species monitoring and photo monitoring are undertaken.

To date, there have been no observable impacts of longwall mining on ecological values or channel geomorphology in the Stage 2 area, with mining of all of the Stage 2 longwall panels completed. There have also been no observed changes to any of the ecological values in the Stage 3 area, with the completion of mining of LWA7 and LWA8 to date.

2.2.6 Longwall Panels A1 and A2 Flora and Fauna Assessment, Austar Coal Mine (ERM 2006)

ERM undertook an ecological survey and assessment for the proposed mining of LWA1 and LWA2 and associated infrastructure, on behalf of Austar Coal Mine (ERM 2006). The ecological survey comprised random meander and vehicle based vegetation transects, habitat assessment and opportunistic fauna observations (including observations for secondary traces of fauna such as scats, tracks, scratches and diggings). This project was located within 3 kilometres of the LWB1-B3 Modification Area.

Three vegetation communities were recorded within the survey area, including the Lower Hunter Spotted Gum – Ironbark Forest and the Hunter Lowland Red Gum Forest, both TSC Act listed EECs. The third community was described as mostly cleared and is unlikely to conform to any TEC listings.

No threatened flora or fauna species were recorded within the survey area during the study, however several species were described as having potential to occur. Two ROTAP species were recorded, being *Grevillea montana* and *Macrozamia flexuosa*.

A 7 Part Test of Significance in accordance with the requirements of the EP&A Act was undertaken for the two EECs recorded and all threatened flora and fauna species found to have potential to occur within the Study Area. This assessment concluded that the proposed longwall mining development and clearing for associated surface infrastructure would not have a significant impact on any threatened species, migratory species, populations or EECs.

2.2.7 Vegetation of Werakata National Park, Hunter Valley, New South Wales. Cunninghamia 8(3): 331-347 (Bell 2004)

Werakata National Park lies within the largest patch of vegetation of the Hunter Valley floor and protects a number of vegetation communities considered to be poorly conserved within the region, as well as populations of a number of threatened flora species. Werakata National Park is located approximately 5 kilometres north-east of the LWB1-B3 Modification Area.

Six vegetation communities were delineated within the Park, which included Lower Hunter Spotted Gum – Ironbark Forest, Central Hunter Riparian Forest, Hunter Lowlands Red Gum Forest, Kurri Sand Swamp Woodland, Kurri Sand Melaleuca Scrub Forest and Riparian Melaleuca Thicket. Each of these communities correspond with a TSC Act listed EEC, aside from Kurri Sand Melaleuca Scrub Forest and Riparian Melaleuca Thicket.

A total of 190 flora species were recorded within the Park; threatened species recorded included *Callistemon linearifolius*, *Grevillea parviflora* subsp. *parviflora*, *Eucalyptus glaucina* and *Eucalyptus parramattensis* subsp. *decadens*. Two ROTAP species were also recorded, being *Grevillea montana* and *Macrozamia flexuosa*.

Callistemon linearifolius was found in two locations within Werakata National Park, which may represent the known northern limit of the species. *Grevillea parviflora* subsp. *parviflora* was found to be common in the southern portion of Werakata National Park near Kitchener. A small population of *Eucalyptus glaucina* was found in the north-west corner of the Bishops Hill portion of Werakata National Park, where it occurs in the Hunter Lowlands Red Gum Forest. In Werakata National Park, *Eucalyptus parramattensis* subsp. *decadens* was found to have a limited distribution, mainly in association with the Neath Soil landscape and the Kurri Sand Swamp Woodland.

2.2.8 Vertebrate Fauna of Werakata National Park (DEC 2005)

A study on the vertebrate fauna of the former Aberdare State Forest (now Werakata State Conservation Area and Werakata National Park) was undertaken to inform the conservation and management of ecological values contained within the Park. The study drew on the findings of a number of previous surveys in the locality, including Ecotone (1995), Hoyer (1995), Webster (1995) and Wellington and Wells (1995). This study area is approximately 5 kilometres north-east of the current LWB1-B3 Modification Area.

In addition to the literature review, a wide range of systematic site-based fauna survey methods were employed for the project. This included diurnal bird and herpetofauna searches, nocturnal spotlighting, harp trapping, Anabat echolocation recording, call playback, Elliott trapping, hair tube sampling, habitat assessment and opportunistic observations.

The compilation of all data from previous and current surveys found that a total of 210 species of vertebrate fauna were found to be present within Werakata National Park, including 18 which are now listed under the NSW TSC Act (four of which are also now listed under the Commonwealth EPBC Act). The following lists all the threatened fauna species that were recorded within Werakata National Park:

- Stephens banded snake (*Hoplocephalus bungaroides*)
- black bittern (*Ixobrychus flavicollis*)
- glossy black-cockatoo (*Calyptorhynchus lathami*)
- swift parrot (*Lathamus discolor*)
- turquoise parrot (*Neophema pulchella*)
- barking owl (*Ninox connivens*)
- powerful owl (*Ninox strenua*)
- masked owl (*Tyto novaehollandiae*)
- brown treecreeper (eastern subsp.) (*Climacteris picumnus victoriae*)
- speckled warbler (*Chthonicola sagittatus*)
- black-chinned honeyeater (eastern subsp.) (*Melithreptus gularis gularis*)
- regent honeyeater (*Anthochaera phrygia*)
- hooded robin (*Melanodryas cucullata*)
- grey-crowned babbler (eastern subsp.) (*Pomatostomus temporalis temporalis*)
- koala (*Phascolarctos cinereus*)
- yellow-bellied glider (*Petaurus australis*)
- squirrel glider (*Petaurus norfolcensis*)
- grey-headed flying-fox (*Pteropus poliocephalus*)
- eastern freetail-bat (*Mormopterus norfolkensis*)
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)
- little bentwing-bat (*Miniopterus australis*)
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Ten introduced fauna species have been recorded in Werakata National Park, the most common being wild/domestic dog (*Canis lupus familiaris*) and European red fox (*Vulpes vulpes*).

The report identifies two areas of high conservation significance, the Tomalpin Arboreal Zone and the known Swift Parrot Locations. In the Tomalpin Arboreal Zone, the highest density of hollow-bearing trees was recorded. Hollow-bearing trees are an important habitat component for a number of threatened fauna species recorded in the park including the squirrel glider, yellow-bellied glider, masked owl, powerful owl and micro-bat species. There were a number of locations at which the swift parrots have been recorded, in which important foraging resources were present such as spotted gum (*Corymbia maculata*) blossom and nectar; and grey box (*Eucalyptus moluccana*) lerp.

Several recovery plan actions were outlined in the document, primarily focusing on the protection of the swift parrot (*Lathamus discolor*), regent honeyeater (*Anthochaera phrygia*), large forest owls, barking owl (*Ninox connivens*), koala (*Phascolarctos cinereus*) and the yellow-bellied glider (*Petaurus australis*). A number of general recovery actions were outlined, including fire and pest species management and other habitat management practices.

2.2.9 Vegetation of the Cessnock-Kurri Kurri Region, Cessnock LGA, New South Wales: Survey, Classification & Mapping (Bell and Driscoll 2008)

A vegetation survey, classification and mapping project was undertaken for the Cessnock-Kurri region (Bell & Driscoll 2008) on behalf of OEH, (formerly DECC). The area covered by the project included 70,000 hectares of land between the foothills of the Watagan Range in the south, the Corrabare and Broken Back Ranges in the west, North Rothbury in the north and the Wallis Creek floodplain in the east. The principal driver for the project was to clarify the composition and distribution of EECs within the project area, while also providing vegetation community maps and descriptions of extant and pre-1750 vegetation. The conservation significance of each vegetation community described was determined, assisted by comparisons with other proximate regional vegetation classification projects. Recommendations for which communities might meet the criteria for nomination as EECs under the TSC Act were also made.

Within the project area close to 800 native plant taxa and 37 vegetation communities were recorded, including 10 threatened flora species and three undiscovered or previously undescribed flora taxa. Seven EECs were found to be present within the Study Area, including Lower Hunter Spotted Gum-Ironbark Forest EEC (TSC Act), Hunter Lowlands Red Gum Forest EEC (TSC Act) and Kurri Sand Swamp Woodland EEC (TSC Act).

2.3 Flora and Vegetation Community Surveys

Targeted field surveys were completed in the LWB1–B3 Modification Area in order to classify and map vegetation communities and fauna habitats and included targeted threatened flora and fauna species searches. Field surveys were designed with consideration of the *Threatened Species Surveys and Assessment: Guidelines for developments and activities* (working draft) (DEC 2004) and Cessnock Council *Flora and Fauna Survey Guidelines – Lower Hunter and Central Coast Region 2002* (Murray, Bell and Hoye 2002).

Survey effort was undertaken between 4 and 6 of August and on 16 September 2015. Temperatures during the surveys ranged between 12 and 22 degrees Celsius and temperatures at night ranged between 1 and 15 degrees Celsius. Wind averaged 12 kilometres an hour and no rain was recorded.

2.3.1 Flora Surveys

Flora surveys comprised plot-based surveys, rapid assessments, and transect-based surveys. The locations of each of the flora surveys methods are shown on **Figure 2.1**. The aims of floristic surveys were to:

- record floristic diversity
- map vegetation communities
- describe the condition of vegetation
- determine the occurrence and extent of any threatened species, endangered populations or TECs within the LWB1-B3 Modification Area.

The extent of flora survey effort undertaken is provided in **Table 2.1** below.

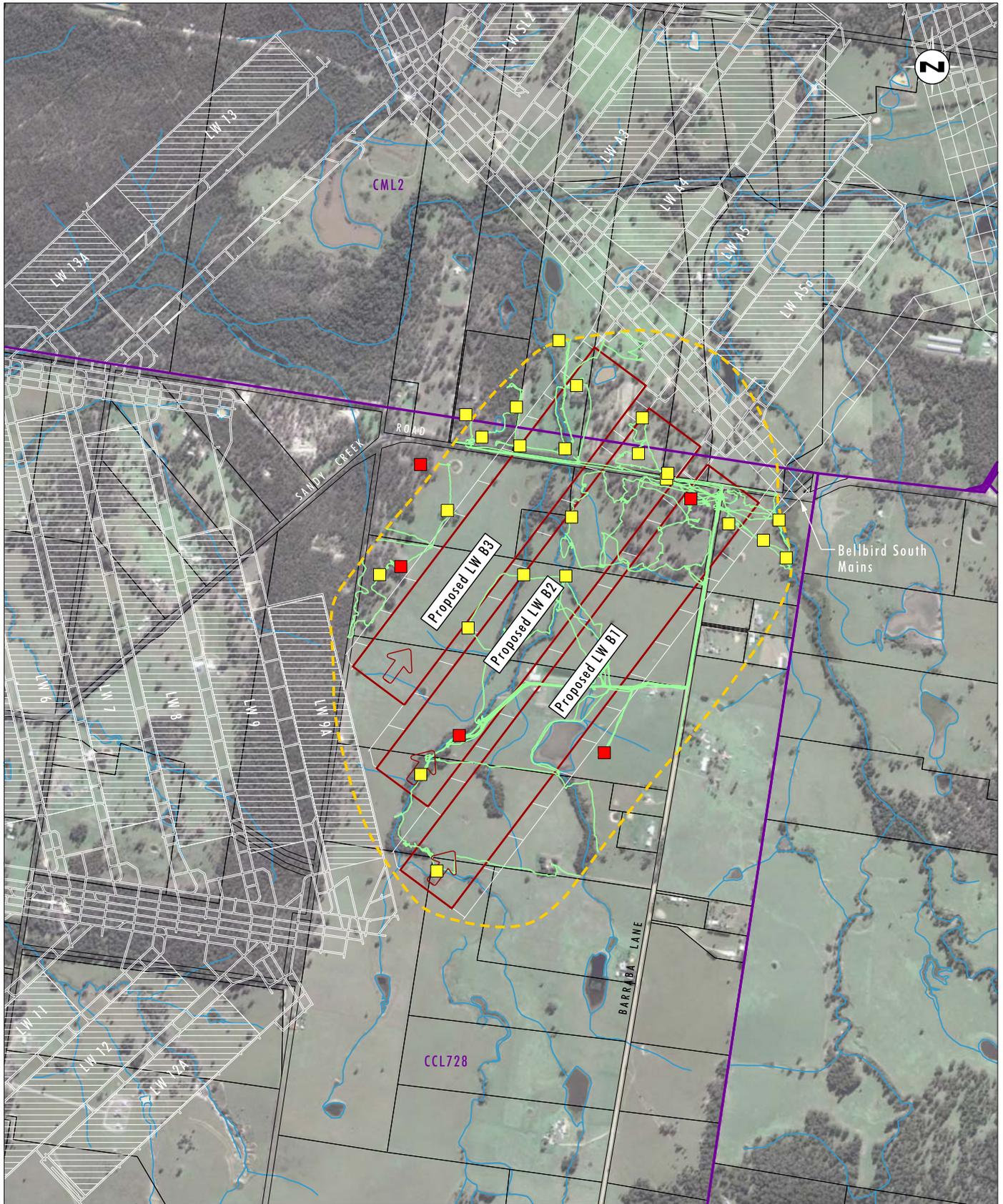


Image Source: Google Earth (2014)
 Data Source: Austar Coal Mine (2015)

0 0.25 0.5 1.0 km
 1:20 000

Legend

- ▭ Proposed LWB1-B3 Longwall Panels
- ▭ LWB1-B3 Modification Area
- ▭ Completed Underground Workings
- ▭ Mining Lease Boundary
- ➔ Direction of Mining
- Drainage Line
- Cadastral Boundary
- Meander Transect
- Plot-based Assessment
- Rapid Assessment

FIGURE 2.1

Flora Survey Methods

Table 2.1 Extent and Adequacy of Flora Surveys Undertaken in the LWB1-B3 Modification Area

Survey Technique	Extent Required in Accordance with OEH Draft Guidelines (DEC 2004)	Extent Undertaken (Vegetation Community)	Adequacy
Floristic Plots	<p>1 quadrat per stratification unit <2 hectares</p> <p>2 quadrats per 2-50 hectares of stratification unit</p> <p>3 quadrats per 51-250 hectares of stratification unit</p>	<p>3 (Spotted Gum – Ironbark Forest)</p> <p>1 (Grassland)</p> <p>1 (Riparian Swamp Oak Open Forest)</p> <p>0 (Melaleuca Scrubland with Emergent Eucalypts)</p> <p>0 (planted vegetation)</p> <p>0 (Riparian Cabbage Gum Open Forest).</p>	<p>Considered sufficient given modified nature of vegetation (all grazing land), high level of fragmentation, and extent of mapping undertaken in region (see Section 3.0)</p>
Rapid Assessments	<p>Not required</p>	<p>8 (Spotted Gum – Ironbark Forest)</p> <p>3 (Grassland)</p> <p>8 (Riparian Swamp Oak Open Forest)</p> <p>3 (Riparian Cabbage Gum Open Forest)</p> <p>1 (Melaleuca Scrubland with Emergent Eucalypts)</p> <p>1 (planted vegetation)</p>	<p>Sufficient to provide supplementary information regarding floristic composition and extent of community.</p>

Survey Technique	Extent Required in Accordance with OEH Draft Guidelines (DEC 2004)	Extent Undertaken (Vegetation Community)	Adequacy
Transects	1x100m traverse per stratification unit <2 hectares 2x100m traverses per 2-50 hectares of stratification unit 3x100m traverses per 51-250 hectares of stratification unit and 30 minutes of random meanders for each quadrat sampled within the same stratification unit	18.1 km (Spotted Gum – Ironbark Forest) 6.0 km (Riparian Swamp Oak Open Forest) 2.1 km (Riparian Cabbage Gum Open Forest) 20.7 km (Grassland) 0.5 km (Melaleuca Shrubland with Emergent Eucalypts) 1.0 km (Planted Vegetation) 0.15 km (Water Body) 0.01 km Wet Soak	Sufficient to provide supplementary information regarding floristic composition and extent of community.

2.3.2 Plot-based Surveys

The plot-based systematic vegetation surveys were undertaken using methods that are standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other surveys could be incorporated into the current work, and that the data from the current study could be analysed in an equivalent way to that collected by other recognised studies.

When undertaking systematic sampling to assist vegetation community mapping and description, plot-based (or quadrat) surveys have several distinct advantages over non-quantitative transects, including:

- providing a quantitative examination of species distribution and abundance
- being likely to detect inconspicuous or rare species (especially forbs and grasses) within the given sampling area, as a smaller area is surveyed in a concentrated search
- providing a basis for any subsequent monitoring required.

Systematic 400 m² plots were used to undertake semi-quantitative sampling of vegetation. The typical dimensions of the plots are 20 x 20 metres. This plot size is used widely, including by the Royal Botanic Gardens Sydney and OEH.

At each plot, roughly 45 to 60 minutes were spent searching for all vascular flora species present within the plot. Searches of each plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of the shrub, mid-understorey, canopy and emergent layers were also thoroughly examined. Effort was made to search the canopy and tree trunks for mistletoes, vines and epiphytes.

Species within the plot were assigned a cover-abundance value to reflect their relative cover and abundance in the plot. Species located outside the plot were marked as present but were not assigned a cover-abundance value. A modified Braun-Blanquet 6-point scale (Braun-Blanquet 1927, with selected modifications sourced from Poore 1955 and Austin *et al.* 2000) was used to estimate cover-abundances of all plant species within each plot. **Table 2.2** shows the cover-abundance categories used.

Table 2.2 Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	-
4	20 – less than 50% cover	-
5	50 – less than 75% cover	-
6	75 – 100% cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al.* 2000).

All flora species that were readily identified in the field were recorded on pro forma field survey datasheets. All flora species that could not be immediately identified and samples of all threatened flora species were collected, dried and identified or sent to the National Herbarium of NSW for identification.

In addition, information was gathered on the condition of the vegetation at each of the survey sites, including fire history and the density of weeds and evidence of disturbance such as feral animals.

2.3.3 Rapid Assessments

A total of 23 rapid vegetation assessments were completed, primarily to assist in the delineation and refinement of vegetation mapping. These assessment sites were located within each broadly mapped vegetation community to allow data collection for each community without confounding effects from adjacent communities. Dominant, common and some uncommon plant taxa were recorded within each vegetation community along meandering transects, carried out on foot, at each location.

The rapid vegetation assessments did not utilise a quantitative sampling approach as this method was designed to allow rapid collection of non-quantitative species dominance data within limited timeframes. This technique involved walking a transect and recording species found at points along the transect. Rapid vegetation assessments were selected instead of the plot-based method because it increased the amount of data that could be collected within the available survey time, thereby maximising the quality and coverage of vegetation description and mapping. This technique also facilitates the recording of general species richness, assists in the delineation of vegetation community boundaries and targets the presence of threatened and significant flora species, endangered populations and TECs.

2.3.4 Meander Transect Surveys

Meander transects and field reconnaissance was undertaken across the LWB1-B3 Modification Area while both walking and driving. This form of survey is an alternative method of flora data collection that enables the surveyor to sample flora across a much larger area than that sampled in systematic plots. However, the data collected are usually in the form of presence records, rather than semi-quantitative values, and therefore do not contribute as much to the delineation of vegetation communities. Notwithstanding this, meander transects and field reconnaissance are valuable in that they enable a wide coverage of the area under investigation, and also facilitate the discovery of widely dispersed rare plant species and the identification of vegetation community boundaries.

Specific threatened species searched for during these surveys were:

- heath wrinklewort (*Rutidosis heterogama*) – vulnerable under the TSC Act and the EPBC Act
- Bynoes wattle (*Acacia bynoeana*) – endangered under the TSC Act and vulnerable under the EPBC Act
- black-eyed Susan (*Tetradlea juncea*) – vulnerable under the TSC Act and the EPBC Act
- netted bottle brush (*Callistemon linearifolius*) – vulnerable under the TSC Act
- *Eucalyptus parramattensis* subsp. *decadens* – vulnerable under the TSC Act and the EPBC Act
- Slaty red-gum (*Eucalyptus glaucina*) – listed as vulnerable under the TSC Act and EPBC Act
- Craven grey box (*Eucalyptus largeana*) – listed as vulnerable under the TSC Act
- Pokolbin mallee (*Eucalyptus pumila*) - listed as vulnerable under the TSC Act and EPBC Act

- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) – vulnerable under the TSC Act and the EPBC Act.

2.3.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within quadrats, at rapid assessment points and along transects were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2015), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney.

2.3.6 Vegetation Mapping

Vegetation mapping involved the following steps to delineate community boundaries:

- review of aerial photography
- review of previous mapping undertaken (particularly Bell and Driscoll 2008)
- revision of existing vegetation mapping based upon ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the Vegetation of the Cessnock-Kurri Region (Bell and Driscoll 2008).

Vegetation communities were grouped into three vegetation formations, which were based solely on structural characteristics rather than floristic components. These comprised:

- woodland (dominated by trees of 10 to 40 per cent cover and typically 6 to 20 metres height, with or without a mid-understorey or understorey)
- riparian and floodplain forest (dominated by trees of 10 to 80 per cent cover and typically 6 to 20 metres height, in a linear strip along waterways, or restricted to floodplains, with or without a mid-understorey or understorey) and
- grassland (dominated by grasses, sedges and forbs, with trees and shrubs very sparse or absent).

2.4 Fauna Surveys

Given that the proposed modification will not cause direct surface disturbance (i.e. tree-clearing), minimal disturbance to fauna habitat is considered likely to occur. As such, the fauna component of the field surveys focussed on potentially occurring threatened fauna with low mobility, or with potential to be impacted by disruptions to surface water (i.e. creek lines and dams). Fauna species surveys were designed with consideration of the *Threatened Species Surveys and Assessment: Guidelines for developments and activities* (working draft) (DEC 2004) and locations are provided on **Figure 2.2**.

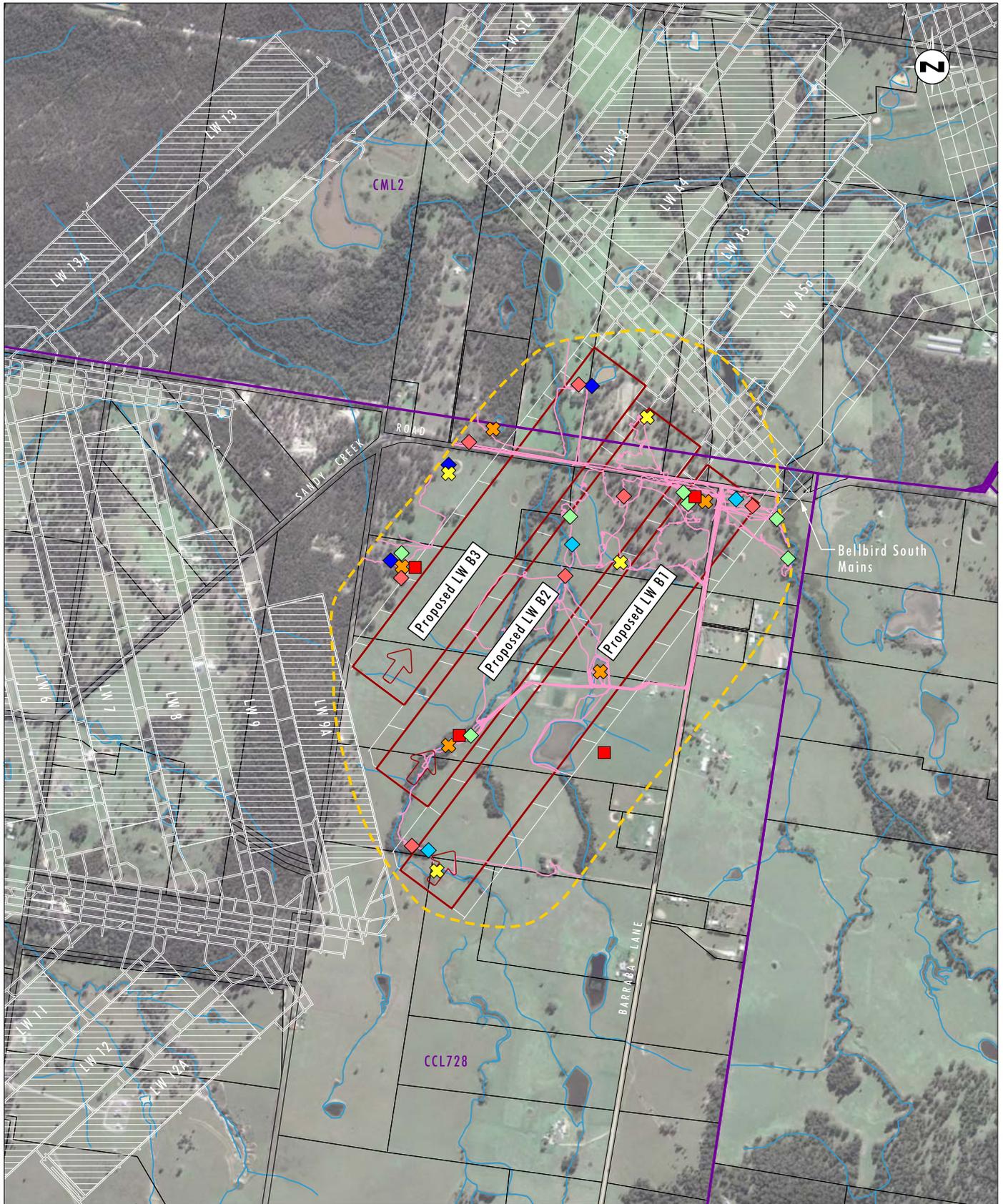


Image Source: Google Earth (2014)
 Data Source: Austar Coal Mine (2015)

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Legend

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|----------------------------------|---|
| Proposed LWB1-B3 Longwall Panels | Habitat Assessment Location |
| LWB1-B3 Modification Area | Diurnal Bird Survey |
| Completed Underground Workings | Green and Golden Bell Frog Call Playback and Search |
| Mining Lease Boundary | Herpetofauna Search |
| Direction of Mining | SEPP 44 Assessment |
| Drainage Line | Threatened Mammal and Bird Call Playback |
| Cadastral Boundary | Anabat Echolocation Survey |
| Spotlighting Track | |

FIGURE 2.2

Fauna Survey Methods

2.4.1 Diurnal Bird Surveys

Bird searches were each undertaken for approximately half an hour (by one or two observers). Bird species were identified from characteristic calls and by observation using a 15 - 45 by 50 spotting scope or 10 by 42 binoculars. Bird surveys included opportunistic observation of dams for waterbirds.

Opportunistic observations were recorded during all other aspects of the field survey, particularly when travelling between survey sites.

A total of six person hours of bird surveys were undertaken across the LWB1-B3 Modification Area, the locations of bird surveys are shown on **Figure 2.2**.

2.4.2 Herpetofauna Searches

Diurnal searches targeting reptiles and amphibians were undertaken during the warmest parts of the day. Diurnal searches were undertaken by two people for between half a person hour and one person hour. Nocturnal searches targeted amphibians and nocturnal reptiles as part of the general spotlighting effort. All reptile and amphibian searches were undertaken by two ecologists for a period of at least 30 minutes. Nocturnal reptile and amphibian searches were undertaken using Petzl headlamps and/or 30 watt Lightforce spotlights.

Habitat features investigated during reptile and amphibian searches included water bodies, emergent vegetation, wet soak areas, logs, rocks, loose bark on tree trunks, exposed bedrock, leaf litter and open grassland areas. Amphibians not identifiable from their calls were captured for visual identification. All amphibians were handled according to the hygiene protocol for the control of disease in frogs (DECC 2008). Non-venomous snake species and small lizards were captured for identification where necessary.

During the surveys a total of three person hours of diurnal, and three person hours of nocturnal reptile and amphibian searches were undertaken across the LWB1-B3 Modification Area (refer to **Figure 2.2**).

Green and Golden Bell Frog Surveys

In addition to general amphibian surveys, four dams within the LWB1-B3 Modification Area were assessed for their potential to provide green and golden bell frog (*Litoria aurea*) habitat. This included:

- searches for this species
- assessment of the presence of appropriate fringing vegetation and diurnal basking sites
- assessment of the clarity of the water
- size of the dam
- presence of tadpole predatorial species such as the plague minnow (*Gambusia holbrooki*).

2.4.3 Anabat Echolocation Surveys

Echolocation calls were detected using an Anabat II Bat Detector. Echolocation calls were recorded using an Anabat CF storage ZCAIM. The combination of detector and recording device is hereafter collectively referred to as the 'Anabat echolocation recorder'. The recorders were positioned horizontally on tree trunks or at an approximate 30 degree angle on the ground, with a small roof protecting the detector from rain. This protective cover enabled the recording of calls regardless of weather conditions.

Anabat echolocation recorders were positioned in the vicinity of potential micro-bat flyways. Anabat echolocation recording was undertaken at three separate locations. At each of these locations Anabat echolocation recorders were left out for the duration of night work.

All Anabat detector recordings were analysed by Anna McConville (a micro-bat specialist) of ECHO Ecology. The echolocation calls were identified to one of four levels of confidence:

- definite
- probable
- possible
- species group (where the call could not be identified to species level and could belong to one of two or more species that were not necessarily of the same genus).

The first three levels of confidence (definite, probable and possible) were treated as positive identifications for the purposes of impact assessment. The 'species group' identification level was only treated as a possible identification, and only where species had previously been recorded in the vicinity of the LWB1-B3 Modification Area; otherwise confidence levels were considered too low to be accepted as a positive identification.

The locations of Anabat surveys are shown on **Figure 2.2**.

2.4.4 Spotlighting

Spotlighting searches were undertaken both on foot and from a moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion. Vehicle spotlighting searches were undertaken by at least the passenger(s) from a slow moving vehicle along vehicle tracks between trapping sites. Walking and vehicle spotlighting searches were undertaken using 30 watt Lightforce spotlights. Vehicle spotlighting was typically taken from roadside vantage points for inaccessible areas, whereas walking spotlighting was undertaken for accessible areas.

At all locations (refer to **Figure 2.2**) spotlighting was undertaken by two people for a period of 30 minutes. A total of 12 person hours and approximately 44.7 kilometres of driving spotlighting searches were completed across the LWB1-B3 Modification Area. Walking spotlighting was always undertaken by two people whereas driving spotlighting was undertaken only by the passenger of the vehicle.

2.4.5 Nocturnal Call Playback

Nocturnal call playback sessions were undertaken within the first 4 hours after dusk. Calls were broadcast using a 10 watt directional loud hailer. Call playback sessions commenced and ended with a quiet listening period of approximately two minutes. Each species' call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next species' call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Call playback sessions included the calls of the:

- squirrel glider (*Petaurus norfolcensis*)
- koala (*Phascolarctos cinereus*)
- masked owl (*Tyto novaehollandiae*)

- barking owl (*Ninox connivens*)
- powerful owl (*Ninox strenua*).

A total of five nocturnal call playback sessions were undertaken (refer to **Figure 2.2**).

2.4.6 Signs of Presence Searches

Searches for indirect evidence of animal presence were conducted opportunistically during all survey activities, particularly during habitat searches and reptile and amphibian searches. Due to the opportunistic nature of signs of presence surveys the level of survey effort was not recorded. Evidence of presence included scats, feathers, nests, burrows, bones, tufts of hair and scratch marks on trees. All hair, scat and bone samples were identified by Barbara Triggs.

2.4.7 SEPP 44 Surveys

Any development application in a SEPP 44 specified local government area, affecting an area of 1 hectare or greater, must be assessed under SEPP 44. Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat.

The species listed in Schedule 2 of the policy are listed in **Table 2.3**.

Table 2.3 Species of Eucalypt listed in Schedule 2 of SEPP 44

Scientific Name	Common Name
<i>Eucalyptus tereticornis</i>	forest red gum
<i>Eucalyptus microcorys</i>	tallowwood
<i>Eucalyptus punctata</i>	grey gum
<i>Eucalyptus viminalis</i>	ribbon or manna gum
<i>Eucalyptus camaldulensis</i>	river red gum
<i>Eucalyptus haemastoma</i>	broad-leaved scribbly gum
<i>Eucalyptus signata</i>	scribbly gum
<i>Eucalyptus albens</i>	white box
<i>Eucalyptus populnea</i>	bimble box or poplar box
<i>Eucalyptus robusta</i>	swamp mahogany

Across the LWB1-B3 Modification Area, an assessment of the presence of koala feed tree species (as listed on **Table 2.3**) was made at eight locations.

2.4.8 Habitat Assessment

Five habitat assessments were undertaken across the range of habitat types present (refer to **Figure 2.2**). The assessment targeted potential habitat and resources for fauna species, particularly threatened fauna species. Records of a number of habitat features were made at each site, including:

- evidence of disturbance such as fire, weeds, feral animals, dumping, erosion and logging
- presence of fallen timber/logs
- presence of stumps and stags
- presence of groundcover features such as rock, litter, grasses, logs, boulder, soil and lichen
- presence of dieback and/or insect attack
- mistletoe presence
- presence of perch sites, fallen and loose bark
- vegetation strata and composition
- tree size class (trunk diameter), and age (old growth, mature, regenerating, saplings)
- presence of other specific feed tree species (such as for cockatoos and honeyeaters)
- collection of detailed hollow data, including tree species and height, hollow size, orientation, position and height.

In addition to these general habitat features, searches for specific habitat requirements for threatened fauna species with potential to occur in the area were also made including the presence of winter-flowering eucalypt species for the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

Habitat features such as tree hollows and fallen logs were inspected for any evidence of fauna occupation such as scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs and scats at the base of trees or near logs.

2.5 Aquatic Surveys

An assessment was undertaken in order to record the aquatic habitats present in the two main ephemeral watercourses within the LWB1-B3 Modification Area, Quorrobolong Creek and an unnamed tributary of Quorrobolong Creek. The assessment also sought to identify aquatic threatened species, populations or communities under the EPBC Act, FM Act or the TSC Act, that have potential to occur.

The AUSRIVAS sampling is a national, standardised sampling and prediction system used for the assessment of the ecological condition of Australia's rivers. It was developed in 1994 as part of the National River Health Program, which has been adopted by the major environmental federal, state and territory agencies in Australia. AUSRIVAS includes a habitat assessment component for recording the river substratum, flow conditions, water quality and aquatic riparian attributes. Locations of aquatic habitat assessment survey effort are identified on **Figure 2.3**.

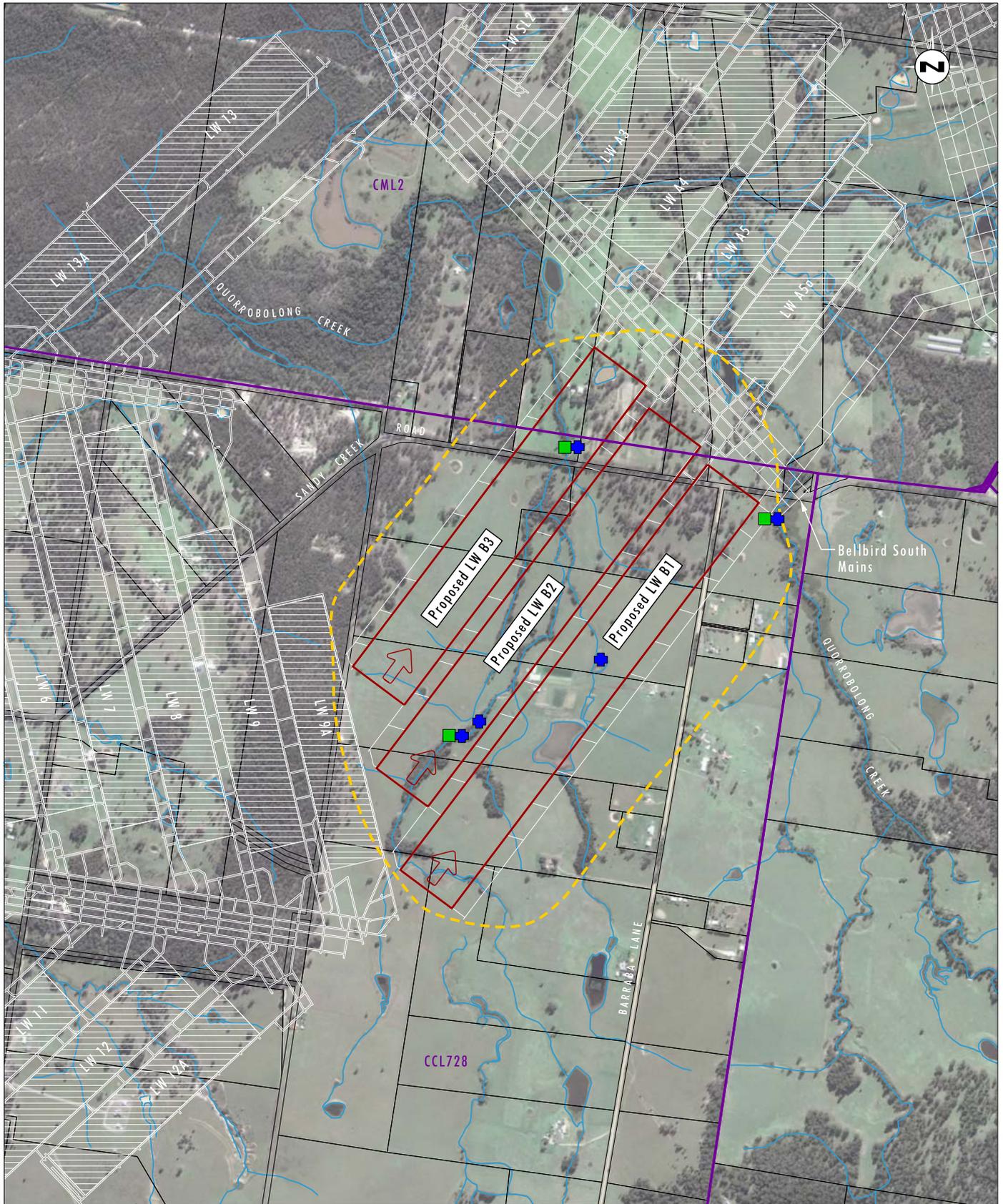


Image Source: Google Earth (2014)
 Data Source: Austar Coal Mine (2015)

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Legend

- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area
- Completed Underground Workings
- Mining Lease Boundary
- ➔ Direction of Mining
- Drainage Line
- Cadastral Boundary
- + Aquatic Fauna Assessment Point
- Stream Assessment

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FIGURE 2.3

Aquatic Survey Methods

Assessment was undertaken along the two separate lengths of Quorrobolong Creek and the unnamed tributary of Quorrobolong Creek within the LWB1-B3 Modification Area, and at a farm dam location. Quorrobolong Creek is located in the north-eastern corner of the modification area and flows in a northerly direction, while the unnamed tributary of Quorrobolong Creek runs from south to north across the modification area, joining Quorrobolong Creek approximately 600 metres to the northwest.

Water flow was absent at several points along Quorrobolong Creek and its unnamed tributary and in places was shallow (less than 5 cm depth). Aquatic fauna assessment points were undertaken at five sites, one along Quorrobolong Creek, three along the unnamed tributary of Quorrobolong Creek and one at a farm dam. Visibility at each of these locations was good and dip-netting sessions for fish and large macroinvertebrates (such as yabbies (*Cherax destructor*)) were undertaken for approximately 15 minutes targeting areas of fringing vegetation and snags where available.

Captured aquatic vertebrates were identified in-situ with the aid of *Field Guide to Freshwater Fishes of Australia* (Allen et al. 2002) and released. Fauna captured were identified to at least a family level. Handling of any fish was undertaken in accordance with *A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research* (Barker et al. 2009).

2.5.1 Aquatic Mammal Surveys

The likelihood of aquatic mammals occurring within the LWB1–B3 Modification Area was also considered during the habitat assessment, in particular the water rat (*Hydromys chrysogaster*) and the platypus (*Ornithorhynchus anatinus*). The potential presence of these species was assessed by searching for suitable bank habitat, burrows and also through searches for characteristic scats, tracks and other signs.

2.5.2 Aquatic Habitat Assessment

An assessment of the aquatic habitat characteristics was undertaken for the length of Quorrobolong Creek and its unnamed tributary within the LWB1-B3 Modification Area, with indicators of creek condition noted. Stream Assessment sampling in accordance with the AUSRIVAS sampling protocol was undertaken at three locations (see **Figure 2.3**) in areas considered likely to provide the greatest aquatic habitat value. The aquatic habitat characteristics were recorded using standard recording sheets (adapted from those developed for the AUSRIVAS sampling protocol). Some of the habitat features and creek condition indicators assessed included:

- local rainfall
- characteristics of bed substrate
- presence of woody debris
- presence of gravel beds
- presence of drought and flood refuge areas
- depth of water
- width of channel
- stream order
- presence of pool, riffle and edge habitats

- height of bank and evidence of erosion
- channel geomorphology
- evidence of sediment deposition
- degree of bank erosion
- presence of natural or artificial barriers to fish passage upstream and downstream
- anthropogenic disturbance
- colour and clarity of water, and any visual evidence of water quality
- characteristics of aquatic, riparian and floodplain vegetation.

An overview of the riparian condition was also made using the Riparian, Channel and Environmental Inventory (RCE) of Peterson (1992). The inventory assesses 16 characteristics for a 100 metre length of stream providing a maximum score of 360 and a lowest of 16 (with 360 indicating excellent habitat and 16 indicating poor habitat).

2.5.2.1 Fish Habitat

The quality of fish habitat at each surveyed site was assessed in accordance with the waterway classifications set out in the DPI 'Policy and Guidelines: Aquatic Habitat Management and Fish Conservation' (NSW Fisheries 1999), namely:

Class 1 – Major Fish Habitat

Waterways in this class consist of large, named and permanently flowing streams, creeks or rivers. These waterways provide threatened species habitat or are declared as 'critical habitat' under the FM Act. High quality native aquatic vegetation and structural habitat is present and it provides known fish habitat and/or fish have been observed inhabiting the water.

Class 2 – Moderate Fish Habitat

Moderate fish habitats are smaller named permanent or intermittent streams, creeks or watercourses with clearly defined drainage channels. They can be permanent waters or semi-permanent pools, or connected areas with limited aquatic vegetation or structure present. Known fish habitat and/or fish observed inhabiting the area.

Class 3 – Minimal Fish Habitat

Class 3 waterways can be named or unnamed with intermittent flows. They provide potential refuge, breeding or feeding areas for some aquatic fauna (such as yabbies). The drainage channel is often poorly defined with semi-permanent pools, ponds, farm dams or wetlands nearby, or in the form of watercourses after rain events. The watercourse may be interconnected with wetlands or other stream habitats.

Class 4 – Unlikely Fish Habitat

These waterways can be named or unnamed with intermittent flows during rain events only. There is little or no defined drainage channel. Little or no free standing water is present after rains and no permanent wetland aquatic flora is present. No aquatic or wetland vegetation is present.

2.5.3 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are described in the NSW GDE Policy (DLWC 2002) and can include terrestrial vegetation, base flow in streams, aquifer and cave ecosystems and wetlands.

A review of the Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (BoM Atlas) was completed in August 2015 to inform the identification of GDEs prior to detailed field surveys that were used to ground truth Atlas of Groundwater Dependent Ecosystems mapping and to identify any other potentially groundwater dependent ecosystems in the LWB1–B3 Modification Area.

It was also confirmed that no high priority GDEs listed under the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 were located within the region potentially impacted by the proposed modification.

3.0 Results

3.1 Flora Species and Vegetation Communities

A full list of flora species recorded in the LWB1-B3 Modification Area is provided in **Appendix B**. A total of 173 flora species were recorded, of which 136 species are native and 37 are introduced. Four species were from the Class Filicopsida (ferns), and 169 from Magnoliopsida (flowering plants) (of which 53 were from sub-class Liliidae (monocots) and 119 from sub-class Magnoliidae (dicots)). Flora species were recorded from 59 plant families, the most speciose being Poaceae (grasses), Asteraceae (daisies), Myrtaceae (eucalypts, Melaleucas and Leptospermums) and Fabaceae (legumes).

Of the introduced species identified in the LWB1-B3 Modification Area, one is listed as a noxious weed under the *Noxious Weeds Act 1993* (NW Act), being blackberry (*Rubus fruticosus*).

3.1.1 Threatened Species, Endangered Populations and Regionally Significant Plants

Of the flora species identified within the LWB1-B3 Modification Area, three are listed as threatened species, being the netted bottlebrush (*Callistemon linearifolius*), small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) and heath wrinklewort (*Rutidosis heterogama*). Locations of threatened species are provided on **Figure 3.1**.

No endangered flora populations were identified occurring within the LWB1-B3 Modification Area, and based upon the habitats identified, none are expected to occur.

In addition to threatened species, the following flora species (**Table 3.1**) were identified in the LWB1-B3 Modification Area that are considered to be locally significant. These species may be considered regionally significant for a range of reasons, including:

- endemic taxa
- uncommon taxa
- records close to a geographic range extension
- significant reductions in population size or areas occupied.

Table 3.1 Locally Significant Flora Species

Species	Hunter Rare Plants Database (Peake 2003)	ROTAP
<i>Grevillea montana</i>	-	2VC
<i>Parsonsia straminea</i>	?W	-
<i>Maytenus silvestris</i>	U	-
<i>Eucalyptus amplifolia subsp. amplifolia</i>	T	-

Key to Criteria

2 = Restricted distribution - range extending over less than 100km

C = Species is known to occur within a proclaimed reserve

U = everywhere uncommon

V = Vulnerable - at risk over a longer period (20-50 years)

N or W = distributional limit in Hunter Region

T = may be threatened

? = code is uncertain

Regionally significant flora identified within the LWB1-B3 Modification Area are relatively widespread throughout the region, and therefore are not considered further within this assessment.

3.1.2 Vegetation Communities

A total of six vegetation communities (**Figure 3.1**) were identified in the LWB1-B3 Modification Area. These are all low-lying communities (between 130 and 163 metres AHD) as no hilltops or ridges are present within the LWB1-B3 Modification Area. The extent of each vegetation type within the LWB1-B3 Modification Area is presented in **Table 3.2** below.

Table 3.2 Vegetation Communities within the LWB1-B3 Modification Area

Vegetation Community	Status	Extent (ha)
Riparian Swamp Oak Open Forest	-	16.4
Riparian Cabbage Gum Open Forest	EEC (TSC)	3.2
Spotted Gum Ironbark Forest	EEC (TSC)	56.7
Melaleuca shrubland with emergent Eucalypts	Potential EEC (TSC)	1.6
Grassland	-	173.0
Planted Vegetation	-	1.3
Total		252.3

Each of the vegetation communities identified in **Table 3.2** above is described in greater detail below.

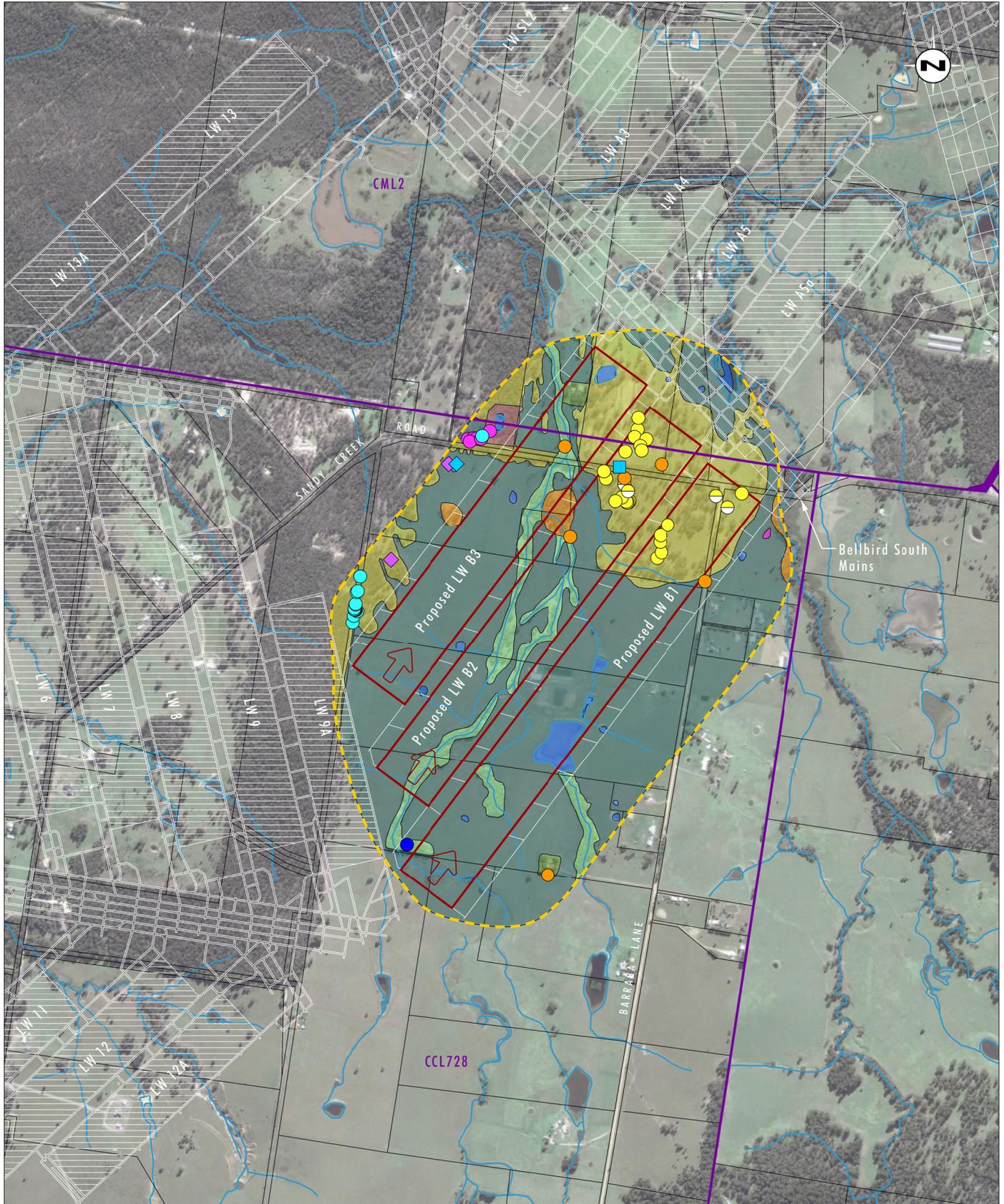


Image Source: Google Earth (2014)
 Data Source: Austar Coal Mine (2015)

0 0.25 0.5 1.0km
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Legend

- | | | |
|----------------------------------|---|--|
| Proposed LWB1-B3 Longwall Panels | Spotted Gum Ironbark Forest | Grey-crowned babbler nests |
| LWB1-B3 Modification Area | Planted Vegetation | Large-eared Pied Bat |
| Completed Underground Workings | Melaleuca Shrubland with Emergent Eucalypts | Greater Broad-nosed Bat |
| Mining Lease Boundary | Riparian Cabbage Gum Open Forest | Squirrel Glider |
| Direction of Mining | Riparian Swamp Oak Open Forest | Varied sittella |
| Drainage Line | Water Body | <i>Callistemon linearifolius</i> |
| Cadastral Boundary | Wet Soak | <i>Grevillea parviflora</i> subsp. <i>parviflora</i> |
| Grassland | Grey-crowned babbler (eastern subspecies) | <i>Rutidosis heterogama</i> |

FIGURE 3.1

**Vegetation Communities
 and Threatened
 Species Records**

3.1.2.1 Riparian Swamp Oak Open Forest

The vegetation along the unnamed tributary of Quorrobolong Creek within the LWB1-B3 Modification Area is dominated by Riparian Swamp Oak Open Forest. This community covers an area of approximately 16.4 hectares. A representative photo of this vegetation type is presented in **Plate 1**.



Plate 1

Photo of Riparian Swamp Oak Open Forest

This community is typified by an emergent occasional cabbage gum (*Eucalyptus amplifolia*), or rough-barked apple (*Angophora floribunda*), and rare occurrences of introduced camphor laurel (*Cinnamomum camphora*). The height of the emergent layer was 20 metres with typically less than 2 per cent cover.

This community typically supported a moderately dense (approximately 30 per cent) low tree stratum comprising swamp oak (*Casuarina glauca*), with occurrences of river oak (*Casuarina cunninghamiana*) (mostly planted) in the north. The height of this layer was typically to approximately 15 metres. Rarely, cabbage gum (*Eucalyptus amplifolia*), rough-barked apple (*Angophora floribunda*), or the introduced camphor laurel (*Cinnamomum camphora*) were noted in the canopy.

This community typically lacked a shrub layer. Where present, species included ball honeymyrtle (*Melaleuca nodosa*) and the introduced wild tobacco bush (*Solanum mauritianum*) were identified.

The ground stratum of the *Riparian Swamp Oak Open Forest* comprised a mixture of native and introduced grasses and small herbs. Species recorded within this stratum include couch (*Cynodon dactylon*), weeping grass (*Microlaena stipoides*), slender rats tail (*Sporobolus creber*), maidenhair fern (*Adiantum aethiopicum*) and barbed wire grass (*Cymbopogon refractus*). Other grass species were present; however were unidentifiable as a result of a lack of flowering or presence of seed heads as a result of recent grazing.

A number of weed species were commonly recorded throughout this vegetation community, including sharp rush (*Juncus acutus*), panic veldtgrass (*Ehrharta erecta*), kikuyu (*Pennisetum clandestinum*), blackberry (*Rubus fruticosus* sp. agg.), fireweed (*Senecio madagascariensis*) and buffalo grass (*Stenotaphrum secundatum*). The weed species and their density varied throughout the LWB1-B3 Modification Area, as a result of the different land management practices.

The majority of riparian areas occurring within the LWB1-B3 Modification Area are unfenced from stock grazing and are subsequently degraded. The vegetation of this community is currently considered to be in moderate condition.

3.1.2.2 Riparian Cabbage Gum Open Forest

Riparian Cabbage Gum Open Forest covers an area of approximately 3.2 hectares. This community is characterised by a cabbage gum (*Eucalyptus amplifolia*) or forest red gum (*Eucalyptus tereticornis*) canopy with occasional occurrences of rough-barked apple (*Angophora floribunda*). The height of this layer was approximately 24 metres with approximately 20 per cent cover. A representative photo of this vegetation type is presented in **Plate 2**.



Plate 2

Riparian Cabbage Gum Open Forest

This community is subject to moderate grazing and is considered to be in moderate condition due to historical clearing and ongoing land management practices.

The shrub layer in these areas is typically absent as a result of clearing and is likely being subdued by cattle grazing. The groundcover species diversity is low and dominated by couch (*Cynodon dactylon*) and kangaroo grass (*Themeda australis*). Other grass species were present but could not be identified due to an absence of seed heads. Introduced species are common in these areas and include flat weed (*Hypochaeris*

radicata), fireweed (*Senecio madagascariensis*), fleabane (*Conyza bonariensis*) and variegated thistle (*Silybum marianum*).

3.1.2.3 Spotted Gum – Ironbark Forest

Spotted Gum – Ironbark Forest covers an area of approximately 56.7 hectares in LWB1-B3 Modification Area (**Figure 3.1**), occupying the drier low slopes in the north-east. This community is widespread within the local area, and is the dominant community within the nearby Werakata State Conservation Area and National Park. A representative photo of this vegetation type is presented in **Plate 3**.



Plate 3

Spotted Gum – Ironbark Forest

The canopy stratum of this community was dominated by broad-leaved ironbark (*Eucalyptus fibrosa*) with lesser occurrences of spotted gum (*Corymbia maculata*). A number of other canopy species occur within this community in different abundances, including grey box (*Eucalyptus moluccana*) with less than 20 per cent cover, growing to heights between 18 and 24 metres. Regeneration of canopy species in this community was variable due to ongoing grazing pressure.

The Spotted Gum – Ironbark Forest has a sparse shrub stratum, generally less than 5 per cent cover as a result of historical clearing and ongoing grazing practices, which ranges in height from 0.5 metres to 4 metres. The dominant species recorded include native blackthorn (*Bursaria spinosa*), narrow-leaved orange bark (*Maytenus silvestris*), *Davies ulicifolia* and western boobialla (*Myoporum montanum*). Many of the shrubs identified appeared to be stunted from grazing.

The ground stratum of this community primarily comprises native grasses, however a number of small herbs, ferns and vines also occur. The more common species recorded include threeawn speargrass (*Aristida vagans*), hedgehog grass (*Echinopogan ovatus*), barbed wire grass (*Cymbopogon refractus*), threeawn speargrass (*Aristida vagans*), couch (*Cynodon dactylon*), poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), *Glycine clandestina* and *Goodenia rotundifolia*. Introduced species were also common, including, fireweed (*Senecio madagascariensis*), onion grass (*Romulea rosea*), flatweed (*Hypochaeris radicata*) and burr medic (*Medicago polymorpha*). The ground stratum has a cover of approximately 70 per cent and was generally less than 0.5 metres in height.

This vegetation community was considered to be in moderate condition.

3.1.2.4 Melaleuca Shrubland with Emergent Eucalypts

A small area (1.6 hectares) in the north-west of the LWB1-B3 Modification Area comprised Melaleuca Shrubland with Emergent Eucalypts. The soil surface in this area appeared sandy. This community was typified by an open canopy to heights of approximately 25 metres with occasional occurrences of grey gum (*Eucalyptus punctata*), forest red gum (*Eucalyptus tereticornis*), and smooth-barked apple (*Angophora costata*) (although no consistent canopy vegetation was identified). The dense understorey layer typified this vegetation and occurred to heights of 5 metres dominated by *Melaleuca nodosa*, *Banksia spinulosa*, needlebush (*Hakea sericea*), *Leptospermum trinerum* and occasional narrow-leaved geebung (*Persoonia linearis*). Groundcover vegetation was sparse as a result of shading from the dense midstorey, however typically encountered species included kangaroo grass (*Themeda australis*) and purple wiregrass (*Aristida vagans*). Typical weed species encountered were whisky grass (*Andropogon virginicus*) and fireweed (*Senecio madagascariensis*) however densities of these species were low. A representative photo of this vegetation type is presented in **Plate 4**.



Plate 4

Photo of Melaleuca Shrubland with Emergent Eucalypts

This vegetation was previously subject to cattle grazing, however since its removal approximately 10 years ago, vegetation has been permitted to regenerate and is recovering well. However, given the regenerating condition of this community, the original floristic dominants of this community are difficult to define.

3.1.2.5 Grassland

The majority of the LWB1-B3 Modification Area (being approximately 173.0 ha) comprises Grassland (**Figure 3.1**). The areas of Grassland are likely to have previously supported woodland vegetation similar to that of surrounding vegetation remnants, however they have been cleared of tree and shrub species primarily for agricultural purposes. These are no longer considered to comprise grasslands derived from native vegetation communities as their species composition is not representative of native vegetation of any of the locally occurring communities and contain virtually no regeneration. A representative photo of this vegetation type is presented in **Plate 5**.



Plate 5

Grassland

The Grassland community lacks tree and shrub strata, however occasional individual trees or shrubs are scattered throughout. The community is characterised by a range of native and introduced grasses, and also a diversity of small herbs. Species commonly recorded include slender rats tail grass (*Sporobolus creber*), couch (*Cynodon dactylon*), kangaroo grass (*Themeda australis*), and the introduced species paspalum (*Paspalum dilatatum*), flatweed (*Hypochaeris radicata*), plantain (*Plantago lanceolata*), *Setaria* sp., burr medic (*Medicago polymorpha*), chickweed (*Stellaria media*), and fireweed (*Senecio madagascariensis*). It should be noted that other grass species were present; however were unidentifiable due a lack of seed heads.

The floristic composition of the Grassland is variable between the different properties throughout the LWB1-B3 Modification Area, which is the result of different land management practices differing between landholders.

This grassland was considered to be in a low condition as a result of historical clearing and current land management practices.

3.1.2.6 Wet Soak

The wet soak vegetation community comprised a small (0.1 ha) shallow depression in the north-east of the LWB1-B3 Modification Area. This area had a small amount of ponded water present and based on the vegetation present was considered to be a permanent water resource. The vegetation present in this area, was less than 0.75m in height and predominantly comprised native permanent wetland vegetation such as nardoo (*Marsilea mutica*), tall sedge (*Carex appressa*), Juncus sp., pennywort (*Centella asiatica*) and *Ranunculus* sp. A representative photo of this vegetation type is presented in **Plate 6**.



Plate 6

Wet Soak Area

3.1.2.7 Planted Vegetation

This vegetation comprised a very small area of approximately 0.6 ha in size. This vegetation was planted around a residence and was not considered to be consistent with native vegetation.

3.1.3 Threatened Ecological Communities

Two TECs and one potential TEC were identified in the LWB1-B3 Modification Area being *River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC* (River-flat Eucalypt Forest EEC), the *Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion EEC* (Lower Hunter Spotted Gum – Ironbark Forest EEC) and potential *Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion EEC* (potential Quorrobolong Scribbly Gum Woodland EEC). These EECs are listed under the TSC Act. No TECs were identified in the LWB1-B3 Modification Area that were consistent with any listings under the EPBC Act. The details of each of these EECs as they occur within the LWB1-B3 Modification Area are provided in greater detail below.

River-flat Eucalypt Forest EEC

Based upon geographic location, geology, structural and floristic composition of the riparian vegetation within the LWB1-B3 Modification Area, 3.2 ha of vegetation (those areas identified as Riparian Swamp Oak Open Forest) were considered to be consistent with River-flat Eucalypt Forest EEC listed under the TSC Act (**Figure 3.1**).

River-Flat Eucalypt Forest EEC is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The community generally occurs below 50 metres above sea level (ASL); however it may occur on localised river flats up to 250 metres ASL. The EEC ranges in structure from tall open forest to woodland, with a canopy dominated by forest red gum (*Eucalyptus tereticornis*), cabbage gum (*Eucalyptus amplifolia* subsp. *amplifolia*), rough-barked apple (*Angophora floribunda*) and broad-leaved apple (*Eucalyptus subvelutina*). A small tree layer often is present, which may comprise *Melaleuca decora*, prickly-leaved tea tree (*Melaleuca styphelioides*), grey myrtle (*Backhousia myrtifolia*), white cedar (*Melia azedarach*), river oak (*Casuarina cunninghamiana*) and swamp oak (*Casuarina glauca*). The mid-stratum is often absent, but where present may comprise species such as black thorn (*Bursaria spinosa*), forest nightshade (*Solanum prinophyllum*), native raspberry (*Rubus parvifolius*), coffee bush (*Breynia oblongifolia*) and *Ozothamnus diosmifolius*. The ground cover consists of a number of forbs, scramblers and grasses (NSW Scientific Committee 2011). The vegetation present is consistent with this EEC, albeit in a modified form.

A seven part test of significance (in accordance with the EP&A Act) was undertaken to determine if the proposed modification would result in a significant impact on this EEC (**Appendix E**). The results of this test have been summarised in **Section 4**.

Lower Hunter Spotted Gum – Ironbark Forest EEC

Based on the geographic location, geology, structural and floristic composition of the Spotted Gum – Ironbark Forest occurring on the lower slopes within the LWB1-B3 Modification Area, the community is considered to be consistent with Lower Hunter Spotted Gum – Ironbark Forest EEC listed under the TSC Act (**Figure 3.1**).

The Lower Hunter Spotted Gum – Ironbark Forest EEC occurs in the central to lower Hunter Valley, principally on Permian geology. The EEC is restricted to a range of approximately 65 kilometres by 35 kilometres centred on the Cessnock – Beresfield area and corresponds to the Lower Hunter Spotted Gum – Red Ironbark Forest as described by Bell and Driscoll (2008) for the Vegetation of the Cessnock-Kurri Region. The dominant canopy species of this community are spotted gum (*Corymbia maculata*) and broad-leaved ironbark (*Eucalyptus fibrosa*), with grey gum (*Eucalyptus punctata*) and narrow-leaved ironbark (*Eucalyptus crebra*) present occasionally in lower frequency. A sparse (due a history of clearing and grazing) understorey comprising the following shrub species is present: (*Daviesia ulicifolia*), black thorn (*Bursaria spinosa* subsp. *spinosa*) and ball honeymyrtle (*Melaleuca nodosa*). The ground layer has a moderate

species diversity, comprising poison rock fern (*Cheilanthes sieberi* subsp. *sieberi*), barbed-wire grass (*Cymbopogon refractus*), blue-flax lily (*Dianella revoluta*), wiry panic (*Entolasia stricta*), love creeper (*Glycine clandestina*), many-flowered mat-rush (*Lomandra multiflora*), weeping grass (*Microlaena stipoides* var. *stipoides*), kangaroo grass (*Themeda australis*) and white root (*Pratia purpurascens*) although dominated by introduced species in patches (NSW Scientific Committee 2010). The vegetation present is consistent with this EEC, albeit in a modified form.

A seven part test of significance (in accordance with the EP&A Act) was undertaken to determine if the proposed modification would have a significant impact on this EEC (**Appendix E**). The results of this test have been summarised in **Section 4**.

Potential Quorrobolong Scribbly Gum Woodland EEC

The Melaleuca Shrubland with Emergent Eucalypts on the lower slopes in the north-west of the LWB1-B3 Modification Area (refer to **Figure 3.1**) has the potential to conform to the Quorrobolong Scribbly Gum Woodland EEC listed under the TSC Act. This is based on the geographic location, geology, structural and floristic composition of the vegetation observed during rapid assessment survey.

The Quorrobolong Scribbly Gum Woodland EEC occurs on residual sand deposits overlying Permian clay sediments in the Hunter Valley. The EEC is only known to occur between Quorrobolong and Mulbring in the Hunter Valley NSW, but may occur elsewhere. The dominant canopy species that typify this EEC are scribbly gum (*Eucalyptus racemosa*), Sydney peppermint (*Eucalyptus piperita*) and red mahogany (*Eucalyptus resinifera*). Although these species were not identified within this area, the composition of the dense shrubby vegetation was sufficiently different from the adjacent areas of Spotted-gum Ironbark Forest to warrant separation of the communities. The following flora species (out of a total list of 57 species) were present in this area and are considered characteristic from the final determination for this community (NSW Scientific Committee 2011):

- *Allocasuarina littoralis*
- *Angophora costata*
- *Aristida vagans*
- *Banksia spinulosa*
- *Billardiera scandens*
- *Daviesia ulicifolia*
- *Dillwynia retorta*
- *Eucalyptus punctata*
- *Eragrostis brownii*
- *Glycine clandestina*
- *Hakea sericea*
- *Imperata cylindrica*
- *Hardenbergia violacea*

- *Jacksonia scoparia*
- *Leptospermum polygalifolium*
- *Leptospermum trinerum*
- *Lomandra multiflora*
- *Melaleuca nodosa*
- *Persoonia linearis*
- *Themeda australis*.

Given the regenerating condition of this community, the floristic dominants of this community are difficult to define. Despite this, the key species present, lead to the possibility of this community comprising the Quorrobolong Scribbly Gum Woodland EEC. As such, the Ecological Assessment has adopted a precautionary approach and assessed the community as being the EEC.

A seven part test of significance (in accordance with the EP&A Act) was undertaken to determine if the proposed modification would have a significant impact on this potentially occurring EEC (**Appendix E**). The results of this test have been summarised in **Section 4**.

3.2 Fauna Results

The following section provides the results of the fauna surveys undertaken. This includes a list of fauna species recorded, threatened species identified and with potential to occur and habitats available to fauna species.

3.2.1 Fauna Species Recorded

A total of 71 fauna species were recorded in the LWB1-B3 Modification Area. The following sections provide detail on the fauna species recorded, with a complete list of species recorded during field surveys provided in **Appendix C**.

3.2.1.1 Amphibian Species

Nine frog species were recorded within the LWB1-B3 Modification Area, the most common of which included the brown froglet (*Crinia signifera*), striped marsh-frog (*Limnodynastes peronii*) and the spotted marsh-frog (*Limnodynastes tasmaniensis*).

No threatened amphibian species were recorded within the LWB1-B3 Modification Area.

3.2.1.2 Reptile Species

Six reptile species were recorded within the LWB1-B3 Modification Area during the surveys. These species were the Jacky lizard (*Amphibolurus muricatus*), eastern water skink (*Eulamprus quoyii*), southern rainbow skink (*Carlia tetradactyla*) and three-toed skink (*Saiphos equalis*). All of these species are considered to be locally common.

No threatened reptile species were recorded at within the LWB1-B3 Modification Area.

3.2.1.3 Bird Species

A total of 44 bird species were recorded within the LWB1-B3 Modification Area. The species recorded are typical of those associated with open woodland and grassland habitats, such as the Australian magpie (*Gymnorhina tibicen*), noisy miner (*Manorina melanocephala*), masked lapwing (*Vanellus miles*) and Australian magpie-lark (*Grallina cyanoleuca*). A number of birds more commonly associated with wetland habitats were recorded, including white-faced heron (*Egretta novaehollandiae*), Australian white ibis (*Threskiornis molucca*), nankeen night heron (*Nycticorax caledonicus*), Australian wood duck (*Chenonetta dubata*) and the Pacific black duck (*Anas superciliosa*).

Two threatened bird species were recorded within the LWB1-B3 Modification Area, being the grey-crowned babbler (*Pomatostomus temporalis temporalis*) and varied sittella (*Daphoenositta chrysoptera*). Both of these species are listed as vulnerable under the TSC Act. The locations of threatened fauna species recorded in the LWB1-B3 Modification Area are shown on **Figure 3.1**.

A single bird species listed as migratory under the EPBC Act was also recorded, being the cattle egret (*Ardea ibis*).

3.2.1.4 Mammal Species

A total of 16 mammal species were recorded within the LWB1-B3 Modification Area. Commonly recorded species included common brush-tail possum (*Trichosurus vulpecula*) and common ring-tailed possum (*Pseudocheirus peregrinus*).

Three threatened mammal species, the squirrel glider (*Petaurus norfolcensis*), large-eared pied bat (*Chalinolobus dwyeri*) and greater broad-nosed bat (*Scoteanax rueppellii*) were recorded in the LWB1-B3 Modification Area (**Figure 3.1**). Although not recorded during surveys undertaken by Umwelt, a single record of the koala (*Phascolarctos cinereus*), has also been identified from Atlas records (BioNet 2015) in the LWB1-B3 Modification Area.

Four introduced fauna species were also identified, being the fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*) and the domesticated cattle (*Bos taurus*) and horse (*Equus caballus*).

3.2.1.5 Threatened Fauna Species

A total of six threatened fauna species were identified in the LWB1-B3 Modification Area: including the squirrel glider (*Petaurus norfolcensis*), large-eared pied bat (*Chalinolobus dwyeri*), greater broad-nosed bat (*Scoteanax rueppellii*), koala (*Phascolarctos cinereus*) (OEH database record), grey-crowned babbler (*Pomatostomus temporalis temporalis*), varied sittella (*Daphoenositta chrysoptera*). One migratory species listed under the EPBC Act was also identified, being the cattle egret (*Ardea ibis*).

A range of potentially occurring threatened flora and fauna species were also identified on the basis of the presence of potential habitat and local records. These species are included in **Appendix A**, along with a preliminary impact assessment to determine the need for further assessment under the EP&A Act or EPBC Act.

Squirrel Glider (*Petaurus norfolcensis*)

A single record of a squirrel glider (*Petaurus norfolcensis*) was made within the LWB1-B3 Modification Area, during surveys undertaken by Umwelt in 2015. It is considered likely that the species is resident in the LWB1-B3 Modification Area, with potential habitat present to both forage and den (in the small amount of hollow-bearing trees). However it is likely that this is only as part of a wider habitat that extends outside of

the LWB1-B3 Modification Area, particularly higher quality and more dense areas of vegetation to the west and north.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

Two definite records of the large-eared pied bat (*Chalinolobus dwyeri*) were made in the north-west of the LWB1-B3 Modification Area. One record was from over a farm dam, and one was made from an area of Spotted Gum Ironbark Forest along the western boundary. It is unlikely that this species would be utilising the habitats of the LWB1-B3 Modification Area for anything other than foraging habitat as this is a cave-roosting species. No cave habitats, cliffs, old mine workings or similar were identified within the LWB1-B3 Modification Area.

This species would only likely be utilising the habitats present as part of a wider habitat range that extends outside of the LWB1-B3 Modification Area.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)

A single probable record of the greater broad-nosed bat (*Scoteanax rueppellii*) was made over a farm dam in the west of the LWB1-B3 Modification Area. For the purposes of this Ecological Assessment, this has been assumed as a positive identification. It is possible that this species consists of a resident population given that it is a hollow-roosting species and appropriate hollow-bearing trees are present. This species could therefore be utilising the habitats available for both roosting and foraging.

It is likely, however, that this is only part of a wider habitat for this species that extends outside of the LWB1-B3 Modification Area, particularly in higher quality and more dense areas of vegetation to the west and north.

Koala (*Phascolarctos cinereus*)

The Atlas of NSW Wildlife identifies a single record of a koala (*Phascolarctos cinereus*) occurring within the LWB1-B3 Modification Area in 2006, the accuracy of this record is to within 10km (i.e. highly inaccurate). The sighting was made by a community group (Dan Lunney's Community Wildlife Survey) and based on the limited availability of koala feed trees present within the modification area (refer to **Section 3.2.3**), it is considered highly likely that this record consisted of an individual passing through the LWB1-B3 Modification Area travelling to areas of better quality habitat.

The EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014) were considered to assist in the determination of the significance of koala habitat in the LWB1-B3 Modification Area. In accordance with the Guideline, assessment of significant impacts on the koala is undertaken primarily through the assessment of habitat critical to the survival of the koala and actions that interfere substantially with the recovery of the koala.

The habitat assessment tool was applied to the LWB1-B3 Modification Area to determine the extent of vegetation that contains at least one known koala food tree. This process identified one primary food tree resource (cabbage gum (*Eucalyptus amplifolia*)) and one secondary food tree resource (grey box (*Eucalyptus moluccana*)). The koala habitat assessment tool resulted in a score of less than 5 indicating that the habitat present in the LWB1-B3 Modification Area is not critical to the survival of the koala.

In addition, no koalas, or evidence of koalas (such as scats or scratchings) were identified in the LWB1-B3 Modification Area.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

Records of the grey-crowned babbler were made at five locations (**Figure 3.1**), predominantly in the northern end of the LWB1-B3 Modification Area. These records ranged from individuals to a group of 12 birds. A single record was made in the south of the LWB1-B3 Modification Area that comprised a single grey-crowned babbler. It is considered likely that the LWB1-B3 Modification Area provides habitat for a resident population of grey-crowned babblers.

Varied Sittella (*Daphoenositta chrysoptera*)

Varied sittellas were recorded at a single location within the LWB1-B3 Modification Area. This record comprised four individuals and was made in the south of the LWB1-B3 Modification Area in riparian vegetation. Although no evidence of breeding was observed, it is considered that a resident population exists due to the sedentary nature of this species.

Although not identified in the LWB1-B3 Modification Area during surveys undertaken by Umwelt in 2015, the threatened fauna species presented in **Table 3.3** below were considered to have potential to occur based on the presence of appropriate habitat

Table 3.3 Threatened Fauna Species with Potential to occur in the LWB1-B3 Modification Area

Species	Status		Comment on Likely Occurrence in the LWB1-B3 Modification Area
	TSC Act	EPBC Act	
green-thighed frog (<i>Litoria brevipalmata</i>)	V		There is a low potential that this species may use the areas of higher quality riparian habitat.
grey-headed flying fox (<i>Pteropus poliocephalus</i>)	V	V	No camp sites were identified for this species however potential foraging habitat was identified. The Modification Area would likely support low densities of this species during mass flowering of canopy eucalypts and as a stepping stone between higher quality areas of habitat.
southern myotis (<i>Myotis macropus</i>)	V		There is a moderate potential that this species could be both foraging and roosting in the riparian habitats present.
eastern freetail-bat (<i>Mormopterus norfolkensis</i>)	V		There is a moderate potential that this species could be both foraging and roosting in the riparian habitats present.
little bentwing-bat (<i>Miniopterus australis</i>)	V		There is a moderate potential that this species could be both foraging and roosting in the riparian habitats present.
swift parrot (<i>Lathamus discolor</i>)	E	E	Potential habitat identified based on the presence of winter flowering eucalypts in the Spotted Gum Ironbark Forest areas and Riparian Cabbage Gum Open Forest. This species would not be utilising the habitats available for breeding.

Species	Status		Comment on Likely Occurrence in the LWB1-B3 Modification Area
	TSC Act	EPBC Act	
regent honeyeater (<i>Anthochaera phrygia</i>)	CE	CE	Potential habitat identified based on the presence of winter flowering eucalypts in the Spotted Gum Ironbark Forest areas and Riparian Cabbage Gum Open Forest. This species is not likely to use the habitats available for breeding.

3.2.2 Habitat Assessment

Four habitat types were identified within the LWB1-B3 Modification Area, and a description of each is provided below.

3.2.2.1 Riparian Habitat

Approximately 19.7 hectares of riparian habitat occurs along the two ephemeral watercourses within the LWB1-B3 Modification Area. Riparian vegetation communities identified included Riparian Swamp Oak Open Forest and Riparian Cabbage Gum Open Forest. These areas are typically quite linear and have a linking function within the landscape rather than providing areas of core habitat for a wide range of species. Riparian vegetation breaks up large expanses of grassland that would otherwise be devoid of treed vegetation.

Riparian habitat areas are typically dominated by swamp oak (*Casuarina glauca*) and subsequently have potential to provide a foraging resource for threatened species such as the glossy black-cockatoo (*Calyptorhynchus lathami*); however this would only likely be in passing between larger areas of higher quality habitat. Less common occurrences of cabbage gum (*Eucalyptus amplifolia*) are also present, these patches of eucalypt vegetation have potential to provide a foraging resources for threatened winter migrant bird species such as the regent honeyeater (*Anthochaera phrygia*) and swift parrot (*Lathamus discolor*).

The groundcover and understory in these riparian areas is typically sparse as a result of grazing. However riparian habitats have the potential to provide foraging habitat for small woodland birds, small reptiles, amphibians and arboreal mammals. These areas may also provide a water resource for micro-bats and terrestrial mammals when water is present.

Some areas of hollow-bearing trees were identified; however these were sparse, and when occurring were typically only very small (<25mm) or small (26 – 50 mm) hollows, or peeling bark/timber fissures that would generally only be suitable as denning habitat for microbat species such as the little bentwing bat (*Miniopterus australis*) or eastern free-tailed bat (*Mormopterus norfolkensis*).

3.2.2.2 Open Forest Habitat

The open forest habitats occur in the north of the LWB1-B3 Modification Area, and comprise *Spotted Gum – Ironbark Forest*, *Melaleuca Shrubland with Emergent Eucalypts* and Planted vegetation. The canopy in the open forest habitats is dominated by eucalypt species, which, when flowering, would provide foraging resources for nectarivorous species. This may include a diversity of birds, micro-bats and small mammals, including threatened species such as the squirrel glider (*Petaurus norfolcensis*) and the grey-headed flying-fox (*Pteropus poliocephalus*). The Eucalypt species would also harbour a diversity of invertebrate species, which would be utilised by insectivorous species such as micro-bats. The canopy trees comprise a

predominantly young age-class, with few large, hollow-bearing trees observed. As such, nesting habitat for hollow-dependent fauna species is limited.

The open forest habitats comprise an understorey of low, prickly shrubs which provide refuge areas for small birds, mammals and reptiles. The grassy ground stratum provides foraging resources for granivorous bird species.

3.2.2.3 Grassland Habitat

Much of the LWB1-B3 Modification Area is vegetated with open grassland habitats. These areas have been heavily cleared and grazed and now support a ground stratum dominated by pasture grass species, some of which are native and some introduced. These areas provide foraging habitat for a range of fauna species, however these are more limited than those of the open forest habitat areas. The scattered trees that occur throughout the Grassland areas are important refuges for fauna, birds in particular, that use these trees for foraging, and for roost and perch sites.

It is not considered that these areas provide substantial habitat for any threatened fauna species

3.2.2.4 Constructed Dam Habitat

The LWB1-B3 Modification Area contains several constructed farm dams ranging in size from approximately 10 metres by 10 metres to 40 metres by 30 metres. The LWB1-B3 Modification Area contains approximately 3.9 ha of constructed farm dam habitat.

These areas typically have an absence of fringing treed vegetation; however do typically have fringing riparian sedge vegetation. Typical sedges in these areas comprise *Carex appressa*, nardoo (*Marsilea muricata*) and introduced sharp acutus (*Juncus acutus*). Emergent and floating vegetation are largely absent. Grazing is likely to be the key contributor to an absence of fringing vegetation of these dams.

These areas likely provide an important freshwater resource to local fauna, particularly for native birds and mammals. It is likely that these dams also provide foraging habitat for water birds as well as several micro-bat species. These areas also provide moderate quality refuge habitat for local amphibian species.

3.2.3 SEPP 44 Koala Habitat Assessment Results

SEPP 44 listed tree species comprised less than 5 per cent of treed vegetation within each vegetation community present in the LWB1-B3 Modification Area, indicating that it does not provide potential koala habitat in accordance with SEPP 44. Although a record of the koala exists in the LWB-B3 Modification Area it is likely that the LWB1-B3 Modification Area provides supplementary habitat and connectivity links across the landscape for dispersing individuals, rather than habitat that supports a population of the species.

The vegetation present in the LWB1-B3 Modification Area is not considered to comprise core koala habitat.

3.3 Connectivity

Connectivity within the LWB1-B3 Modification Area is poor, with the majority of the area subject to historical clearing and agriculture. Vegetation occurring in the north-east shows connectivity to a large remnant of vegetation associated with Quorrobolong Creek to the north-west; however internal connectivity comprises highly fragmented riparian vegetation along the unnamed tributary of Quorrobolong Creek that flows the length of the LWB1-B3 Modification Area in a north-south direction.

The LWB1-B3 Modification Area is considered to have poor connectivity in terms of contiguous vegetative cover.

3.4 Critical Habitat

There are currently four critical habitat declarations in NSW that are listed under the TSC Act. None of these areas are within or in proximity to the LWB1-B3 Modification Area. There is no potential for the proposed modification to have an impact on any areas of declared critical habitat.

3.5 Aquatic Results

Results of aquatic surveys have been summarised in **Appendix D. Plates 7 and 8** present photos of the variable quality of aquatic habitats recorded in the LWB1-B3 Modification Area.



Plate 7

Aquatic Habitat provided by the LWB1-B3 Modification Area



Plate 8

Low Quality Aquatic Habitat provided by the LWB1-B3 Modification Area

The unnamed tributary of Quorrobolong Creek has several barriers to fish passage in the LWB1-B3 Modification Area, mostly in the form of sand/silt bars and was assessed as providing Class 3 or minimal fish habitat (as defined in **Section 2.5.2.1**). Quorrobolong Creek within the LWB1-B3 Modification Area was considered relatively un-impeded (with the exception of a small man-made weir at the trap site) and was classified as providing Class 2 or moderate fish habitat. Both were considered to be slow-moving watercourses and as such only one minor riffle was identified in the unnamed tributary of Quorrobolong Creek directly following a small weir.

The volume of water in both watercourses was identified as slightly lower than capacity at the time of the field investigations and was found to be generally clear, occasionally with some minor tannins, and occasional areas of turbidity associated with disturbance by cattle.

Both watercourses provide habitat for small aquatic fauna species and small vertebrate fish, such as the introduced mosquito fish (*Gambusia holbrooki*).

Both watercourses were sinuous, and both banks and the substrate were comprised of silt/clay/sands with no gravel beds identified. Some bank erosion was present in the form of under-cutting, however this was minor and tended to occur along bends in areas where cattle grazing was more intense.

Both watercourses contained moderate amounts of woody debris and tree roots which would provide moderate habitat and refugia for aquatic fauna.

Out of a score of 200 (200 being high quality and 0 being low quality), the RCE assessments provided a score of 133 for Quorrobolong Creek, 119 for the unnamed tributary of Quorrobolong Creek south of Sandy Creek Road and 172 for the unnamed tributary of Quorrobolong Creek north of Sandy Creek Road, each of which are considered to indicate sub-optimal physical and biological conditions.

It is considered that both watercourses are ephemeral water bodies.

Typically encountered fringing flora species included narrow-leaved typha (*Typha domingensis*) and the introduced sharp rush (*Juncus acutus*); and typically encountered aquatic vegetation included water ribbons (*Triglochin procerum*) and nardoo (*Marsilea mutica*).

Aquatic surveys undertaken identified two vertebrate fish species utilising the watercourses with numerous introduced mosquito fish (*Gambusia holbrooki*) (recorded in both watercourses) and an unidentified gudgeon (Eleotridae) (only recorded in the unnamed tributary of Quorrobolong Creek). The mosquito fish were identified in abundance throughout the watercourses and are likely to be impeding colonisation by native fish species. Invertebrate shrimp were also observed in each water course.

No areas were identified in the LWB1-B3 Modification Area that were considered to have potential to provide habitat for the water rat (*Hydromys chrysogaster*) or platypus (*Ornithorhynchus anatinus*).

No threatened aquatic species listed as threatened under the TSC Act, EPBC Act or FM Act were identified or considered likely to occur.

3.6 Groundwater Dependent Ecosystems

As outlined in the NSW State Groundwater Dependent Ecosystems (GDE) Policy 2002, there are four types of groundwater dependent ecosystems, namely:

- terrestrial vegetation
- base flows in streams
- aquifer and cave ecosystems
- wetlands.

A review of the Bureau of Meteorology Atlas of Groundwater Dependent Ecosystems (BoM Atlas) and the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009 was completed in August 2015. No high priority GDEs listed under the Water Sharing Plan were located within the region potentially impacted by the proposed modification. The BoM Atlas identified Congewai Creek and Ellalong Lagoon as the only GDEs (or partial GDEs) in the vicinity of the LWB1-B3 Modification Area. Ellalong Lagoon occurs approximately 4km west of the proposed LWB1-B3 Modification Area and Congewai Creek occurs more than 5km west and south of the LWB1-B3 Modification Area. Based on this mapping, Congewai Creek and Ellalong Lagoon are both classed as an “Ecosystems that rely on the surface expression of groundwater”; however the southern end of Congewai Creek was classified as having a “low potential for groundwater interaction”, the northern end was classified as having a “moderate potential for groundwater interaction” and Ellalong Lagoon was classified as having a “high potential for groundwater interaction”. Neither of these GDEs occur within the LWB1-B3 Modification Area and based on predictions of the subsidence, flooding and groundwater impact assessment reports, the proposed modification will not adversely impact these GDEs.

The groundwater resources present in the LWB1-B3 Modification Area occur in the shallow alluvial aquifers associated with Quorrobolong Creek and its tributaries and within the deeper Newcastle Coal Measures. It is highly likely that the riparian vegetation comprising Riparian Swamp Oak Open Forest and Riparian Cabbage Gum Open Forest is at least partially dependent upon groundwater during periods of reduced surface water flow.

A small wet soak area was identified at a rapid assessment point approximately 40 metres west of the unnamed tributary that flanks the north-east of the LWB1-B3 Modification Area. The soak was approximately 15 metres in diameter and is dominated by perennial wetland groundcover plants. While not listed as a GDE or high priority GDE by the BoM Atlas or Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009, this soak is expected to comprise an area of groundwater seepage and is therefore likely to comprise a groundwater dependent ecosystem.

4.0 Impact Assessment

4.1 Potential Impacts of the Proposed Modification

The proposed modification does not involve any additional surface development and therefore will have no direct impact on vegetation as a result of clearing. The potential impacts of the project on flora and fauna are therefore limited to impacts associated with subsidence.

Biodiversity values have the potential to be impacted by subsidence related surface cracking in the soil, and by any associated remediation of surface cracking post mining. Secondary impacts associated with hydrological changes are also possible and typically impact greatest on riparian areas. Such secondary impacts could include:

- changes to runoff and flow volumes through subsidence induced changes to catchment boundaries
- changes to bank stability and channel alignment
- changes to in-channel and out of channel ponding through changes to the bed profile of the creeks which may result in drying or waterlogging of root systems
- loss of water to near-surface groundwater flows due to subsidence-induced cracks occurring beneath a stream or other surface water body.

Potential changes in the ground surface resulting from subsidence have been assessed by MSEC (2015). The subsidence assessment findings conclude that due to the depth of mining within the proposed modification area (greater than 480 metres), the small magnitude of predicted ground curvatures and strains and the absence of any steep slopes or cliffs within the modification area, the potential for surface cracking is low.

This conclusion is supported by monitoring evidence within the Stage 2 and 3 area, where there has been no significant or visible surface cracking above previously extracted longwalls A3 to A8. Similarly, ecological monitoring undertaken within the Stage 2 and Stage 3 areas since 2008 and 2012 respectively shows no evidence of any impacts on ecological features as a result of longwall mining (Austar 2014). Subsidence predictions for the LWB1-B3 Modification Area are less than those predicted within the Stage 2 and Stage 3 areas, therefore impacts are also predicted to be similar to or less than those experienced in these areas.

Any surface cracking that does occur is expected to be minor and isolated and unlikely to directly or adversely impact site vegetation communities and fauna habitat. Based on previous experience within the broader Austar Coal Mine, remediation of surface cracking is unlikely to be required within the LWB1-B3 Modification Area.

Flood modelling has been undertaken by Umwelt (2015) to assess the changes in flooding and surface water flows resulting from predicted subsidence within the LWB1-B3 Modification Area. The surface water assessment concludes that the proposed modification will not have a significant impact on runoff regimes, bank stability, channel alignment, in-channel and out of channel ponding.

An assessment of potential impacts on groundwater has also been undertaken by Dundon Consulting (2015). The groundwater assessment concludes that given the depth of mining, the geomorphology of the area and the geology overlying the coal seam, the potential for the LWB1-B3 Modification to adversely impact on groundwater availability or quality within the alluvium is negligible. This is supported by monitoring of shallow groundwater levels within the Stage 2 area that indicate no detectable impact on the

alluvium as a result of mining (Auercon 2013). Potential impacts on groundwater dependent ecosystems are considered further in **Section 4.5**.

Based on the findings of the surface water and groundwater assessments, the potential for the proposed modification to result in secondary impacts on ecological values as a result of changes in hydrology is therefore considered low.

4.2 Impact on Biodiversity Values

Based on the assessment provided in **Section 4.1** above, there is considered to be little potential for longwall mining to adversely impact vegetation communities and fauna habitat identified in the LWB1-B3 Modification Area.

Similarly aquatic fauna habitats are considered to have little potential to be impacted as surface cracking and subsequent loss of surface flows are not predicted to occur. The proposed modification is not likely to result in an adverse impact to the biodiversity values identified in the LWB1-B3 Modification Area and therefore negligible changes to flora and fauna species diversity, vegetation community extent and aquatic species and habitat complexity is predicted.

4.3 Impact on Threatened Species and Communities

4.3.1 Threatened Species

The following threatened flora and fauna species listed under the TSC Act were assessed in accordance with Section 5A of the EP&A Act (provided in **Appendix E**) as they were identified within the LWB1-B3 Modification Area or were considered to be potentially affected as a result of the proposed modification:

- heath wrinklewort (*Rutidosis heterogama*) – listed as vulnerable under the TSC Act
- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) – listed as vulnerable under the TSC Act
- netted bottle brush (*Callistemon linearifolius*) – listed as vulnerable under the TSC Act
- green-thighed frog (*Litoria brevipalmata*) – listed as vulnerable under the TSC Act
- regent honeyeater (*Anthochaera phrygia*)- listed as critically endangered under the TSC Act
- swift parrot (*Lathamus discolor*) – listed as endangered under the TSC Act
- grey-crowned babbler (*Pomatostomus temporalis temporalis*) – listed as vulnerable under the TSC Act
- varied sittella (*Daphoenositta chrysoptera*) – listed as vulnerable under the TSC Act
- grey-headed flying fox (*Pteropus poliocephalus*) – listed as vulnerable under the TSC Act
- squirrel glider (*Petaurus norfolcensis*) - listed as vulnerable under the TSC Act
- koala (*Phascolarctos cinereus*) – listed as vulnerable under the TSC Act
- southern myotis (*Myotis macropus*) – listed as vulnerable under the TSC Act
- large-eared pied bat (*Chalinolobus dwyeri*) listed as vulnerable under the TSC Act

- eastern free-tailed bat (*Mormopterus norfolkensis*) – listed as vulnerable under the TSC Act
- little bentwing bat (*Miniopterus australis*) – listed as vulnerable under the TSC Act
- greater broad-nosed bat (*Scoteanax rueppellii*) listed as vulnerable under the TSC Act.

As discussed in **Sections 4.1** and **4.2**, the proposed modification will not result in any direct clearing of vegetation and the potential impacts associated with subsidence are not predicted to impact adversely on vegetation communities or fauna habitat. Given the mobile nature of the fauna species assessed, and that only negligible change to the overall landscape is predicted as a result of the proposed modification, it was not considered likely that there would be a significant impact on any threatened fauna species listed under the TSC Act as a result of the proposed modification.

4.3.2 Endangered Populations

There are no endangered flora or fauna populations present within the LWB1-B3 Modification Area. The proposed modification will not result in a significant impact on endangered populations.

4.3.3 Endangered Ecological Communities

Two EECs and one potential EEC were recorded within the LWB1-B3 Modification Area being River-flat Eucalypt Forest EEC, the Lower Hunter Spotted Gum – Ironbark Forest EEC and potential Quorrobolong Scribbly Gum Woodland EEC.

The predicted subsidence, surface cracking and surface and groundwater impacts of the proposed modification are not expected to result in a significant impact on the floristic diversity, condition or extent of EECs occurring in the LWB1-B3 Modification Area.

The significance of any potential impacts on the River-flat Eucalypt Forest EEC, Lower Hunter Spotted Gum – Ironbark Forest EEC and potential Quorrobolong Scribbly Gum Woodland EEC, were assessed in accordance with the requirements of the EP&A Act. This assessment, provided in **Appendix E**, concludes that the proposed modification will not have a significant impact on the River-flat Eucalypt Forest, Lower Hunter Spotted Gum – Ironbark Forest and potential Quorrobolong Scribbly Gum Woodland EECs such that it would place the local occurrence of the EECs at risk of extinction.

4.3.4 Threatened Aquatic Species and Ecosystems

The Darling River Hardyhead Endangered Population is the only species listed under the FM Act that occurs within the Hunter Catchment. This species is usually found in slow flowing, clear, shallow waters or in aquatic vegetation at the edge of such waters. The species has also been recorded from the edge of fast flowing habitats such as the runs at the head of pool. This species is rarely recorded in the Hunter catchment but has been found in the headwaters of the Hunter system near Pages River. The species is not expected to occur in the LWB1-B3 Modification Area due to a lack of suitable habitat and the species will not be significantly impacted as a result of the proposed modification.

4.4 Matters of National Environmental Significance

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and communities

- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- the Great Barrier Reef Marine Park
- World Heritage properties
- National Heritage places
- nuclear actions
- a water resource, in relation to coal seam gas development and large coal mining development.

The LWB1-B3 Modification Area includes the following

- listed threatened species and communities
- listed migratory species
- a water resource, in relation to coal seam gas development and large coal mine development.

The EPBC Act lists criteria which are used to determine whether an action is likely to have a significant impact on the MNES relevant to the proposed modification, that is, listed threatened species and communities; and listed migratory species. These criteria are addressed in the Assessment of Significance provided in **Appendix F** and included the EPBC Act listed species identified below.

- regent honeyeater (*Anthochaera phrygia*)- listed as critically endangered under the EPBC Act
- swift parrot (*Lathamus discolor*) – listed as endangered under the EPBC Act
- grey-headed flying fox (*Pteropus poliocephalus*) listed as vulnerable under the EPBC Act
- koala (*Phascolarctos cinereus*) – listed as vulnerable under the EPBC Act
- large-eared pied bat (*Chalinolobus dwyeri*) – listed as vulnerable under the EPBC Act
- heath wrinklewort (*Rutidosis heterogama*) – listed as vulnerable under the EPBC Act
- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) – listed as vulnerable under the EPBC Act.

The assessments of significance undertaken for threatened and migratory species listed under the EPBC Act determined that the proposed modification would be unlikely to result in a significant impact on these species. Subsequently, referral of the proposed modification to the Minister of the Environment on the basis of impacts on listed threatened species or listed migratory species is not required.

4.5 Groundwater Dependent Ecosystems

It is considered likely that the approximately 19.7 ha of Riparian Swamp Oak Forest and Riparian Cabbage Gum Open Forest present in the modification area is at least partially dependent on groundwater flows. In addition, a further small, potentially groundwater dependent soak area (less than 0.1 ha in size) was identified in the north-east of the LWB1-B3 Modification Area. As outlined in **Section 3.5** these areas are considered to have at least some dependence on shallow groundwater resources during periods of reduced surface water flow.

Previous monitoring of the impacts of mining on shallow aquifers within the Austar Coal Mine has identified no observable impact on alluvial or shallow rock aquifers as a result of mining (Austar 2014). Fluctuations in groundwater level within these shallow aquifers have reflected rainfall conditions, with groundwater levels trending higher during periods of above average rainfall and lower during periods of below average rainfall (Dundon 2015). The surface water and groundwater assessments completed for this project indicate that impacts on groundwater and surface water regimes are predicted to be minor or negligible. Therefore groundwater dependent ecosystems occurring in the LWB1-B3 Modification Area, including the Riparian Swamp Oak Open Forest, Riparian Cabbage Gum Open Forest and the small soak area identified, are unlikely to be adversely impacted as a result of the proposed modification. Their condition may however change over the period of the proposed modification as a result of fluctuations in groundwater levels associated with rainfall. Monitoring of alluvial groundwater levels and rainfall is proposed to be undertaken on a regular basis as described in the Groundwater Assessment undertaken by Peter Dundon (2015).

4.6 Key Threatening Processes

A number of Key Threatening Processes (KTPs) listed under the Schedules of the TSC Act, the EPBC Act and the FM Act, are relevant to the proposed modification. A discussion of the implications of the relevant KTPs under each Act is detailed below.

4.6.1 Threatened Species Conservation Act 1995 Listed KTPs

There are four KTPs listed under the TSC Act that are potentially relevant to the LWB1-B3 Modification, being:

- *Alteration of habitat following subsidence due to longwall mining*

This KTP is most relevant to the proposed modification. Subsidence as a consequence of longwall mining is recognised as potentially altering habitats as well as the species and communities dependent on these habitats. Some habitats such as aquatic and riparian areas are considered to be particularly susceptible to subsidence (as a result of subsidence, tilt, curvature, cracking and subsequent hydrological changes).

Two threatened species are identified within this KTP determination as being susceptible to subsidence as a result of longwall mining that are considered to have potential to occur within the LWB1-B3 Modification Area, being the southern myotis (*Myotis macropus*) and grey-headed flying fox (*Pteropus poliocephalus*). As such these two species have been included within the relevant assessments of significance.

Longwall mining has the potential for surface movement (change to surface tilt and curvature) to cause habitat tree fall and the potential for disruption to natural water flow regimes and retention capacity in water bodies.

The subsidence predictions prepared by MSEC (2015) indicate that subsidence experienced over LWB1-B3 will be less than that experienced elsewhere within the Stage 2 and 3 areas, where Longwall Top Coal Caving methods were used. The overall magnitude of predicted subsidence parameters is also relatively small given the depth of cover (greater than 480 metres), the geology of the area and local topography. It is anticipated that longwall mining will result in a similar final land surface to that currently present with some minor overall lowering.

Given the small magnitude of predicted tilts and curvatures, tree fall as a result of subsidence is highly unlikely. There is also considered to be a low potential for an increase to surface ponding (within riparian areas or elsewhere) and a low potential for any significant hydrological alterations such that there will be an impact on threatened flora, fauna or TECs.

- *Alteration to natural flow regimes of rivers and streams and their floodplains and wetlands*

Based on the predicted subsidence expected as a result of the project described above, no significant changes to the natural flow regime of the surface water and groundwater regimes currently operating in the LWB1-B3 Modification Area is predicted.

- *Anthropogenic climate change*

As an indirect impact of the proposed modification, greenhouse gas emissions will contribute to anthropogenic climate change as part of the energy production from the coal extracted from the LWB1-B3 Modification Area. This will not occur directly as a result of the proposed modification and the extent of this contribution is considered to be minor (see the Greenhouse Gas Assessment undertaken within the main text of this Environmental Assessment).

- *Loss of hollow-bearing trees*

The predicted alterations to the topography of the land in terms of tilt and curvature are not predicted to be substantially modified to the extent that they will result in tree-fall and subsequent hollow-bearing tree loss.

4.6.2 Environment Protection and Biodiversity Conservation Act 1999 Listed KTPs

There is one KTP listed under the EPBC Act that is potentially relevant to this project, being :

- *Loss of climactic habitat caused by anthropogenic emissions of greenhouse gases*

Greenhouse gas emissions will be generated both directly and indirectly as a result of the proposed modification. The vast majority of these emissions (95 per cent) will be indirect emissions attributable to third party emissions as a result of use of the coal extracted from the LWB1-B3 Modification Area. Direct emissions attributable to the LWB1-B3 Modification will contribute approximately 0.00018 per cent to global emissions per annum, the extent of this contribution is considered to be minor (see the Greenhouse Gas Assessment undertaken within the main text of this Environmental Assessment).

4.6.3 Fisheries Management Act Listed KTPs

There is one KTP listed under the Fisheries Management Act that is potentially relevant to this project, being:

- Human-caused climate change

As an indirect impact of the proposed modification, greenhouse gas emissions will contribute to human-caused climate change as part of the energy production from the coal extracted from the LWB1-B3 Modification Area. This will not occur directly as a result of the proposed modification and the extent of this contribution is considered to be minor (see the Greenhouse Gas Assessment undertaken within the main text of this Environmental Assessment).

5.0 Mitigation and Management

The LWB1-B3 Modification proposes that an Extraction Plan condition is added to the Bellbird South consent to cover the LWB1-B3 workings, consistent with contemporary Extraction Plan requirements.

It is proposed that Austar Coal Mine will prepare a specific Biodiversity Management Plan (BMP) as a component plan of an Extraction Plan for the LWB1-B3 Modification Area to manage any potential impacts from secondary extraction of LWB1-B3 on biodiversity values within the extraction area. The BMP will identify baseline information on ecological values within the LWB1-B3 Modification Area, and the potential impacts to those aspects by predicted subsidence as identified in this assessment report. The BMP will identify specific monitoring recommendations as outlined in **Section 5.1** below. Any monitoring on private lands is subject to landowner access.

Subsidence predictions indicate no likely impact to ecological features within the LWB1-B3 Modification Area, however, it is proposed that contingency measures for any required subsidence remediation works will be provided in the BMP.

5.1 Ecological Monitoring

In order to ensure subsidence predictions are accurate and that there will be no significant impacts to EECs, it is recommended that ecological monitoring be undertaken of:

- River-flat Eucalypt Forest EEC vegetation
- Lower Hunter Spotted Gum – Ironbark Forest EEC vegetation
- potential Quorrobolong Scribbly Gum Woodland EEC vegetation.

At least one monitoring site will be established in each EEC, subject to landholder access.

Given the results of vegetation monitoring undertaken within subsidence affected areas of the Austar Coal Mine since 2007 do not show any evidence of adverse impacts on vegetation, the monitoring of threatened flora species, including the netted bottlebrush (*Callistemon linearifolius*) population, heath wrinklewort (*Rutidosia heterogama*) population, and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) population, is not proposed. Should the results of EEC monitoring surveys reveal sufficient reason to conduct further surveys of threatened species populations, the monitoring program should be appropriately adapted

Specific surveys targeting fauna groups is also not deemed necessary given the minimal surface disturbances predicted and the extensive effort required to collect sufficient data on fauna species to allow reliable comparisons to be made. Should the results of vegetation monitoring surveys reveal sufficient reason to conduct fauna surveys, the monitoring program should be appropriately adapted.

Monitoring will be undertaken as mining proceeds to ensure that any actual impacts are discovered quickly and managed appropriately. In the event that monitoring does reveal impacts, mitigation and management measures will be implemented in accordance with procedures to be outlined in the BMP. In addition, monitoring will ensure that any mitigation measures recommended are successfully implemented.

It is proposed that monitoring be undertaken on an annual basis. A baseline survey will be undertaken at each site prior to the commencement of longwall extraction. The cessation of monitoring will be linked with the results of the subsidence monitoring. The timeframe for completion of monitoring will depend strongly on whether any impacts are observed and whether remediation works are required. Monitoring will need to continue for a longer period of time if remediation works are required or if changes to the ecological values are observed that are linked to subsidence impacts, in which case monitoring would continue until the condition of the site is found to be stable.

The monitoring program would incorporate survey methods such as: permanent vegetation plots, vegetation condition assessment, habitat assessment and photo monitoring, where relevant.

6.0 References

Allen, G. R, Midgley, S.H and Allen M, 2002. *Field Guide to Freshwater Fishes of Australia* Western Australian Museum, Western Australia

Barker, D., Allan, G.L., Rowland, S.J., Kennedy, J.D. and Pickles, J.M., 2009. A Guide to Acceptable Procedures and Practices for Aquaculture and Fisheries Research – 3rd Edition. Prepared for the Primary Industries (Fisheries) Animal Care and Ethics Committee

Austar, (2014) Austar Annual Environmental Management Report July 2013 – June 2014

Austin, M, P, Cawsey, E, M, Baker, B, L, Yialeloglou, M, M, Grice, D, J, and Briggs, S, V, 2000. *Predicted Vegetation Cover in the Central Lachlan Region*. Final report of the Natural Heritage Trust Project AA 1368.97. CSIRO Wildlife and Ecology, Canberra.

Bell, S (2004) Vegetation of Werakata National Park, Hunter Valley, New South Wales. *Cunninghamia* 8(3): 331-347.

Bell, S A J and Driscoll, C (2008) Vegetation of the Cessnock-Kurri Region, Cessnock LGA, New South Wales: Survey, Classification & Mapping. Prepared for the Department of Environment and Conservation, Newcastle.

Bionet 2015. Bionet – the website for the NSW Atlas of Wildlife. <http://www.bionet.nsw.gov.au/>

Bureau of Meteorology Atlas of Groundwater Dependant Ecosystems (<http://www.bom.gov.au/water/groundwater/gde/index.shtml>)

Botanic Gardens Trust, 2015. *PlantNET* – The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (version 2.0). <<http://plantnet.rbgsyd.nsw.gov.au>>

Braun-Blanquet, J, 1927. *Pflanzensoziologie*. Springer, Vienna.

Churchill, S 2008. *Australian Bats*. Reed New Holland, Sydney.

Cogger, H, G. (2000) *Reptiles and Amphibians of Australia*. Reed Books, Chatswood.

Cronquist, A, (1981) *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York. Department of the Environment (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance.

DEC (2005) *The Vertebrate fauna of Werakata National Park*. Unpublished report funded by the Central Branch Parks and Wildlife Division Biodiversity Survey Priorities Program by NSW Department of Environment and Conservation, Information and Assessment Section, Metropolitan Branch, Environment Protection and Regulation Division.

(DECC) NSW Department of Environment and Climate Change, 2008. *Hygiene Protocol for the Control of Disease in Frogs*. Information Circular Number 6. NSW National Parks and Wildlife Service, Hurstville NSW.

Department of the Environment (DotE) (2013) Matters of National Environmental Significance Significant Impact Guidelines 1.1. Commonwealth of Australia.

- Department of the Environment (DotE) 2015. *Species Profile and Threats Database*. Available: <http://www.environment.gov.au/cgibin/sprat/public/sprat.pl>.
- Department of Primary Industries (Fisheries and Aquaculture (2015). Threatened and Protected Species – records viewer. <http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer>
- Department of the Environment (DoE) (2014) EPBC Act Referral Guidelines for the Vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Commonwealth of Australia.
- (DLWC) Department of Land and Water Conservation (2002) The NSW State Groundwater Dependent Ecosystems Policy.
- Dundon, P, (2015) Austar Coal Mine – LWB1-B3 Modification – Groundwater Assessment.
- Elliot, M (2014). Floristic Species List of Duckworth Property. Prepared on behalf of Trevor Duckworth.
- ERM, (2006) Longwall Panels A1 and A2 Flora and Fauna Assessment, prepared for Austar Coal Pty Limited, April 2006.
- Garnett, S, T, and Crowley, G, M, (2000) *The Action Plan for Australian Birds*. Environment Australia.
- Harden, G, J, Editor, 1992. *Flora of New South Wales. Volume 3*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.
- Harden, G, J, Editor, 1993. *Flora of New South Wales. Volume 4*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.
- Harden, G, J, Editor, 2000. *Flora of New South Wales. Volume 1*. 2nd edition. New South Wales University Press and Royal Botanic Gardens, Sydney.
- Harden, G, J, Editor, 2002. *Flora of New South Wales. Volume 2*. Revised edition. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.
- Menkhorst, P and Knight, F 2011. *A field guide to the Mammals of Australia*. Oxford University Press, South Melbourne.
- MSEC, 2015. Austar Coal Mine: Longwalls B1 and B2 Subsidence Predictions and Impact Assessments for the Natural and Built Features in Support of the Environmental Assessment for a Section 75W Modification Application for the Inclusion of the Proposed Longwalls B1 and B2 at the Austar Coal Mine.
- Murray, Bell and Hoye 2002. *Flora and Fauna Survey Guidelines – Lower Hunter and Central Coast Region 2002*.
- NSW Fisheries, 1999. 'Policy and Guidelines: Aquatic Habitat Management and Fish Conservation (1999 Update). Smith, A. K and Pollard, D. A. (eds.)' NSW Fisheries, Port Stephens.
- NSW Scientific Committee (2011a) River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions – Determination to make a minor amendment to part 3 of Schedule 1 of the Threatened Species Conservation Act.

NSW Scientific Committee (2011b) Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion – Determination to make a minor amendment to part 3 of Schedule 1 of the Threatened Species Conservation Act.

Petersen, R. C. 1992. The RCE: a Riparian, Channel, and Environmental Inventory for small streams in the agricultural landscape. *Freshwater Biology*, 27: 295–306.

Peake, T C, Bell, S A J, Tame, T M, Simpson, J A and Curran, T J, 2003. The Hunter Rare Plants Database: Identification and Listing of Regionally Significant Flora for the Hunter Region, New South Wales. Poster at Ecological Society of Australia Conference, Armidale, December 2003.

Poore, M, E, D. 1955. The use of phytosociological methods in ecological investigations. I. The Braun-Blanquet system. *Journal of Ecology* 42: 216-224.

Robinson, M, (2002) *A Field Guide to Frogs of Australia*. Australian Museum/Reed New Holland, Sydney.

Saunders, D. (2002) *Swifts Across the Strait*. *Swifts Across the Strait*. February 2002.

Slater, P, Slater, P, and Slater, R. (2003). *The Slater Field Guide to Australian Birds*. Reed Natural History.

Swan, G, Shea, G, and Sadler, R, (2004) *A Field Guide to Reptiles of New South Wales*. Reed New Holland, Sydney.

Umwelt (Australia) Pty Limited (2007) Austar Stage 2 Subsidence Management Plan – Appendix 1 Ecological Assessment, February 2007. Prepared on behalf of Austar Coal Mine Pty Limited.

Umwelt Australia Pty Limited (2008) Austar Ecological Assessment, Stage 3 Mine Area, (Longwalls 6 to 17), and Surface Infrastructure Site, September 2008. Prepared on behalf of Austar Coal Mine Pty Limited.

Umwelt Australia Pty Limited (2009) Baseline Ecological Monitoring Report for Stage 2 Longwalls, Austar Mine, Quorrobolong, June 2009. Prepared on behalf of Austar Coal Mine Pty Limited.

Umwelt (Australia) Pty Limited (2010). Proposed Stage 2 Extension – Ecological Assessment for Longwall A5a. Prepared for Austar Coal Mine.

Umwelt Australia Pty Limited (2011a) Ecological Assessment for Austar Proposed Stage 3 Modification. Prepared on behalf of Austar Coal Mine Pty Limited.

Umwelt (Australia) Pty Limited (2011b). Revised Ecological Monitoring Program for Stage 2 Longwall Mining, Austar Coal Mine, Quorrobolong.

Umwelt (Australia) Pty Limited, 2013a. 2012 Ecological Monitoring Report for Stage 2 Longwalls, Austar Coal Mine, Quorrobolong NSW.

Umwelt (Australia) Pty Limited, 2014a. 2013 Ecological Monitoring Report for Stage 2 and Stage 3 Longwalls, Austar Coal Mine, Quorrobolong NSW.

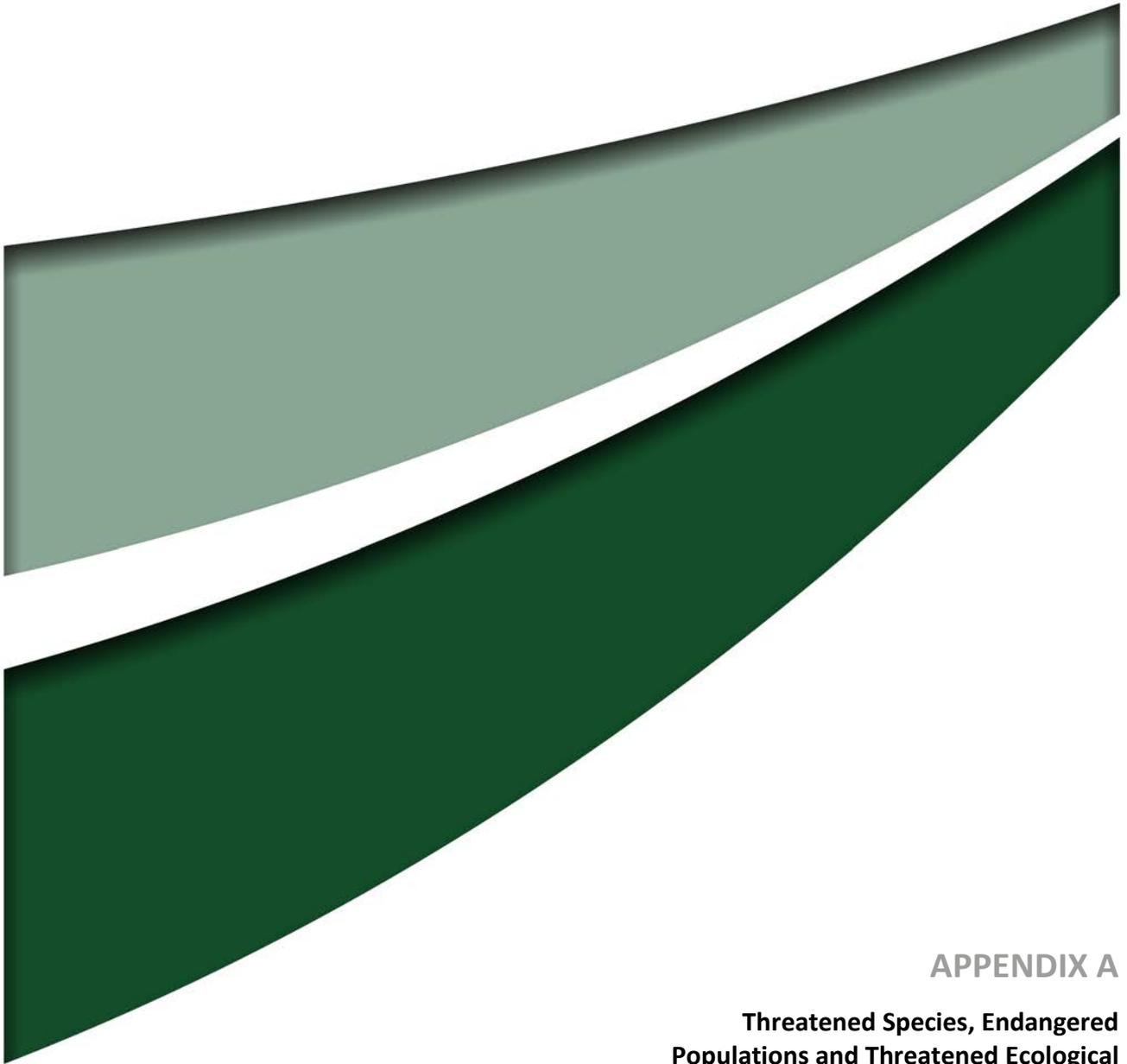
Umwelt (Australia) Pty Limited, 2014b. Austar Coal Mine Pty Ltd Biodiversity Management Plan.

Umwelt (Australia) Pty Limited, 2013b. 2014 Ecological Monitoring Report for Stage 2 and Stage 3 Longwalls, Austar Coal Mine, Quorrobolong NSW.

Wheeler, D.J.B., Jacobs, S.W.L. and Whalley, R.D.B, 2002. *Grasses of New South Wales*. 3rd edition. The University of New England, Armidale.

Wilson, S, and Swan, G, (2008) *A Complete Guide to Reptiles of Australia*. Reed New Holland, Sydney.

Van Dyke, S, and Strahan, R 2008. *The Mammals of Australia: Third Edition*. Reed New Holland, Sydney.



APPENDIX A

**Threatened Species, Endangered
Populations and Threatened Ecological
Communities with Potential to Occur**

Appendix A – Threatened Species, Endangered Populations and TECs with Potential to Occur

Threatened species, migratory species, endangered populations, and threatened ecological communities (TECs) recorded during surveys of the LWB1-B3 Modification Area, and records from the ecological database searches, are listed in **Tables 1** and **2**. To assist in the impact assessment process, the tables also contain relevant ecological details of each listing, including their habitat requirements, known range and reservation within conservation reserves. For the purposes of these tables, the 'region' is broadly defined as the Lower Hunter Valley, the western limit being Singleton and the eastern limit being approximately West Wallsend. The northern and southern boundaries of the region are approximately 30 kilometres north and south of the Project Area.

The tables presented below are intended to streamline the impact assessment process, ensuring that only those species with reasonable potential to occur in the Project Area and with reasonable potential to be impacted by the Proposed Modification are assessed under a 7 part test.

The 7 part tests of significance for species listed under the TSC Act are provided in **Appendix E** (EP&A Act). Species listed under the EPBC Act with reasonable potential to be impacted by the Proposed Modification are further assessed in **Appendix F** following the guidelines of that Act.

Table 1 Threatened Flora, Endangered Populations and TECs Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
THREATENED FLORA SPECIES						
Bynoes wattle <i>Acacia bynoeana</i>	E (TSC) V (EPBC) 3VC- (ROTAP)	Occurs in heath or dry sclerophyll forest on sandy soils. Often prefers open, sometimes slightly disturbed sites such as track margins, edges of roadside spoil mounds and in recently burnt areas.	Occurs in central eastern NSW, from Morisset to the Illawarra region and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra, and in the Kurri Kurri, Cessnock and Ellalong areas in the lower Hunter Valley.	Olney SF Yengo NP	There is a low potential for this species to occur within the Spotted Gum – Ironbark Forest of the LWB1-B3 Modification Area. The Proposed Development will not modify habitat of this species. There is no potential for a significant impact on potential habitat for this species.	No
<i>Allocasuarina glareicola</i>	E (TSC) E (EPBC)	This species is found in open Castlereagh woodland in lateritic soils.	This species is only known from the north-west Cumberland Plains district, with an additional outlying population at Liverpool.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Charmhaven apple <i>Angophora inopina</i>	V (EPBC) V (TSC) 2R- (ROTAP)	This species typically occurs on the shallow sandy soils of the Narrabeen Group, on exposed ridges and slopes with westerly or northerly aspect. It has also been recorded on shallow alluvial soils of this geological type, in upper catchments and in embedded clay soil lenses with sandstone. This species is known to naturally hybridise with rough-barked apple (<i>A. floribunda</i>) particularly around major drainage lines.	Distribution confined to the Wyong, Lake Macquarie and Port Stephens LGA of NSW. Pure forms of this species have been recorded from the Wallarah catchment in the south and north to the Toronto area. Disjunct populations have been identified at Karuah.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
<i>Asterolasia elegans</i>	E (TSC) E (EPBC) 2ECa (ROTAP)	This species occurs on Hawkesbury sandstone on the mid to lower slopes of valleys within sheltered forests. This species is typically associated with turpentine (<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>), smooth-barked apple (<i>Angophora costata</i>), Sydney Peppermint (<i>Eucalyptus piperita</i>), forest oak (<i>Allocasuarina torulosa</i>) and Christmas bush (<i>Ceratopetalum gummiferum</i>).	This species is known to the Baulkham Hills, Hawkesbury and Hornsby LGAs and is predicted to occur in the Gosford LGA. Only six populations of this species are known, all of which are within either the Colo or Hawkesbury River Catchment. Only one of the known populations of this species occurs within a conservation reserve.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the Modification Area. There is no potential for a significant impact on this species.	No
nettled bottle brush <i>Callistemon linearifolius</i>	V (TSC) 2RCi (ROTAP)	Typically grows in dry sclerophyll forest on the coast and adjacent ranges	The distribution of this species is primarily known from the areas of the Georges River and the Hawkesbury River near Sydney, reaching to Nelsons Bay in the north (although species have been recorded in the past from as far north as Woolgoolga), and to the west at Cessnock in the Hunter Valley.	Heaton SF Werakata NP	This species was identified in the LWB1-B3 Modification Area. This species is potentially sensitive to the Proposed Modification.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
leafless tongue orchid <i>Cryptostylis hunteriana</i>	V (TSC) V (EPBC) 3VC- (ROTAP)	This species appears to favour moist soils on the flat coastal plains. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing hard-leaved scribbly gum (<i>Eucalyptus haemastoma</i>), brown stringybark (<i>E. capitellata</i>) and red bloodwood (<i>Corymbia gummifera</i>).	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region.	This species is not known to occur in any reserves in the region.	This species potentially occurs in the LWB1-B3 Modification Area in various habitats. The Proposed Development will not modify habitat of this species. There is no potential for a significant impact on potential habitat of this species.	No
slaty red gum <i>Eucalyptus glaucina</i>	V (TSC) V (EPBC) 3VCa (ROTAP)	This species grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	Found only on the North Coast of NSW and in separate districts: near Casino (where it can be locally common) and further south, from Taree to Broke, west of Maitland. Scattered occurrences around Singleton.	Pokolbin SF Uffington SF Werakata NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Craven grey box <i>Eucalyptus largeana</i>	E (TSC)	Craven grey box is often found in areas of wet forest in the sub-coastal ranges.	Only known to occur in the Gloucester-Craven district from near Pokolbin.	Copeland Tops SCA Berrico NR Talawahl NR Glen NR Willi Willi NP	There is no potential for this species to occur in the Modification Area. There is no potential for a significant impact on this species.	No
Parramatta red gum <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V (EPBC) V (TSC) 2V (ROTAP)	Typically grows on deep, low-nutrient sands, often those subject to periodic inundation. Occurs in dry sclerophyll woodland with dry heath understorey and also as an emergent in dry or wet heathland.	There are two separate meta-populations, in the Kurri Kurri and Tomago areas.	Heaton SF Werakata NP Werakata SCA	There is no potential for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
Pokolbin mallee <i>Eucalyptus pumila</i>	V (TSC) V (EPBC) 2VCi (ROTAP)	The single known population occupies north-west-facing slopes derived from sandstone.	Currently known only from a few small populations west of Pokolbin in the Hunter Valley. Historical records also exist for Wyong and Sandy Hollow, however, has not been recorded recently in these areas.	Pokolbin SF	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
<i>Euphrasia arguta</i>	CE (TSC) CE (EPBC) 3X (ROTAP)	This species grows in eucalypt forest with a mixed grass and shrub understory; with plants appearing to be most dense in open disturbed areas.	<i>Euphrasia arguta</i> was historically recorded in relatively few places extending from Sydney to Bathurst and north to Walcha and was believed extinct until 2008 when it was rediscovered in the Nundle area. This species is not known to occur within 20 km of the centre of the Project area.	This species is not known to occur in any reserves in the region.	This species potentially occurs in the LWB1-B3 Modification Area in various habitats. The Proposed Development will not modify habitat of this species. There is no potential for a significant impact on potential habitat of this species.	No
variable midge orchid <i>Genoplesium insignis</i>	E (TSC) CE (EPBC)	Grows in patches of kangaroo grass (<i>Themeda australis</i>) amongst shrubs and sedges in heathland and forest.	Recorded from four localities between Chain Valley Bay and Wyong in Wyong LGA.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
small-flower grevillea <i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V (EPBC) V (TSC)	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest and a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Sporadically distributed throughout the Sydney Basin mainly occurring around Picton, Appin, Bargo and possibly Moss Vale, as well as in the north from Putty to Wyong, Lake Macquarie, Cessnock and Kurri Kurri in the lower Hunter.	Werakata NP Werakata SCA	This species was identified in the LWB1-B3 Modification Area in the north-west of LWB3. This species is potentially sensitive to the Proposed Modification.	Yes
<i>Maundia triglochinosides</i>	V (TSC)	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. This species is typically associated with wetland species such as water ribbons (<i>Triglochin procerum</i>) and flowers between November and January.	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
biconvex paperbark <i>Melaleuca biconvexa</i>	V (TSC)	Biconvex paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Scattered and dispersed populations of this species are known to occur in the Karuah Manning and Wyong sub-regions of the Hunter-Central Rivers CMA area.	Olney SF Sugarloaf SCA	There is no potential for this species to occur within the LWB1-B3 as it was not identified during surveys and has not been recorded within 10km of the LWB1-B3 Modification Area There is no potential for a significant impact on this species.	No
Groves paperbark <i>Melaleuca groveana</i>	V (TSC) 3RC- (ROTAP)	Groves paperbark grows in heath and shrubland, often in exposed sites, at high elevations, on rocky outcrops and cliffs. It also occurs in dry woodlands.	Widespread, scattered populations in coastal districts north of Port Stephens to south-east Queensland.	Corrabare SF Yengo NP Werakata SCA	There is no potential for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Omeos stork's-bill <i>Pelargonium</i> sp. Striatellum	E (EPBC)	Typically occurs just above the high water level of irregularly inundated or ephemeral lakes. During dry periods it is known to colonise dry lake beds.	This species is known to occur in both Victoria and NSW. It occurs within the south-eastern highlands and South East Corner IBRA Bioregions and the Hawkesbury-Nepean, Murrumbidgee, Southern Rivers and North East Natural Resource Management Regions.	This species is not known to occur in conservation reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
leek orchid <i>Prasophyllum</i> sp. Wybong (C.Phelps ORG 5269)	CE (EPBC)	This species generally occurs in grassy and scrubby habitats in open eucalypt woodland and grasslands.	This species is endemic to NSW, from which there are only seven known populations from near NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. It is not known to occur outside the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes bioregions. It's area of occupancy is estimated at 1.5 km ²	This species is not known from any conservation reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
Singleton mint bush <i>Prostanthera</i> <i>cineolifera</i>	V (TSC) V (EPBC) 2K (ROTAP)	Grows in open woodlands on exposed sandstone ridges. Usually found in association with shallow or skeletal sands.	Restricted to only a few localities near Walcha, Scone and St Albans. The species was once known in Yengo NP, however, no records have been made here in many years.	Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Illawarra greenhood <i>Pterostylis gibbosa</i>	E (TSC) E (EPBC) 2E (ROTAP)	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	This species is not known to occur in any reserves in the region.	This species potentially occurs in the LWB1-B3 Modification Area in various habitats. The Proposed Development will not modify habitat of this species. There is no potential for a significant impact on potential habitat of this species.	No
eastern underground orchid <i>Rhizanthella slateri</i>	V (TSC) E (EPBC) K (ROTAP)	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
heath wrinklewort <i>Rutidosia heterogama</i>	V (TSC) V (EPBC) 2VCa (ROTAP)	Occurs mostly in heath, often along disturbed roadsides, and also in open forest, primarily in coastal districts.	In coastal districts from Maclean to the Hunter Valley and inland to Torrington. It has also been recently recorded at Coorabong on the Central Coast and extensively around the Cessnock district.	Werakata NP Werakata SCA	This species occurs along the western boundary of the LWB1-B3 Modification Area and is considered potentially sensitive to the development.	Yes
Rainforest cassia <i>Senna acclinis</i>	E (TSC) 3RC- (ROTAP)	Grows in or on the edges of subtropical and dry rainforest.	Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
Siah's backbone <i>Streblus pendulinus</i>	E (EPBC)	This species occurs in warmer rainforest, mostly along watercourses, north from Milton. Listing advice for this species indicates that the species is endangered on Norfolk Island and taxonomic revisions may have unintentionally included mainland occurrences of the species. For the purposes of this assessment it is assumed that the listing relates only to the Norfolk Island population of the species.	There are a number of known records of this species occurring in the Muswellbrook and Singleton areas.	Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
<i>Magenta lily pily</i> <i>Syzygium paniculatum</i>	E (TSC) V (EPBC) 3VCi (ROTAP)	This species grows in subtropical and littoral rainforests on sandy soils or stabilised dunes near the sea.	Occurs in widely separated localities between Bulahdelah and Jervis Bay.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
black-eyed Susan <i>Tetratheca juncea</i>	V (TSC) V (EPBC) 3VCa (ROTAP)	Low open forest, woodland, heathland and moist forest, with a shrub understorey and grassy groundcover on low nutrient soils. Generally prefers well-drained slopes (often south-facing) and ridges, although it also found on upper and mid-slopes and occasionally in gullies.	Confined to coastal districts from Bulahdelah to Lake Macquarie. Furthest inland occurrences are at Buttai, near Mt Sugarloaf.	Heaton SF Sugarloaf SCA	This species was not recorded in the LWB1-B3 Modification Area and there is no potential for it to occur. There is no potential for a significant impact on this species.	No
Austral toadflax <i>Thesium australe</i>	V (TSC) V (EPBC)	This species occurs in grassland or grassy woodland and is often found in damp sites in association with kangaroo grass (<i>Themeda australis</i>). This species is a root parasite that takes water and some nutrient from other plants, especially kangaroo grass.	This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania, Queensland and in eastern Asia. Occurs also at Mangoola, west of Muswellbrook, NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded in the LWB1-B3 Modification Area and there is no potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
<i>Zannichellia palustris</i>	E (TSC)	Grows in fresh or slightly saline stationary or slowly flowing water.	Known to occur in the Hunter, Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers CMA area.	This species is not known to occur in any reserves in the region.	This species was not recorded in the LWB1-B3 Modification Area and there is considered to be a very low potential for its occurrence. There is no potential for a significant impact on this species.	No
ENDANGERED FLORA POPUALTIIONS						
weeping myall <i>Acacia pendula</i> in the Hunter Catchment	EP (TSC)	Grows on major river floodplains on heavy clay soils, sometimes as the dominant species and forming low open woodlands. Within the Hunter catchment it typically occurs on heavy soils, sometimes at the margins of small floodplains, but also in more undulating locations remote from floodplains, such as at Jerrys Plains.	There are 17 confirmed and four unconfirmed naturally occurring remnants of the <i>A. pendula</i> population in the Hunter catchment. These range as far east as Warkworth, and as far west as Kerrabee, west of Sandy Hollow. <i>Acacia pendula</i> is not known to occur naturally further north than the Muswellbrook-Wyong area. Eight planted <i>A. pendula</i> populations (not naturally occurring) have been recorded in the Hunter, and it is likely that numerous more planted populations occur.	This population is not known to occur in any reserves in the region.	No individuals of <i>Acacia pendula</i> were recorded within the LWB1-B3 Modification Area, and there is no potential for this species to occur. There is no potential for a significant impact on this endangered population.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
tiger orchid <i>Cymbidium canaliculatum</i> in the Hunter Catchment	EP (TSC)	This species occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. It is usually found occurring singly or as a single clump, typically between two and six metres above the ground.	The population of <i>Cymbidium canaliculatum</i> in the Hunter Catchment is at the south-eastern limit of the geographic range for this species.	This population is not known to occur in any reserves in the region.	No individuals of <i>Cymbidium canaliculatum</i> were recorded within the LWB1-B3 Modification Area. There is no potential for a significant impact on this endangered population.	No.
river red gum <i>Eucalyptus camaldulensis</i> in the Hunter Catchment	EP (TSC)	River red gums are located on the banks and floodplains of watercourses on alluvial soils. This endangered population may occur with forest red gum (<i>Eucalyptus tereticornis</i>), yellow box (<i>Eucalyptus melliodora</i>), river oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) and rough-barked apple (<i>Angophora floribunda</i>).	The Hunter population occurs from the west at Bylong, south of Merriwa, to the east at Hinton, on the bank of the Hunter River. It has been recorded in the LGAs of Lithgow, Maitland, Mid-Western Regional, Muswellbrook, Port Stephens, Singleton and Upper Hunter.	This population is not known to occur in any reserves in the region.	No individuals of <i>Eucalyptus camaldulensis</i> were recorded within the LWB1-B3 Modification Area. There is no potential for a significant impact on this endangered population.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
<i>Leionema lamprophyllum</i> subsp. <i>obovatum</i> in the Hunter Catchment	EP (TSC)	Grows in heath on exposed ridges at higher altitudes. The Hunter population occurs on a rocky cliff line in a dry eucalypt forest.	The Hunter Catchment population of <i>L. lamprophyllum</i> subsp. <i>obovatum</i> is currently known to occur in Pokolbin State Forest. The total number of mature individuals is estimated to be very low with only 4 individuals currently known.	This population is not known to occur in any reserves in the region.	No individuals of <i>Leionema lamprophyllum</i> subsp. <i>obovatum</i> were recorded within the LWB1-B3 Modification Area. There is no potential for a significant impact on this endangered population.	No
THREATENED ECOLOGICAL COMMUNITIES						
Central Hunter Valley Eucalypt Forest and Woodland Complex	CEEC (EPBC)	This CEEC is dominated by one or more of the following canopy species narrow-leaved ironbark (<i>Eucalyptus crebra</i>), spotted gum (<i>Corymbia maculata</i>), slaty gum (<i>Eucalyptus dawsonii</i>), grey box (<i>Eucalyptus moluccana</i>) and may occasionally contain bullock (<i>Allocasuarina luehmannii</i>) as a dominant. This CEEC generally occurs on Permian sedimentary bedrock on valley floors, lower hill slopes and lower ridges.	This CEEC occurs in the central region of the Hunter valley within the Hunter catchment. It is mostly present within the Muswellbrook and Singleton LGAs, with smaller occurrences within the Cessnock, Maitland, Lake Macquarie, Newcastle and Port Stephens LGAs.	Singleton Military Area	This CEEC does not occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this CEEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, mud or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back-swamps, lagoons and lakes but may also occur in back-barrier landforms where floodplains adjoin coastal sand plains. Generally occur below 20 m elevation on level areas.	Known from along the majority of the NSW coast. There is less than 150 ha remaining on the Tweed lowlands (estimate in 1985); about 10,600 ha on the lower Clarence floodplain (in 1982); about 11,200 ha on the lower Macleay floodplain (in 1983); about 3500 ha in the lower Hunter – Central Hunter region (in 1990s); less than 2700 ha on the NSW south coast from Sydney to Moruya (in the mid 1990s), including about 660 ha on the Cumberland Plain (in 1998) and about 100 ha on the Illawarra Plain (in 2001); and less than 1000 ha in the Eden region (in 1990).	This community is poorly reserved but is known from Hunter Estuary NP	This EEC has no potential to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC (TSC)	This community generally occurs on floodplains and their associated floodplain rises in along the Hunter River and its tributaries. The community is generally tall woodland, with typical canopy species consisting of rough-barked apple (<i>Angophora floribunda</i>), river red gum (<i>Eucalyptus camaldulensis</i>), forest red gum (<i>Eucalyptus tereticornis</i>) and yellow box (<i>Eucalyptus melliodora</i>). Other common species are inclusive of kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>) and river oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>)	This community can be found along the Hunter River and its associated tributaries and is only known to occur in the NSW North Coast and Sydney Basin Bioregions. It has been recorded from the LGAs of Maitland, Mid-Western, Muswellbrook, Singleton and Upper Hunter.	This EEC is not known from any conservation reserves in the region.	This EEC does not occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregion	EEC (TSC)	This EEC occurs on the Permian sediments of the Hunter Valley floor. Much of the remaining community is disturbed and fragmented. The floristic composition and structure of the community is influenced by both the size and disturbance history of the remaining fragments. Consequently at heavily disturbed sites only some of the species which characterise the community may be present.	This EEC occurs from Muswellbrook to the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton LGAs, but may occur elsewhere in these bioregions.	Werakata NP Werakata SCA.	This EEC does not occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No
Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion	EEC (TSC)	This EEC occurs in the central to lower Hunter Valley, principally on Permian geology.	The EEC is restricted to a range of approximately 65 km by 35 km centred on the Cessnock – Beresfield area.	Corrabare SF Pokolbin SF Werakata NP	This EEC occurs within the LWB1-B3 Modification Area, on the drier slopes and ridges.	Yes
Potential Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	EEC (TSC)	This EEC occurs on a residual sand deposit overlying the Permian clay sediments in the Hunter Valley.	This EEC is known from a small area between Quorrobolong and Mulbring in the Cessnock LGA but may occur elsewhere.	This EEC is not known from any conservation reserves in the region.	A small quantity of the vegetation in the north-west of LWB3 is considered potentially consistent with this EEC This EEC is potentially sensitive to the Proposed Modification.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Occurs on with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The composition of this EEC is highly variable, although typical species include forest red gum (<i>Eucalyptus tereticornis</i>), cabbage gum (<i>E. amplifolia</i>), rough-barked apple (<i>Angophora floribunda</i>) and broad-leaved apple (<i>A. subvelutina</i>).	This EEC occurs in numerous LGAs on the south coast of NSW. It is believed to be bounded to the north by Port Stephens, to the south by the NSW-VIC border and to occur no further west than Canberra.	This EEC is not known from any conservation reserves in the region.	This EEC occurs within the LWB1-B3 Modification Area, on the drier slopes and ridges associated with drainage lines.	Yes
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation	This community is known from parts of the LGAs of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	Hunter Estuary NP	This EEC has no potential to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No

Species	Legal Status	Specific Habitat	Distribution in relation to LWB1-B3 Modification Area	Reservation in the Region (Bionet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation. The composition of the community is primarily determined by the frequency and duration of water logging and the texture, salinity nutrient and moisture content of the soil, and latitude. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	This community is known to occur in numerous LGAs, but is believed to be restricted to the areas of coastal NSW; no further south than the Shoalhaven LGA and as far north as the NSW-Queensland border, but no further west than Bathurst.	Ellalong Lagoon LCA Hunter Estuary NP	This EEC has no potential to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No
Hunter Valley Weeping Myall (<i>Acacia Pendula</i>) Woodland	CEEC	This TEC consists of weeping myall (<i>Acacia pendula</i>) with coobah (<i>Acacia salicina</i>) and scrub wilga (<i>Geijera salicifolia</i>). Yarran (<i>Acacia omalophylla</i>) and stiff canthium (<i>Canthium buxifolium</i>) are also present in the small tree/shrub layer. The ground stratum is dense and primarily grassy. Grasses include kangaroo grass (<i>Themeda triandra/australis</i>), wallaby grass (<i>Austrodanthonia</i> spp.), snow grass (<i>Poa sieberiana</i>) and barbed wire grass (<i>Cymbopogon refractus</i>).	The CEEC occurs in a small stand on heavy, brown clay soil at Jerrys Plains in the Hunter Valley, in the South Hunter Province of the Sydney Basin Bioregion.	This CEEC is not known to occur in any conservation reserves in the region.	This CEEC has no potential to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this EEC.	No

Note:

found over < 100 km
found over > 100 km
adequately reserved

poorly known
Landscape Conservation Area
Local Government Area

in a conservation reserve
critically endangered
:: Critically endangered ecological community
endangered
endangered ecological community
endangered population
:: Environment Protection Biodiversity Conservation Act
inadequately reserved

Nature Reserve
National Park
rare
Threatened Species Conservation Act
Vulnerable
extinct
species recorded from a reserve but population size unknown

Table 2 Threatened and Migratory Fauna Assessment

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
AMPHIBIANS						
giant burrowing frog <i>Heleioporus australiacus</i>	V (TSC) V (EPBC)	Found in heath, woodland and open forest with sandy soils.	Occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone. It has been found from the coast to the Great Dividing Range.	Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
stuttering frog <i>Mixophyes balbus</i>	E (TSC) V (TSC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Occur along the east coast of Australia from southern Queensland to the north-eastern Victoria	Killarney NR Watagans NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
giant barred frog <i>Mixophyes iteratuts</i>	E (TSC) E (EPBC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold.	Watagans NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
red-crowned toadlet <i>Pseudophryne coriacea</i>	V(TSC)	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters.	This species is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains.	Olney SF Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
green and golden bell frog <i>Litoria aurea</i>	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as <i>Typha</i> spp. and <i>Eleocharis</i> spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland. The Survey Area is close to the inland limit of this species' known distribution.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
green-thighed frog <i>Litoria brevipalmata</i>	V (TSC)	Occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain.	Isolated localities along the coast and ranges from the NSW central coast to south-east Queensland.	This species is not known to occur in any reserves in the region.	There is a low potential for this species to occur in the riparian habitats of the LWB1-B3 Modification Area. The species is potentially sensitive to the Proposed Modification.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Littlejohns treefrog <i>Litoria littlejohni</i>	V (TSC) V (EPBC)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria.	Olney SF	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
REPTILES						
broad-headed snake <i>Hoplocephalus bungaroides</i>	E (TSC) V (EPBC)	This species is nocturnal and shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	The broad-headed snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney.	Olney SF Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
Stephens banded snake <i>Hoplocephalus stephensii</i>	V (TSC)	Occurs in rainforest and eucalypt forests and rocky areas up to 950 m in altitude.	Coast and ranges from Southern Queensland to Gosford in NSW.	Killarney NR Watagans NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Rosenbergs goanna <i>Varanus rosenbergii</i>	V (TSC)	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat.	Occurs on the Sydney Sandstone in Wollemi NP to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River.	Olney SF Yengo NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
BIRDS						
black-necked stork <i>Ephippiorhynchus asiaticus</i>	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	Hunter Estuary NP	There are no appropriate freshwater wetland habitats present within the LWB1-B3 Modification Area that would provide suitable habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Australasian bittern <i>Botaurus poiciloptilus</i>	E (TSC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spikerushes (<i>Eleocharis</i> spp.).	This species may be found over most of the state except for the far north-west.	Hunter Estuary NP	There are no appropriate freshwater wetland habitats present within the LWB1-B3 Modification Area that would provide suitable habitat for this species. There is no potential for a significant impact on this species.	No
Eastern bristlebird <i>Dasyornis brachypterus</i>	E (TSC) E (EPBC)	The eastern bristlebird inhabits low, dense vegetation across a variety of habitats inclusive of sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest. This species occurs in coastal areas, tablelands and ranges.	This species occurs in three geographically separate areas of south-east Australia; a northern population in south-eastern Queensland and north-eastern NSW; a central population on the central coast of NSW; and a southern population in the south-east of NSW and eastern Victoria. There are no known records of this species within 20 km of the centre of the Project area.	This species is not known to occur in conservation reserves in the region.	There are no habitats present within the LWB1-B3 Modification Area that would be suitable for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
Australian painted snipe <i>Rostratula australis</i>	E (TSC) V (EPBC) MIG (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	Pambalong NR	There are no habitats present within the LWB1-B3 Modification Area that would be suitable for this species. There is no potential for a significant impact on this species.	No
freckled duck <i>Stictonetta naevosa</i>	V (TSC)	This species prefers permanent freshwater swamps and creeks with heavy growth of cumbungi, lignum or tea-tree. During drier times it moves from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. This species generally rests in dense cover during the day, usually in deep water. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. The nests are usually located in dense vegetation at or near water level.	The freckled duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. This species may also occur as far as coastal NSW and Victoria during such times.	This species is not known to occur in any reserves in the region.	There is no potential for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
rose-crowned fruit-dove <i>Ptilinopus regina</i>	V (TSC)	Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria.	Corrabare SF	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
black-breasted buzzard <i>Hamirostra melanosternon</i>	V (TSC)	Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Hunts over grasslands and sparsely timbered woodlands.	Found sparsely in areas of less than 500 mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts.	Werakata NP	There is no potential for this species to occur in the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
black falcon <i>Falco niger</i>	V (TSC)	The black falcon is associated with a wide variety of habitats.	The black falcon is distributed widely yet sparsely across NSW. It is assumed that all individuals comprise a single population.	This species is not known to occur in any reserves in the region.	There is potential foraging and nesting habitat for this species in various habitats throughout the LWB1-B3 Modification Area. There will be no modification to the potential habitats of this species as a result of the Proposed Development. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
little eagle <i>Heiraaetus morphnoides</i>	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment.	Olney SF Werakata SCA	There is potential foraging and nesting habitat for this species in various habitats throughout the LWB1-B3 Modification Area. There will be no modification to the potential habitats of this species as a result of the Proposed Development. There is no potential for a significant impact on this species.	No
square-tailed kite <i>Lophoictinia isura</i>	V (TSC)	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area supports potential foraging and nesting habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
spotted harrier <i>Circus assimilis</i>	V (TSC)	Their habitat of choice is open grassy woodland, grassland, inland riparian woodland and shrub steppe. Although mostly associated with native grasslands it has also been identified in agricultural farmland. Their nest is made in a tree and composed of sticks.	The spotted harrier can be found throughout mainland Australia except for areas of dense forest on the coast, escarpments and ranges and rarely ever in Tasmania.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area supports potential foraging and nesting habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
comb-crested jacana <i>Irediparra gallinacea</i>	V (TSC)	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW.	This species is not known to occur in any reserves in the region.	There are no habitats suitable for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
red goshawk <i>Erythroriorchis radiatus</i>	CE (TSC) V (EPBC)	In NSW, the red goshawk is mainly found along or near watercourses, in swamp forest and woodlands on the coastal plain. It favours patches of dense forest interspersed with open woodland or cleared land and often frequents forest edges.	Across northern Australian south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area supports potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
little lorikeet <i>Glossopsitta pusilla</i>	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri.	Olney SF Pokolbin SF Sugarloaf SCA Werakata NP Werakata SCA Yengo NP	The LWB1-B3 Modification Area provides potential foraging and nesting habitats for this species. The Proposed Development will not modify any habitat requirements of this species. As such, there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
glossy black-cockatoo <i>Calyptorhynchus lathami</i>	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key <i>Allocasuarina</i> feed species. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith.	Killarney NR Watagans NP Werakata NP Yengo NP	The LWB1-B3 Modification Area provides potential foraging habitat, and potential nest sites. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
gang-gang cockatoo <i>Callocephalon fimbriatum</i>	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes.	Pambalong NR Watagans NP Werakata NP Yengo NP	The LWB1-B3 Modification Area provides potential foraging and nesting habitats for this species. The Proposed Development will not modify any habitat requirements of this species. As such, there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
swift parrot <i>Lathamus discolor</i>	E (TSC) E (EPBC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box. This bird is a migratory species that breeds in Tasmania during the spring and summer, and migrates to the mainland during the cooler months of the year.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW. The project area is within the known distribution of this species.	Werakata NP	Several winter-flowering species occur in the LWB1-B3 Modification Area which may provide foraging resources for this species and the species is known to occur in the local area. The species is potentially sensitive to the Proposed Modification.	Yes
regent honeyeater <i>Anthochaera phrygia</i>	CE (TSC) CE (EPBC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine casuarina woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Corrabare SF Werakata NP Werakata SCA Yengo NP	Several winter-flowering species occur in the LWB1-B3 Modification Area which may provide foraging resources for this species and it is known to occur in the local area. The species is potentially sensitive to the Proposed Modification.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
turquoise parrot <i>Neophema pulchella</i>	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrots range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.	This species is not known to occur in any reserves in the region.	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
powerful owl <i>Ninox strenua</i>	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland.	Killarney NP Monkerai NP Werakata NP Yengo NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
barking owl <i>Ninox connivens</i>	V (TSC)	Habitat for this species includes dry forests and woodlands, often in association with hydrological features such as rivers and swamps.	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia, however it is most abundant in the tropical north. Most records for this species occur west of the Great Dividing Range.	Watagans NP Werakata NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
masked owl <i>Tyto novaehollandiae</i>	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea.	Killarney NR Pokolbin SF Watagans NP Werakata SCA	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
sooty owl <i>Tyto tenebricosa</i>	V (TSC)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree hollows.	Occupies the eastern most one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Corrabare SF Heaton SF Olney SF Pokolbin SF Watagans NP	There is no potential habitat for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
brown treecreeper (eastern subsp.) <i>Climacteris picumnus victoriae</i>	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.	Werakata NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
black-chinned honeyeater (eastern subspecies) <i>Melithreptus gularis</i>	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga ironbark, white box, grey box, yellow box and forest red gum. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	Werakata NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
speckled warbler <i>Chthonicola sagittata</i>	V (TSC)	The speckled warbler occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	Patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians.	Werakata NP Yengo NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
grey-crowned babbler (eastern subspecies) <i>Pomatostomus temporalis temporalis</i>	V(TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. The Survey Area is not at the limit of this species' known distribution.	Werakata NP Yengo NP	This species was recorded within the LWB1-B3 Modification Area. This species is potentially sensitive to the Proposed Modification.	Yes
varied sittella <i>Daphoenositta chrysoptera</i>	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west.	Corrabare SF Olney SF Pokolbin SF Werakata NP Werakata SCA Yengo NP	This species was recorded within the LWB1-B3 Modification Area. This species is potentially sensitive to the Proposed Modification.	Yes
olive whistler <i>Pachycephala olivacea</i>	V (TSC)	Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes. Forage in trees and shrubs and on the ground.	Inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria.	Corrabare SF	There is no potential for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
scarlet robin <i>Petroica boodang</i>	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA.	Olney SF Werakata NP Yengo NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
flame robin <i>Petroica phoenicea</i>	V (TSC)	This species is known to breed in moist eucalypt forests and woodlands. It can usually be seen on ridges and slopes in areas where there is an open understorey layer. This species migrates during the winter to more lowland areas such as grasslands where there are scattered trees, as well as open woodland of the inland slopes and plains.	This robin is located in south-eastern Australia from the Queensland border to Tasmania and into Victoria as well as south-east SA.	Chichester SF Yengo NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
diamond firetail <i>Stagonopleura guttata</i>	V (TSC)	Habitat includes a range of eucalypt dominated communities with a grassy understorey, including woodland, forest and mallee. It appears that populations are unable to persist in areas where there are no vegetated remnants larger than 200 ha.	The diamond firetail occurs through central and eastern NSW, north into southern and central Queensland and south through Victoria to South Australia. In NSW it mainly occurs west of the Great Dividing Range, although populations are known from drier coastal areas such as the Cumberland Plain and the Hunter, Clarence, Richmond and Snowy River valleys.	Werakata SCA Yengo NP	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
MAMMALS						
spotted-tailed quoll <i>Dasyurus maculatus</i>	V (TSC) E (EPBC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north-east of the state. It occurs from the coast to the snowline and inland to the Murray River.	Awaba SF Corrabare SF Heaton SF Killarney NP Olney SF Pokolbin SF Uffington SF Watagans NP Watagan SF Werakata SCA Yengo NP	There is potential for this species to occur in the more densely vegetated habitats in the north of the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
koala <i>Phascolarctos cinereus</i>	V (TSC) V (EPBC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species; however it tends to specialise on a small number in different areas. <i>Eucalyptus tereticornis</i> , <i>E. punctata</i> , <i>E. cypellocarpa</i> , <i>E. viminalis</i> , <i>E. microcorys</i> , <i>E. robusta</i> , <i>E. albens</i> , <i>E. camaldulensis</i> and <i>E. populnea</i> are some preferred species.	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range.	Awaba SF Corrabare SF Heaton SF Killarney NR Monkerai NR Olney SF Pokolbin SF Uffington SF Watagans NP Watagan SF Werakata NP Werakata SCA Yengo NP	A single atlas of NSW wildlife record of this species is present within the Project Area This species is potentially sensitive to the Proposed Modification.	Yes
yellow-bellied glider <i>Petaurus australis</i>	V (TSC)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	The yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Corrabare SF Heaton SF Olney SF Pokolbin SF Watagans NP Watagan SF Werakata NP Yengo NP	There is no potential for this species to occur within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
squirrel glider <i>Petaurus norfolcensis</i>	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria.	Olney SF Uffington SF Werakata NP Werakata SCA Yengo NP	This species was identified within the LWB1-B3 Modification Area. The species is potentially sensitive to the Proposed Development.	Yes
eastern pygmy possum <i>Cercartetus nanus</i>	V (TSC)	Found in a broad range of habitats from rainforest through sclerophyll (including box-ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	This species is found in south-eastern Australia, from southern Queensland to eastern SA and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes.	This species is not known to occur in any conservation reserves in the region.	There is potential for this species to occur within the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
long-nosed potoroo <i>Potorous tridactylus</i>	V (TSC) V (EPBC)	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	This species is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range.	Heaton SF Killarney NR	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No
brush-tailed rock-wallaby <i>Petrogale penicillata</i>	E (TSC) V (EPBC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or bask during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. Its distribution roughly followed the Great Dividing Range for 2500 km from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 km NW of Brisbane) in Queensland.	Watagans NP Heaton SF Olney SF Pokolbin SF Watagans NP Yengo NP	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
parma wallaby <i>Macropus parma</i>	V (TSC)	Preferred habitat for this species is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest. It typically feeds at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day it shelters in dense cover.	Although it once occurred from north-eastern NSW to the Bega area in the southeast, its range is now confined to the coast and ranges of central and northern NSW.	Corrabare SF Killarney NR Olney SF Yengo NP	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No
red-legged pademelon <i>Thylogale stigmatica</i>	V (TSC)	Inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub. Wet gullies with dense, shrubby ground cover provide shelter from predators. In NSW, rarely found outside forested habitat.	Patchily distributed along coastal and sub-coastal eastern Australia from Cape York to the Hunter Valley in NSW.	Olney SF	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No
grey-headed flying-fox <i>Pteropus poliocephalus</i>	V (TSC) V (EPBC)	This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Grey-headed flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.	Olney SF Pokolbin SF Watagan SF Werakata NP Werakata SCA Yengo NP	The LWB1-B3 Modification Area supports potential foraging habitat for this species, however, there are no known roost sites.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
eastern freetail-bat <i>Mormopterus norfolkensis</i>	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW.	Awaba SF Werakata NP Werakata SCA Yengo NP	This species has potential to roost and forage within the LWB1-B3 Modification Area. There is potential for a significant impact on this species	Yes
eastern bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bent-wing bats occur along the east and north-west coasts of Australia.	Awaba SF Olney SF Uffington SF Werakata NP Yengo NP	This species has potential to utilise the foraging resources of the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on this species.	No

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eastern false pipistrelle <i>Falsistrellus tasmaniensis</i>	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 m high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast.	Heaton SF Olney SF Werakata NP Yengo NP	This species has potential to utilise the foraging resources of the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
little bentwing-bat <i>Miniopterus australis</i>	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Occurs in coastal north-eastern NSW and eastern Queensland.	Awaba SF Uffington SF Werakata NP Werakata SCA	This species has potential to roost and forage within the LWB1-B3 Modification Area. There is potential for a significant impact on this species	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
large-eared pied bat <i>Chalinolobus dwyeri</i>	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range.	Awaba SF Olney SF Pokolbin SF Watagans NP Yengo NP	This species was recorded in the LWB1-B3 Modification Area. There is potential for a significant impact on this species.	Yes
southern myotis <i>Myotis macropus</i>	V (TSC)	This species generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, and storm-water channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	The large-footed myotis is found in the coastal band from the north-west of Australia, across the Top-End and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers.	Awaba SF Pokolbin SF Uffington SF Werakata NP	This species has potential to roost and forage within the LWB1-B3 Modification Area. There is potential for a significant impact on this species.	Yes
greater broad-nosed bat <i>Scoteanax rueppellii</i>	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres.	Awaba SF Olney SF Pokolbin SF Werakata NP Werakata SCA Yengo NP	This species was identified within the LWB1-B3 Modification Area. There is potential for a significant impact on this species.	Yes

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
golden-tipped bat <i>Kerivoula papuensis</i>	V (TSC)	Found in rainforest and adjacent sclerophyll forest. Roosts in abandoned hanging yellow-throated scrubwren and brown gerygone nests located in rainforest gullies on small first- and second-order streams. Will fly up to two km from roosts to forage in rainforest and sclerophyll forest on upper-slopes.	The golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW.	Corrabare SF Heaton SF Olney SF Pokolbin SF Watagan SF	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No
eastern cave bat <i>Vespadelus troughtoni</i>	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT.	Pokolbin SF Yengo NP	This species has potential to utilise the foraging resources of the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
New Holland mouse <i>Pseudomys novaehollandiae</i>	V (EPBC)	This species inhabits a range of habitats from open heathlands, open woodlands with a heath understorey, as well as vegetated dunes. The New Holland mouse lives in a burrow which is shared with other individuals.	This species has a disjunct distribution across Tasmania, Victoria, Queensland and NSW.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area does not support suitable habitat for this species. There is no potential for a significant impact on this species.	No
Hastings River mouse <i>Pseudomys oralis</i>	E (TSC) E (EPBC)	Known to inhabit a variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops. Nests may be in either gully areas or ridges and slopes.	This species has a patchy distribution along the east side of the Northern Tablelands and great escarpment of north-east NSW, usually but not always at elevations between 500 m and 1100 m. Also recorded in south-east Queensland.	This species is not known to occur in any reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
FISH						
Darling River Hardyhead in the Hunter River Catchment	EP (FM Act)	This species is usually found in slow flowing, clear, shallow waters or in aquatic vegetation at the edge of such waters. The species has also been recorded from the edge of fast flowing habitats such as the runs at the head of pools.	The species is rarely recorded in the Hunter catchment but has been found in the headwaters of the Hunter system near Pages River.	This species is not known to occur in any reserves in the region.	The aquatic habitats in the LWB1-B3 Modification Area do not conform with the known habitat range of this species There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
MIGRATORY SPECIES						
fork-tailed swift <i>Apus pacificus</i>	MIG (EPBC)	The fork-tailed swift is mostly found in Australia through the months of October through to April. This swift spends most of its time when in flight ahead of storm fronts and updraughts (Slater et al. 2003).	The fork-tailed swift can be found throughout Australia during migrating. In Australia it is most common west of the Great Dividing Range. This species is uncommon in Tasmania.	Pokolbin SF	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
great egret <i>Ardea alba</i>	MIG (EPBC)	The great egret typically inhabits areas of shallow, flowing waters, but also uses damp grasslands and other watered areas. They can be observed both in flocks and on their own, and roost during the night in groups (Australian Museum Online 2005).	The great egret is distributed throughout the world, and is common throughout most areas of Australia, with exception to extremely arid areas.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
cattle egret <i>Ardea ibis</i>	MAR (EPBC) MIG (EPBC)	The cattle egret can be found in grasslands, wetlands and woodlands and has never been identified in arid areas. These birds are commonly sighted at garbage dumps, pastures and croplands (especially where poor drainage is present) are common (Australian Museum Online 2005).	The cattle egret is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern WA, the NT and in south-eastern Australia from Bundaberg Queensland through to Port Augusta SA. It has also been identified in Tasmania.	Werakata NP	This species was identified in the LWB1-B3 Modification Area. As such, this species is potentially sensitive to the modification.	Yes
Japanese snipe <i>Gallinago hardwickii</i>	MIG (EPBC)	The Japanese snipe can be found in permanent and ephemeral wetlands up to 2000 m ASL. These water bodies are usually freshwater with low, dense vegetation. They forage in areas of mud with some vegetation cover and roost nearby to these areas. The Japanese snipe does not breed in Australia, only passing through for migration.	This species has been recorded from Cape York through to south-east SA. The range of this species extends from inland of the eastern tablelands in south-east Queensland to west of the Great Dividing Range in NSW. Richmond River, NSW is a favourite area for non-breeding birds.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
eastern osprey <i>Pandion cristatus</i>	V (TSC) MIG (EPBC)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	This species is found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.	This species is not known to occur in any reserves in the region.	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
white-throated needletail <i>Hirundapus caudacutus</i>	MIG (EPBC)	This species is only in Australia approximately between the months of October and May. They forage upon flying insects and drink whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires. (Australian Museum Online 2003)	This species is distributed over eastern and northern Australia	Heaton SF Pokolbin SF Werakata NP Werakata SCA Yengo NP	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
rainbow bee-eater <i>Merops ornatus</i>	MIG (EPBC)	The preferred habitat of the rainbow bee-eater is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually in close proximity to permanent water, however, during migration this bird may fly over areas of non-preferential habitat.	This species is distributed throughout most of mainland Australia as well as several near-shore islands. It is not found in Tasmania and has only been identified in a thin strip in the most arid regions of central WA.	Corrabare SF Pokolbin SF Werakata SCA Werakata SF Yengo NP	This species has potential to occur in the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
black-faced monarch <i>Monarcha melanopsis</i>	MIG (EPBC)	This bird can be identified in coastal scrub, damp gullies, eucalypt woodlands and rainforests. This bird can be seen foraging for insects amongst foliage, and builds a deep, cup-shaped nest in a tree fork (3 to 6 m above the ground) which is made up of cobwebs, casuarinas needles, bark, moss and roots (Australian Museum Online2005).	The black-faced monarch is distributed along the eastern coast of Australia, gradually becoming less common towards the south.	Awaba SF Corrabare SF Heaton SF Pokolbin SF Werakata NP Watagan SF Yengo NP	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
spectacled monarch <i>Monarcha trivigatus</i>	MIG (EPBC)	This species prefers habitats with a thick understorey including mangroves, rainforests, wet gullies and waterside vegetation.	This species is found along the coast of north-east and eastern Australis. It is also known from Papua New Guinea, the Moluccas and Timor.	This species is not known from conservation reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
satin flycatcher <i>Myiagra cyanoleuca</i>	MIG (EPBC)	This species typically inhabits wet areas of tall forests, particularly in gullies. The satin flycatcher moves north in the winter and is seldom seen in NSW, Tasmania, Victoria or SA during these times. This bird nests in loose colonies in broad-based cup-shaped nests on a bare horizontal branch. These nests are constructed from bark, grass, lichen and cobwebs (Australian Museum Online 2005).	The satin flycatcher can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern SA.	Pokolbin SF	This species has the potential to occur in the LWB1-B3 Modification Area. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No

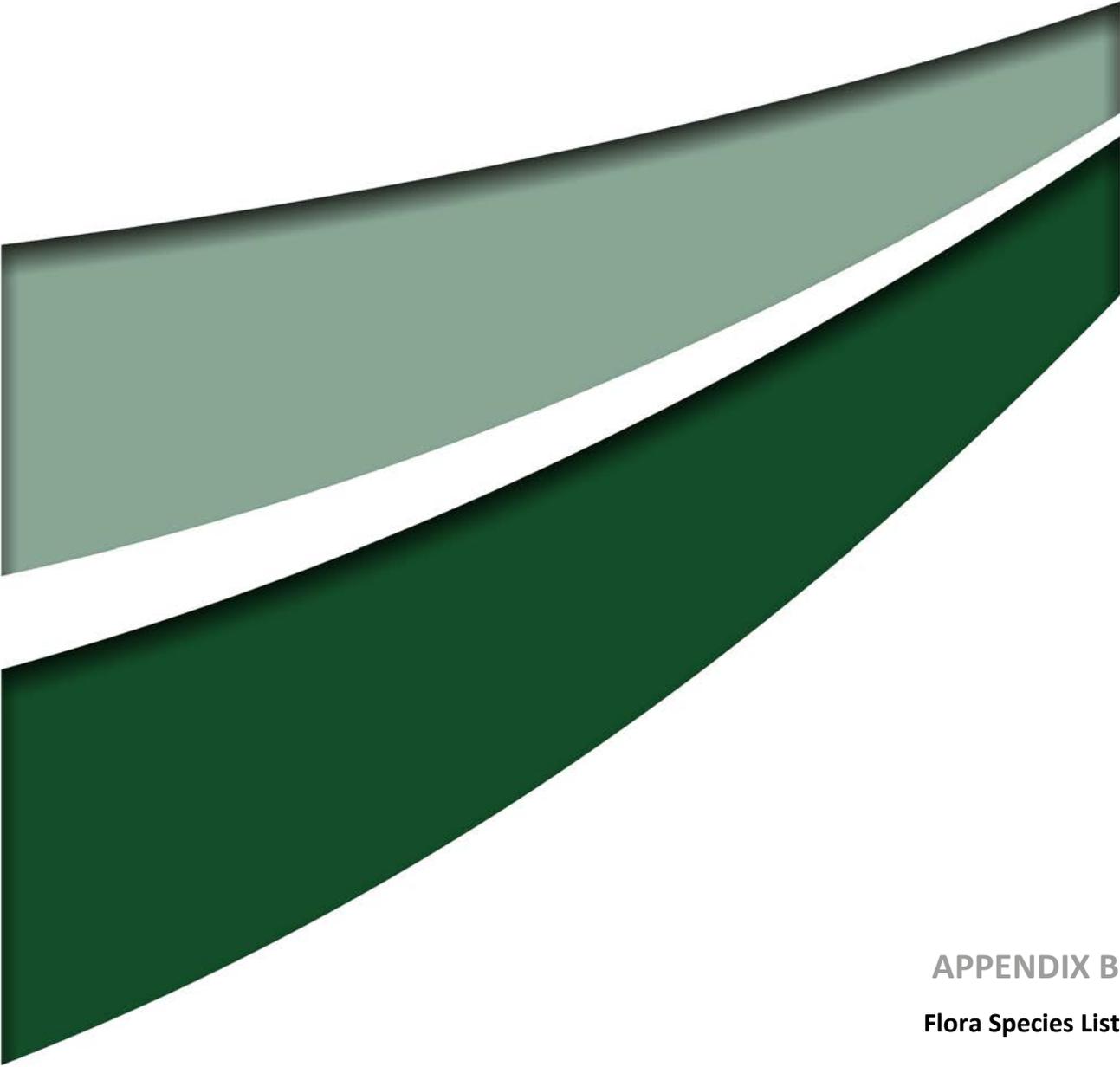
Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
rufous fantail <i>Rhipidura rufifrons</i>	MIG (EPBC)	The rufous fantail typically inhabits areas of dense wet forest, mangrove, rainforest or swamp woodlands. It prefers areas where there is intense shade available and is often seen close to ground. In winter it is seldom found in NSW or Victoria.	This species is distributed across the north and eastern coast of Australia, but is also found in Guam, New Guinea, the Solomon Islands and Sulawesi.	Awaba SF Belford NP Heaton SF Pokolbin SF Uffington SF Watagan SF Werakata NP Werakata SCA Yengo NP	The LWB1-B3 Modification Area provides potential habitat for this species. The Proposed Development will not modify any habitat requirements of this species. As such there is no potential for a significant impact on potential habitat for this species.	No
Australian painted snipe <i>Rostratula australis</i>	E (TSC) V (EPBC) MIG (EPBC)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	Pambalong NR	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
common sandpiper <i>Actitis hypoleucos</i>	MIG (EPBC)	This species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	This species is found along all coastlines of Australia and in many areas inland, the common sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia.	This species is not known from conservation reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
sharp-tailed sandpiper <i>Calidris acuminata</i>	MIG (EPBC)	This species prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage treatment plants, flooded fields, mudflats, mangroves, rocky shores and beaches.	This species is a summer migrant from Arctic Siberia, being found on wetlands throughout Australia.	This species is not known from conservation reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No
common greenshank <i>Tringa nebularia</i>	MIG (EPBC)	The common greenshank is a marine and migratory bird species, it is typically found in coastal habitats such as estuaries, mudflats and saltmarshes, but can also be identified in appropriate fresh or saline inland habitats such as clay pans, commercial saltfields, lake margins and sewage ponds (Pizzey & Knight 1997).	This species is known to breed from Scotland to Siberia. It has also been identified in Europe, Asia, Africa, Papua New Guinea, Australia and New Zealand. In Australia, this species is widespread and has been identified in coastal areas across the entire country. On the mainland it does not occur in the central areas of WA and the north-west of SA (Pizzey & Knight 1997).	This species is not known from conservation reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to Survey Area	Reservation in the Region (BioNet 2015)	Potential to be Impacted	Detailed Assessment of Significance Required?
bridled tern <i>Onychoprion anaethetus</i>	MIG (EPBC)	This species inhabits offshore tropical and subtropical seas.	This species occurs across tropical areas of the Pacific and Atlantic oceans. Including Central America, Caribbean, western Africa, India as well as much of south-east Asia and Australasia.	This species is not known from conservation reserves in the region.	There is no potential habitat for this species within the LWB1-B3 Modification Area. There is no potential for a significant impact on this species.	No

Note

CE	critically endangered
E:	endangered
EP:	Endangered Population
EPBC:	Environment Protection Biodiversity Conservation Act
FM	Fisheries Management Act
LGA:	Local Government Area
MIG	migratory
NR:	Nature Reserve
NP:	National Park
SCA	State Conservation Area
SF	State Forest
TSC:	Threatened Species Conservation Act
V:	vulnerable



APPENDIX B
Flora Species List

Appendix B – Flora Species List

The following list was developed from surveys as detailed in **Section 4.0** of the main report. It includes all species of vascular plants observed in the LWB1-B3 Modification Area.

Not all species are readily detected at any one time of the year; therefore the list will not necessarily include all plant species likely to occur in the LWB1-B3 Modification Area. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

- sp. specimens that are identified to genus level only;
- poss. specimens for which identification was considered likely but not definite.
- Spp agg species complex (group of closely related species similar in appearance such that species distinctions are often unclear).

The following abbreviations or symbols may be used in the list:

- asterisk (*) denotes species not indigenous to the LWB1-B3 Modification Area;
- subsp. subspecies; and
- var. variety;

Note: Those species highlighted in bold are threatened species.

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler et al. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2015), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

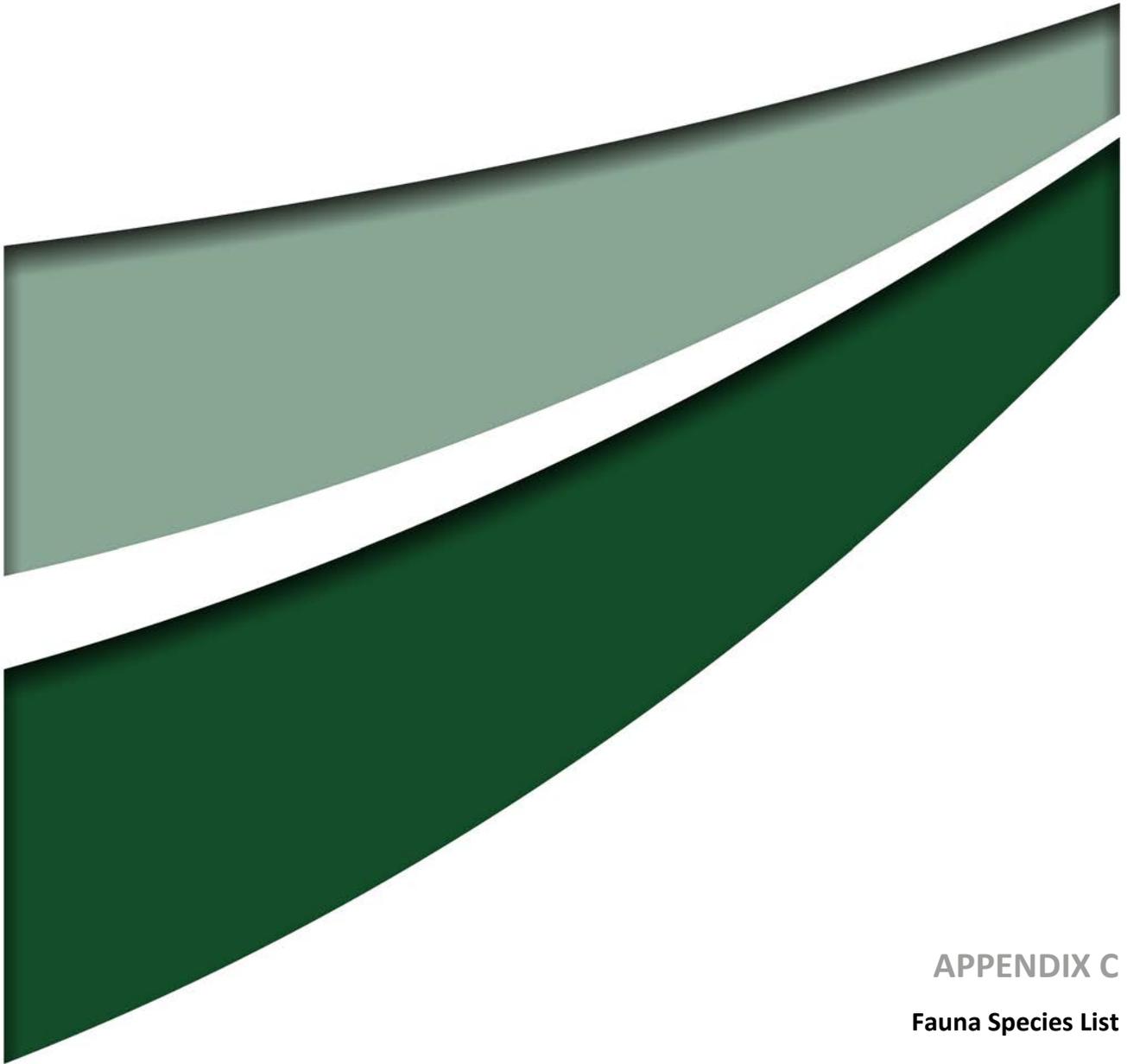
Family/Sub Family	Scientific Name	Common Name
FILICOPSIDA (FERNS)		
Adiantaceae	<i>Adiantum aethiopicum</i>	common maidenhair fern
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	poison rock fern
Dennstaedtiaceae	<i>Pteridium esculentum</i>	bracken
Marsileaceae	<i>Marsilea mutica</i>	nardoo
MAGNOLIOPSIDA (FLOWERING PLANTS) – LILIIDAE (MONOCOTS)		
Cyperaceae	<i>Baumea</i> sp.	
Cyperaceae	<i>Carex appressa</i>	tall sedge
Cyperaceae	<i>Cyperus</i> sp.	

Family/Sub Family	Scientific Name	Common Name
Cyperaceae	<i>Schoenus</i> sp.	
Cyperaceae	<i>Lepidosperma laterale</i>	
Iridaceae	* <i>Romulea rosea</i>	onion grass
Juncaceae	* <i>Juncus acutus</i> subsp. <i>acutus</i>	sharp rush
Juncaceae	<i>Juncus</i> sp.	common rush
Juncaceae	<i>Juncus usitatus</i>	
Juncaginaceae	<i>Triglochin procerum</i>	water ribbons
Linaceae	<i>Linum marginale</i>	Native flax
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	wattle mat-rush
Lomandraceae	<i>Lomandra glauca</i>	
Lomandraceae	<i>Lomandra longifolia</i>	spiny-headed mat-rush
Lomandraceae	<i>Lomandra multiflora</i>	
Orchidaceae	<i>Caladenia catenata</i>	white fingers
Orchidaceae	<i>Calochilus robertsonii</i>	
Orchidaceae	<i>Diuris sulphurea</i>	
Orchidaceae	<i>Microtis parviflora</i>	
Orchidaceae	<i>Thelymitra</i> sp.	
Phormiaceae	<i>Dianella caerulea</i> var. <i>cinerascens</i>	
Phormiaceae	<i>Dianella longifolia</i>	
Phormiaceae	<i>Dianella</i> sp.	
Philydraceae	<i>Philydrum lanuginosum</i>	frogsmouth
Poaceae	* <i>Andropogon virginicus</i>	whisky grass
Poaceae	<i>Aristida</i> sp.	a speargrass
Poaceae	<i>Aristida vagans</i>	threeawn speargrass
Poaceae	<i>Austrostipa</i> sp.	
Poaceae	* <i>Briza maxima</i>	
Poaceae	* <i>Briza minor</i>	shivery grass
Poaceae	<i>Bothriochloa</i> sp.	
Poaceae	<i>Chloris</i> sp.	
Poaceae	<i>Cymbopogon refractus</i>	barbed wire grass
Poaceae	<i>Cynodon dactylon</i>	common couch
Poaceae	<i>Digitaria diffusa</i>	open summer grass
Poaceae	<i>Digitaria</i> sp.	
Poaceae	<i>Echinopogon ovatus</i>	forest hedgehog grass
Poaceae	* <i>Ehrharta erecta</i>	panic veldtgrass
Poaceae	<i>Eragrostis brownii</i>	
Poaceae	<i>Eragrostis</i> sp.	a lovegrass
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	blady grass
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	weeping grass
Poaceae	* <i>Paspalum dilatatum</i>	paspalum
Poaceae	* <i>Pennisetum clandestinum</i>	kikuyu grass
Poaceae	<i>Poa affinis</i>	
Poaceae	<i>Rytidosperma</i> sp.	

Family/Sub Family	Scientific Name	Common Name
Poaceae	<i>*Setaria gracilis</i>	pigeon grass
Poaceae	<i>Setaria</i> sp.	pigeon grass
Poaceae	<i>Sporobolus creber</i>	slender rats tail grass
Poaceae	<i>*Stenotaphrum secundatum</i>	buffalo grass
Poaceae	<i>Themeda australis</i>	kangaroo grass
Typhaceae	<i>Typha domingensis</i>	narrow-leaved cumbungi
Xanthorrhoeaceae	<i>Xanthorrhoea</i> sp.	
MAGNOLIOPSIDA (FLOWERING PLANTS) – MAGNOLIIDAE (DICOTS)		
Acanthaceae	<i>Brunoniella australis</i>	blue trumpet
Alismataceae	<i>Alisma plantago-aquatica</i>	water plantain
Apiaceae	<i>Centella asiatica</i>	pennywort
Apiaceae	<i>*Cyclospermum leptophyllum</i>	slender celery
Apocynaceae	<i>Parsonsia straminea</i>	common silkpod
Asteraceae	<i>Ambrosia</i> sp.	a lacy ragweed
Asteraceae	<i>*Bidens pilosa</i>	cobblers pegs
Asteraceae	<i>Chrysocephalum apiculatum</i>	
Asteraceae	<i>Chrysocephalum</i> sp.	
Asteraceae	<i>*Cirsium vulgare</i>	spear thistle
Asteraceae	<i>*Conyza bonariensis</i>	fleabane
Asteraceae	<i>Cymbonotus lawsonianus</i>	bears-ear
Asteraceae	<i>*Gamochaeta</i> sp.	cudweed
Asteraceae	<i>Euchiton involucratus</i>	
Asteraceae	<i>*Hypochoeris radicata</i>	catsear
Asteraceae	<i>Lagenophora</i> sp.	
Asteraceae	<i>Lagenophora stipitata</i>	
Asteraceae	<i>Ozothamnus diosmifolius</i>	rice flower
Asteraceae	<i>Rutidosis heterogama</i>	heath wrinklewort
Asteraceae	<i>*Senecio madagascariensis</i>	fireweed
Asteraceae	<i>*Silybum marianum</i>	variegated thistle
Asteraceae	<i>Solenogyne bellioides</i>	
Asteraceae	<i>*Soliva sesilis</i>	Lawn burrweed
Asteraceae	<i>*Sonchus oleraceus</i>	common sowthistle
Asteraceae	<i>*Taraxacum officinale</i>	dandelion
Brassicaceae	<i>*Lepidium africanum</i>	
Campanulaceae	<i>Wahlenbergia communis</i>	
Campanulaceae	<i>Wahlenbergia gracilis</i>	
Campanulaceae	<i>Wahlenbergia</i> sp.	
Caryophyllaceae	<i>*Cerastium glomeratum</i>	mouse-ear chickweed
Caryophyllaceae	<i>*Petrohragia nanteuillii</i>	
Caryophyllaceae	<i>*Stellaria media</i>	common chickweed
Casuarinaceae	<i>Casuarina cunninghamiana</i>	river oak
Casuarinaceae	<i>Casuarina glauca</i>	swamp oak
Celastraceae	<i>Denhamia silvestris</i>	narrow-leaved orangebark

Family/Sub Family	Scientific Name	Common Name
Chenopodiaceae	<i>Einadia hastata</i>	berry saltbush
Clusiaceae	<i>Hypericum gramineum</i>	small St Johns wort
Convolvulaceae	<i>Dichondra repens</i>	kidney weed
Crassulaceae	<i>Crassula sieberiana</i>	Australian stonecrop
Dilleniaceae	<i>Hibbertia aspera</i>	rough guinea flower
Dilleniaceae	<i>Hibbertia obtusifolia</i>	hoary guinee flower
Dilleniaceae	<i>Hibbertia pedunculata</i>	
Dilleniaceae	<i>Hibbertia sp.</i>	
Droseraceae	<i>Drosera peltata</i>	
Ericaceae (Styphelioideae)	<i>Lissanthe strigosa</i>	peach heath
Ericaceae (Styphelioideae)	<i>Styphelia viridis</i>	Green five-corners
Fabaceae (Faboideae)	<i>Daviesia ulicifolia</i>	gorse bitter pea
Fabaceae (Faboideae)	<i>Desmodium varians</i>	slender tick-trefoil
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>	
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	twining glycine
Fabaceae (Faboideae)	<i>Glycine microphylla</i>	
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	variable glycine
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	false sarsparilla
Fabaceae (Faboideae)	<i>Indigofera australis</i>	Australian indigo
Fabaceae (Faboideae)	<i>Jacksonia scoparia</i>	dogwood
Fabaceae (Faboideae)	* <i>Medicago polymorpha</i>	burr medic
Fabaceae (Faboideae)	<i>Mirbelia rubiifolia</i>	heathy mirbelia
Fabaceae (Faboideae)	<i>Pultenaea retusa</i>	notched bush-pea
Fabaceae (Faboideae)	<i>Pultenaea villosa</i>	hairy bush-pea
Fabaceae (Mimosoideae)	<i>Acacia brownii</i>	prickly mooses
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> var. <i>longifolia</i>	Sydney golden wattle
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>	prickly Moses wattle
Geraniaceae	<i>Geranium homeanum</i>	
Goodeniaceae	<i>Goodenia hederacea</i>	
Goodeniaceae	<i>Goodenia rotundifolia</i>	a goodenia
Haloragaceae	<i>Gonocarpus tetragynus</i>	Poverty raspwort
Lamiaceae	<i>Ajuga australis</i>	Austral bugal
Lauraceae	* <i>Cinnamom camphora</i>	camphor laurel
Lobeliaceae	<i>Pratia concolor</i>	poison pratia
Lobeliaceae	<i>Pratia purpurascens</i>	whiteroot
Loranthaceae	<i>Amyema gaudichaudii</i>	
Malvaceae	* <i>Sida rhombifolia</i>	Paddys lucerne
Myrtaceae	<i>Angophora costata</i>	smooth-barked apple
Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple
Myrtaceae	<i>Callistemon linearifolius</i>	netted bottlebrush
Myrtaceae	<i>Callistemon rigidus</i>	stiff bottle brush
Myrtaceae	<i>Callistemon salignus</i>	willow bottlebrush

Family/Sub Family	Scientific Name	Common Name
Myrtaceae	<i>Corymbia maculata</i>	spotted gum
Myrtaceae	<i>Eucalyptus acmenoides</i>	white mahogany
Myrtaceae	<i>Eucalyptus amplifolia</i>	Cabbage gum
Myrtaceae	<i>Eucalyptus fibrosa</i>	red ironbark
Myrtaceae	<i>Eucalyptus longifolia</i>	woollybutt
Myrtaceae	<i>Eucalyptus moluccana</i>	grey box
Myrtaceae	<i>Eucalyptus paniculata</i>	grey gum
Myrtaceae	<i>Eucalyptus tereticornis</i>	forest red gum
Myrtaceae	<i>Leptospermum polygalifolium</i>	tantoon
Myrtaceae	<i>Leptospermum</i> sp.	
Myrtaceae	<i>Melaleuca thymifolia</i>	thyme honey-myrtle
Myrtaceae	<i>Melaleuca linariifolia</i>	flax-leaved paperbark
Myrtaceae	<i>Melaleuca nodosa</i>	ball honeymyrtle
Oxalidaceae	<i>Oxalis</i> sp.	
Pittosporaceae	<i>Billardiera scandens</i>	hairy apple berry
Pittosporaceae	<i>Bursaria spinosa</i> var. <i>spinosa</i>	blackthorn
Plantaginaceae	* <i>Plantago lanceolata</i>	lambs tongues
Plantaginaceae	<i>Plantago</i> sp.	
Polygonaceae	<i>Rumex brownii</i>	swamp dock
Polygonaceae	* <i>Rumex crispus</i>	curled dock
Proteaceae	<i>Banksia spinulosa</i>	hairpin banksia
Proteaceae	<i>Grevillea montana</i>	
Proteaceae	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	small-flower grevillea
Proteaceae	<i>Persoonia linearis</i>	narrow-leaved geebung
Primulaceae	* <i>Anagallis arvensis</i>	scarlet/blue pimpernel
Ranunculaceae	<i>Clematis glycinoides</i>	headache vine
Ranunculaceae	<i>Ranunculus inundatus</i>	river buttercup
Rosaceae	* <i>Rubus fruticosus</i> sp. agg.	blackberry complex
Rubiaceae	* <i>Richardia</i> sp.	
Rutaceae	<i>Geijera salicifolia</i>	brush wilga
Sapindaceae	<i>Dodonaea triquetra</i>	large-leaf hop-bush
Scrophulariaceae	<i>Myoporum montanum</i>	Western boobialla
Solanaceae	* <i>Solanum mauritianum</i>	wild tobacco bush
Solanaceae	* <i>Solanum nigrum</i>	black-berry nightshade
Solanaceae	* <i>Solanum pseudocapsicum</i>	madeira cherry
Solanaceae	<i>Solanum</i> sp.	
Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia
Thymelaeaceae	<i>Pimelea linifolia</i>	slender rice flower
Verbenaceae	* <i>Verbena bonariensis</i>	purpletop



APPENDIX C
Fauna Species List

Appendix C – Fauna Species List

The following list was developed from surveys as detailed in **Section 4** of the main report. It includes all fauna species observed by Umwelt in the LWB1-B3 Modification Area. This is not an exclusive list, and it is likely that further species are present that were not identified at the time of survey.

All threatened species are indicated in **bold** type.

The following abbreviations or symbols are used in the list:

- asterisk (*) denotes species not indigenous to the Stage LWB1-B2 Modification Area;
- def call was identified to a definite level of confidence based on characteristics;
- MIG Listed migratory species under the EPBC Act;
- prob call was identified to a probable level of confidence based on characteristics; and
- V Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995* (TSC Act).

Birds recorded were identified using descriptions in Slater *et al.* (2003) and the scientific and common name nomenclature of BirdLife Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan *et al.* (2004) and Wilson and Swan (2010) and the scientific and common name nomenclature of Cogger (2000).

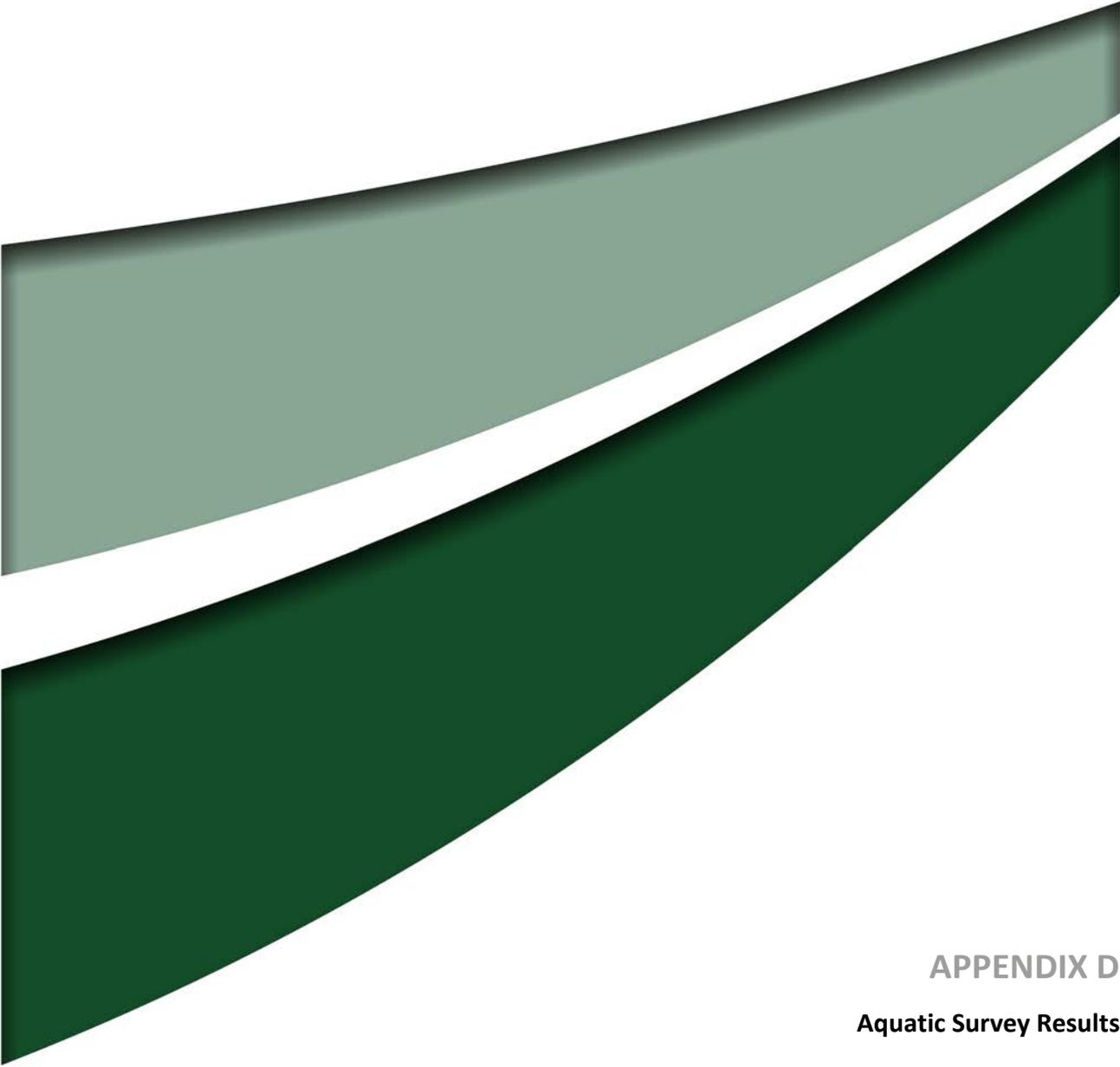
Amphibians recorded were identified using keys and descriptions in Cogger (2000) and Robinson (2002) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Van Dyke and Strahan (2008), Churchill (2008) and Menkhorst and Knight (2011) and the scientific and common name nomenclature of Van Dyke and Strahan (2008).

Table 1 Fauna Species Recorded within the LWB1-B3 Modification Area

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
BIRDS			
Anatidae			
<i>Chenonetta jubata</i>	Australian wood duck		
<i>Anas superciliosa</i>	Pacific black duck		
Charadriidae			
<i>Vanellus miles</i>	masked lapwing		
Ardeidae			
<i>Ardea ibis</i>	cattle egret		MIG
<i>Egretta novaehollandiae</i>	white-faced heron		
<i>Nycticorax caledonicus</i>	nankeen night heron		
Threskiornithidae			
<i>Threskiornis molucca</i>	Australian white ibis		
Accipitridae			
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		
Falconidae			
<i>Falco cenchroides</i>	nankeen kestrel		
<i>Falco berigora</i>	brown falcon		
Rallidae			
<i>Porphyrio porphyrio</i>	purple swamphen		
Charadriidae			
<i>Vanellus miles</i>	masked lapwing		
Columbidae			
<i>Ocyphaps lophotes</i>	crested pigeon		
<i>Geopelia humeralis</i>	bar-shouldered dove		
<i>Leucosarcia melanoleuca</i>	wonga pigeon		
Cuculidae			
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		
Cacatuidae			
<i>Cacatua roseicapilla</i>	galah		
Psittacidae			
<i>Platycercus eximius</i>	eastern rosella		
Strigidae			
<i>Ninox noveseelandiae</i>	southern boobook		
Podargidae			
<i>Podargus strigoides</i>	tawny frogmouth		
Halcyonidae			
<i>Dacelo novaeguineae</i>	laughing kookaburra		
Ptilonorhynchidae			
<i>Ptilonorhynchus violaceus</i>	satin bowerbird		
Maluridae			
<i>Malurus cyaneus</i>	superb fairy-wren		

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
Pardalotidae			
<i>Pardalotus striatus</i>	striated pardalote		
Meliphagidae			
<i>Lichenostomus chrysops</i>	yellow-faced honeyeater		
<i>Entomyzon cyanotis</i>	blue-faced honeyeater		
<i>Anthochaera carunculata</i>	red wattlebird		
<i>Manorina melanocephala</i>	noisy miner		
<i>Philemon corniculatus</i>	noisy friarbird		
Petroicidae			
<i>Petroica rosea</i>	rose robin		
Pomatostomidae			
<i>Pomatostomus temporalis temporalis</i>	grey-crowned babbler (eastern subspecies)	V	
Eupetidae			
<i>Psophodes olivaceus</i>	eastern whipbird		
Neosittidae			
Daphoenositta chrysoptera	varied sittella	V	
<i>Pachycephala rufiventris</i>	rufous whistler		
<i>Pachycephala pectoralis</i>	golden whistler		
Corcoracidae			
<i>Corcorax melanorhamphos</i>	white-winged chough		
Monarchidae			
<i>Grallina cyanoleuca</i>	magpie-lark		
Rhipiduridae			
<i>Rhipidura albiscapa</i>	grey fantail		
<i>Rhipidura leucophrys</i>	willie wagtail		
Artamidae			
<i>Cracticus torquatus</i>	grey butcherbird		
<i>Gymnorhina tibicen</i>	Australian magpie		
Corvidae			
<i>Corvus coronoides</i>	Australian raven		
Estrilidae			
<i>Neochmia temporalis</i>	red-browed finch		
Hirundinidae			
<i>Hirundo neoxena</i>	welcome swallow		
REPTILES			
Agamidae			
<i>Amphibolurus muricatus</i>	Jacky lizard		
<i>Pogona barbata</i>	eastern bearded dragon		
Scincidae			
<i>Eulamprus quoyii</i>	eastern water skink		
<i>Carlia tetradactyla</i>	southern rainbow skink		
<i>Saiphos equalis</i>	three-toed skink		

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
Varanidae			
<i>Varanus varius</i>	lace monitor		
AMPHIBIANS			
Myobatrachidae			
<i>Crinia signifera</i>	brown froglet		
<i>Limnodynastes fletcheri</i>	barking marsh frog		
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog		
<i>Limnodynastes peronii</i>	striped marsh frog		
<i>Uperoleia laevigata</i>	smooth toadlet		
Hylidae			
<i>Litoria fallax</i>	dwarf tree frog		
<i>Litoria latopalmata</i>	broad-palmed frog		
<i>Litoria peronii</i>	Peron's tree frog		
<i>Litoria verreauxii</i>	Verreauxs tree frog		
MAMMALS			
Vombatidae			
<i>Vombatus ursinus</i>	common wombat		
Tachyglossidae			
<i>Tachyglossus aculeatus</i>	echidna		
Petauridae			
<i>Petaurus norfolcensis</i>	squirrel glider	V	
<i>Petaurus sp.</i>	unidentified glider		
Phalangeridae			
<i>Trichosurus vulpecula</i>	common brushtail possum		
Pseudocheiridae			
<i>Pseudocheirus peregrinus</i>	common ringtail possum		
Macropodidae			
<i>Macropus giganteus</i>	eastern grey kangaroo		
Vespertilionidae			
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat		
<i>Chalinolobus dwyeri</i> (def)	large-eared pied bat	V	V
<i>Chalinolobus gouldii</i> (def)	Gould's wattled bat		
<i>Chalinolobus morio</i> (def)	chocolate wattled bat		
<i>Scoteanax rueppellii</i> (prob)	greater broad-nosed bat	V	
Canidae			
* <i>Vulpes vulpes</i>	fox		
Leporidae			
* <i>Oryctolagus cuniculus</i>	rabbit		
Bovidae			
* <i>Bos taurus</i>	cow		
Equidae			
* <i>Equus caballus</i>	horse		



APPENDIX D
Aquatic Survey Results

Appendix D - Aquatic Survey Results and Data

This appendix provides the results of the aquatic assessment undertaken as provided within **Section 4.4** of the Ecological Assessment. **Table 1** provides the results of the Habitat Assessments undertaken at the three separate aquatic habitat assessment locations (two along the unnamed tributary of Quorrobolong Creek flowing in a northerly direction across LWB2 and LWB3 (one section north of Sandy Creek Road and one section south of Sandy Creek Road)) and the third along the section of Quorrobolong Creek that flows in a northerly direction along the north-eastern corner of the LWB1-B3 Modification Area (referred to as Quorrobolong Creek). **Table 2** provides a summary of the Riparian Channel and Environmental Inventory (RCE) categorisation undertaken at these sites. Both sets of data are qualitative in nature and were collected to inform the likelihood of occurrence of significant aquatic ecological values base on habitat

Table 1 Aquatic Habitat Attributes

Habitat Attribute		Quorrobolong Creek	Unnamed Tributary of Quorrobolong Creek – North of Sandy Creek Rd	Unnamed Tributary of Quorrobolong Creek – South of Sandy Creek Rd
Easting		346177.9	345397.3	345008.8
Northing		6356062	6356328	6355259
Bank height (m)		2.0	0.5	1.8
Bank full width (m)		8	>5m	10
Length of reach (m)		200m	300	500m
Stream width (m)	minimum	0.5	0.5	0.5
	maximum	4.5	3	3
	mode	1.5	1.5	1
Riffle		Absent	Absent	Small amount of riffling present at man-made weir. Very slow moving.
Pool %		10	Absent	10
Run %		90%	100%	90
Macrophyte		Small amounts of water ribbons	Absent	Small amounts of water ribbons
Riparian zone width (m)	left	2	3	3m
	right	3	3	3m
% cover of riparian zone	trees (>10 m)	15	15	15
	trees (<10 m)	5	40	15
	shrubs	5	0	0
	grasses/ferns/ sedges	90	90	80
Vegetation description		Riparian Swamp Oak Open Forest	Riparian Swamp Oak Open Forest (dominated by planted <i>Casuarina cunninghamiana</i>)	Riparian Swamp Oak Open Forest – Eucalypt Dominant Variant
Shading of river%		40	90	80
Vegetation %	native	70	50	80
	exotic	30	50	20
Water odour		nil	nil	nil
Water oils (natural or manmade)		None.	nil	None. Small level of tannins
Turbidity		High- likely from cattle	nil	low

Habitat Attribute		Quorrobolong Creek	Unnamed Tributary of Quorrobolong Creek – North of Sandy Creek Rd	Unnamed Tributary of Quorrobolong Creek – South of Sandy Creek Rd
Plume		nil	nil	nil
Sediment oils		nil	nil	nil
Sediment odours		nil	Could not be identified as could not access water course	nil
Flow level		Moderate	Low	Moderate
Bare ground above water mark (%)	left	5	5	5
	right	5	5	5
Are the undersides of stones that are not deeply embedded black?		No	No _not stony	No
Sediment deposits		Very little	None observed	Very little
Local catchment erosion		Minor	Minor	Minor
Local point source pollution		Agriculture	Agriculture	Agriculture
Local non point source pollution		None likely	None likely	None likely – maybe small amount of road runoff and waste from grazing cattle
Dams/barriers		Culvert to north from Sandy Creek Road Crossing. Does not appear to be impeding flow	None identified	Culvert to north from Sandy Creek Road Crossing and small weir. Does not appear to be impeding flow.
River braiding		nil	nil	nil
Land use Left bank		Grazing	Fenced and protected	Grazing
Land use Right bank		Grazing	Fenced and protected	Grazing
Bars		Some minor sand bar occurrences	Nil	Nil
Reach: substratum description (% cover)	bedrock	0	0	0
	boulder	0	0	0
	cobble	0	0	0
	pebble	0	0	0
	gravel	0	0	0
	sand	70	0	80

Habitat Attribute		Quorrobolong Creek	Unnamed Tributary of Quorrobolong Creek – North of Sandy Creek Rd	Unnamed Tributary of Quorrobolong Creek – South of Sandy Creek Rd
	silt	10	80 (based on observation-could not access)	10
	clay	20	20 (based on observation-could not access)	10
Organic substratum	detritus (sticks, wood)	5%	15%	<5%
	muck/mud	Nil	Could not be observed as could not access	Nil
Percent of reach covered by	periphyton	5		5
	moss	0	0	0
	filamentous algae	15	0	10
	macrophytes	5	0	5
Macrophytes	submerged/floating	5 (water ribbons)	<5	5 (water ribbons)
	emergent	0	0	0

Table 2 RCE Categorisation (Scores) of Habitat Attributes

Habitat variable	Quorrobolong Creek		Unnamed Tributary of Quorrobolong Creek – North of Sandy Creek Rd		Unnamed Tributary of Quorrobolong Creek – South of Sandy Creek Rd	
Bottom substrate/available cover	Sub-optimal (12)		Sub-optimal (14)		Sub-optimal (11)	
Pool Substrate Characterisation	Sub-optimal (12)		Sub-optimal (11)		Sub-optimal (11)	
Pool Variability	Marginal (7)		Marginal (6)		Marginal (8)	
Sediment Deposition	Optimal (17)		Optimal (18)		Optimal (16)	
Channel flow status	Optimal (18)		Optimal (18)		Optimal (17)	
Channel Alteration	Sub-optimal (15)		Sub-optimal (16)		Optimal (17)	
Channel Sinuosity	Marginal (10)		Marginal (7)		Marginal (9)	
Bank Stability	Sub-optimal (8)	Sub-optimal (8)	Optimal (18)	Optimal (18)	Sub-optimal (8)	Sub-optimal (8)
Vegetation Protection	Sub-optimal (8)	Sub-optimal (8)	Optimal (18)	Optimal (18)	Marginal (5)	Marginal (4)
Riparian Zone	Marginal (5)	Marginal (5)	Marginal (5)	Marginal (5)	Poor (2)	Marginal (3)
Total Score	133		172		119	



APPENDIX E

**Seven Part Test of Significance under
the Environmental Planning and
Assessment Act 1979**

Appendix E – Assessment of Significance (EP&A Act)

Assessments of significance have been used to determine potential impacts as a result of the proposed modification. The tables presented in **Appendix A** are intended to streamline the impact assessment process, ensuring that only those species with reasonable potential to occur in the LWB1-B3 Modification Area and with reasonable potential to be impacted by the proposed modification are assessed under a 7 part test.

A 7 part test of significance was prepared in accordance with the requirements of Section 5A of the EP&A Act for each threatened species, population or EECs potentially impacted as a result of the proposed modification. As discussed in **Section 4** of the Ecological Assessment, biodiversity values have the potential to be directly impacted by subsidence related surface cracking, and by any associated remediation of surface cracking post mining. Secondary impacts associated with hydrological changes are also possible and typically impact greatest on riparian areas. Such secondary impacts could include:

- changes to runoff and flow volumes through subsidence induced changes to catchment boundaries
- changes to bank stability and channel alignment
- changes to in-channel and out of channel ponding through changes to the bed profile of the creeks which may result in drying or waterlogging of root systems
- loss of water to near-surface groundwater flows due to subsidence-induced cracks occurring beneath a stream or other surface water body (valley closure).

Due to the depth of mining within the proposed modification area (>480 metres), and the small magnitude of predicted ground curvatures and strains, the potential for surface cracking is low. This is supported by monitoring evidence within the Stage 2 mining area, where there has been no significant or visible surface cracking above previously extracted longwalls A3 to A8. Any surface cracking that does occur is expected to be minor and isolated and unlikely to directly or adversely impact site vegetation communities and fauna habitat.

Based on previous experience within the broader Austar Mine Complex, remediation of surface cracking is unlikely to be required within the LWB1-B3 Modification Area.

Flood modelling indicates that the potential for secondary impacts such as increased erosion of the landscape as a result of the proposed modification is also expected to be minimal.

Based on the preliminary impact assessment detailed in **Appendix A**, further assessment is required for the following species:

- River-flat Eucalypt Forest EEC
- Lower Hunter Spotted Gum – Ironbark Forest EEC
- potential Quorrobolong Scribbly Gum Woodland EEC
- netted bottle-brush (*Callistemon linearifolius*)

-
- heath wrinklewort (*Rutidosia heterogama*)
 - small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)
 - green-thighed frog (*Litoria brevipalmata*)
 - swift parrot (*Lathamus discolor*)
 - regent honeyeater (*Anthochaera phrygia*)
 - grey-crowned babbler (*Pomatostomus temporalis temporalis*)
 - varied sittella (*Daphoenositta chrysoptera*)
 - grey-headed flying fox (*Pteropus poliocephalus*)
 - squirrel glider (*Petaurus norfolcensis*)
 - koala (*Phascolarctos cinereus*)
 - large-eared pied bat (*Chalinolobus dwyeri*)
 - southern myotis (*Myotis macropus*)
 - eastern freetail bat (*Mormopterus norfolkensis*)
 - little bentwing bat (*Miniopterus australis*)
 - greater broad nosed bat (*Scoteanax rueppellii*).

Below is a 7 part test of significance for each of these, which is prepared in accordance with the requirements of the EP&A Act.

1.0 River-flat Eucalypt Forest EEC

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

A total of 3.2 hectares of River-Flat Eucalypt Forest EEC occurs within the LWB1-B3 Modification Area. The potential for surface cracking or significant deformation of the ground surface within the LWB1-B3 Modification Area as a result of subsidence is expected to be minimal and therefore very little disturbance of surface and groundwater flow patterns is predicted. Based on the subsidence predictions summarised in **Section 4**, it is not likely that the proposed modification will result in the loss or modification of any areas of River-flat Eucalypt Forest EEC and therefore the local occurrence of the community will not be placed at risk of extinction.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

The proposed modification is predicted to have very minor surface impacts and minor impacts on surface and groundwater flows. Based on the subsidence predictions, it is not likely that the proposed modification will adversely modify the composition of the River-flat Eucalypt Forest EEC such that its local occurrence will be placed at risk of extinction.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of habitat for the River-flat Eucalypt Forest EEC. It is predicted that the proposed modification will result in negligible changes to the habitat characteristics of the EEC in the LWB1-B3 Modification Area.

- ii) **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification does not involve any clearing of vegetation that would result in the fragmentation or isolation of any areas of the River-flat Eucalypt Forest EEC, within or adjacent to the LWB1-B3 Modification Area.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises approximately 3.3 hectares of River-flat Eucalypt Forest, which also occurs in several other locations within the locality. Bell and Driscoll (2008) identify approximately 1531.31 hectares of this EEC within the Cessnock-Kurri Region. The remnants of River-flat Eucalypt Forest within the LWB1-B3 Modification Area are in moderate condition, with evidence of historic clearing, fragmentation and ongoing grazing management practices, and are regarded to have moderate conservation significance.

Given that the proposed modification will not involve the removal or modification of any areas of this EEC, there will be no impact on the long-term viability of this EEC within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this EEC or any other threatened species or populations.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to this EEC and the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

2.0 Lower Hunter Spotted Gum – Ironbark Forest EEC

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Approximately 56.7 hectares of Lower Hunter Spotted Gum – Ironbark Forest EEC occurs in the LWB1-B3 Modification Area, where it occupies lower slopes. Large areas of this EEC are protected in the nearby Werakata SCA and elsewhere in the locality and region.

The potential for surface cracking or significant deformation of the ground surface within the LWB1-B3 Modification Area as a result of subsidence is expected to be minimal and therefore very little disturbance of surface and groundwater flow patterns is predicted. The secondary impacts of subsidence (decreased creek bank stability, hydrological changes, tree fall etc) typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. Therefore there is very low potential for this EEC to be impacted. Based on the subsidence predictions summarised in **Section 4** and in the main EA, it is not likely that the proposed modification will result in the loss or modification of any areas of the Lower Hunter Spotted Gum - Ironbark EEC and therefore the local occurrence of the community will not be placed at risk of extinction.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

The proposed modification is predicted to have very minor surface impacts, and minor impacts on surface and groundwater flows. Based on the subsidence predictions, it is not likely that the proposed modification will adversely modify the composition of the Lower Hunter Spotted Gum – Ironbark Forest EEC such that its local occurrence will be placed at risk of extinction.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of habitat for the Lower Hunter Spotted Gum – Ironbark Forest EEC. It is predicted that the proposed modification will result in negligible changes to the floristic composition or extent of this EEC.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification does not involve any clearing of vegetation that would result in the fragmentation or isolation of any areas of Lower Hunter Spotted Gum – Ironbark Forest EEC, within or adjacent to the LWB1-B3 Modification Area.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises approximately 56.7 hectares of the Lower Hunter Spotted Gum – Ironbark Forest EEC that is in moderate condition. High conservation value examples of this community are protected widely within the Werakata State Conservation Area which occurs in proximity to the LWB1-B3 Modification Area.

Given that the proposed modification will not involve the removal or modification of any areas of the Lower Hunter Spotted Gum – Ironbark Forest EEC, there will be no impact on the long-term viability of this EEC within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for the Lower Hunter Spotted Gum – Ironbark Forest EEC or any other threatened species or populations.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to the Lower Hunter Spotted Gum – Ironbark Forest EEC or the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

3.0 Potential Quorrobolong Scribbly Gum EEC

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- iii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Approximately 1.6 hectares of potential Quorrobolong Scribbly Gum Woodland EEC occurs in the LWB1-B3 Modification Area, where it occupies lower slopes in the north-west. The known geographic distribution of this community is highly restricted.

The potential for surface cracking or significant deformation of the ground surface within the LWB1-B3 Modification Area as a result of subsidence is expected to be minimal and therefore very little disturbance of surface and groundwater flow patterns is predicted. The secondary impacts of subsidence (decreased creek bank stability, hydrological changes, tree fall etc) typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. Therefore there is very low potential for this potentially occurring EEC to be impacted. Based on the subsidence predictions summarised in **Section 4** and in the main EA, it is not likely that the proposed modification will result in the loss or modification of any areas of the potential Quorrobolong Scribbly Gum Woodland EEC and therefore the local occurrence of the community will not be placed at risk of extinction.

- iv) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

The proposed modification is predicted to have very minor surface impacts, and minor impacts on surface and groundwater flows. Based on the subsidence predictions, it is not likely that the proposed modification will adversely modify the composition of the potential Quorrobolong Scribbly Gum Woodland EEC such that its local occurrence will be placed at risk of extinction.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of habitat for the potential Quorrobolong Scribbly Gum Woodland EEC. It is predicted that the proposed modification will result in negligible changes to the floristic composition or extent of this EEC.

- v) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification does not involve any clearing of vegetation that would result in the fragmentation or isolation of any areas of potential Quorrobolong Scribbly Gum Woodland EEC, within or adjacent to the LWB1-B3 Modification Area.

- vi) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The LWB1-B3 Modification Area comprises approximately 1.6 hectares of potential Quorrobolong Scribbly Gum Woodland EEC that is in moderate condition. The other known occurrences of this EEC are more consistent with the determination and contain greater biodiversity value than the extent present in the LWB1-B3 Modification Area.

Given that the proposed modification will not involve the removal or modification of any areas of the potential Quorrobolong Scribbly Gum Woodland EEC, there will be no impact on the long-term viability of this EEC within the locality.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for the potential Quorrobolong Scribbly Gum Woodland EEC or any other threatened species or populations.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to the potential Quorrobolong Scribbly Gum Woodland EEC or the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

4.0 Netted bottlebrush (*Callistemon linearifolius*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Netted bottlebrush (*Callistemon linearifolius*) was possibly identified within the north of the LWB1-B3 Modification Area. Approximately 30 individuals were recorded. This threatened flora species is also known to occur within the proximate Werakata State Conservation Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. Therefore there is very low potential for an impact on this species which occurs in dry habitats on slopes and ridges. The proposed modification will not have an adverse effect on the life cycle of any netted bottlebrush (*Callistemon linearifolius*) such that a viable local population of the species is likely to be placed at risk of extinction.

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**
- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Known and potential habitat for the netted bottlebrush (*Callistemon linearifolius*) within the LWB1-B3 Modification Area will not be removed or modified as a result of the proposed modification. There is no potential for the habitats this species occurs within to be impacted by the proposed modification.

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- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

As there will be no removal or modification of habitat for the netted bottlebrush (*Callistemon linearifolius*) within the LWB1-B3 Modification Area, there is no potential for habitats to be fragmented or isolated.

- iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

Known and potential habitat for the netted bottlebrush (*Callistemon linearifolius*) occurs in the areas of remnant vegetation in the LWB1-B3 Modification Area. Known and potential habitat for netted bottlebrush (*Callistemon linearifolius*) also occurs widely within the locality, including within Werakata State Conservation Area which occurs in proximity to the LWB1-B3 Modification Area. The habitats present in the LWB1-B3 Modification Area are not considered to be important for the long-term survival of the species in the local area.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species or populations.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species or the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

5.0 Heath wrinklewort (*Rutidosia heterogama*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Approximately 150 heath wrinklewort (*Rutidosia heterogama*) were identified within the LWB1-B3 Modification Area in the north-west and it is considered likely that more than this are actually present. This threatened flora species is also known to be widespread within the large remnant of the proximate Werakata State Conservation Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. The proposed modification will not have an adverse effect on the life cycle of any occurring or potentially occurring heath wrinklewort (*Rutidosia heterogama*) such that a viable local population of the species is likely to be placed at risk of extinction.

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**
- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Approximately 150 heath wrinklewort (*Rutidosia heterogama*) were identified within the LWB1-B3 Modification Area, in addition 61.5 ha of potential habitat was identified comprising areas of forest vegetation. Neither known nor potential habitat will be removed or modified as a result of the proposed modification. It is unlikely that the heath wrinklewort will be adversely affected by the proposed modification.

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- ii) **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

As there will be no removal or modification of known or potential habitat for the heath wrinklewort (*Rutidosia heterogama*) within the LWB1-B3 Modification Area, there is no potential that any habitats will be fragmented or isolated.

- iii) **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The heath wrinklewort (*Rutidosia heterogama*) occurs in the remnant vegetation in the north-west of the LWB1-B3 Modification Area. Known and potential habitat for heath wrinklewort (*Rutidosia heterogama*) occurs widely within the locality, including within Werakata State Conservation Area which occurs in proximity to the LWB1-B3 Modification Area. The habitats present in the LWB1-B3 Modification Area are not considered to be important for the long-term survival of the species in the local area.

- e) **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species or populations.

- f) **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species or the proposed modification.

- g) **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

6.0 Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was identified within the LWB1-B3 Modification Area in the north-west. Approximately 58 individuals were identified and it is anticipated that more occur in this area. This threatened flora species is also known to be widespread within the large remnant of the proximate Werakata State Conservation Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. The proposed modification will not have an adverse effect on the life cycle of any potentially occurring small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) such that a viable local population of the species is likely to be placed at risk of extinction.

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- iii) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- iv) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- iv) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

Approximately 58 individuals of this species were identified in the north-west of the LWB1-B3 Modification Area. Known and potential habitat will not be removed or modified as a result of the proposed modification. It is unlikely that the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) will be adversely affected by the proposed modification.

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- v) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

As there will be no removal or modification of known or potential habitat for the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the LWB1-B3 Modification Area, there is no potential that any habitats will be fragmented or isolated.

- vi) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) occurs in the remnant vegetation in the north-west of the LWB1-B3 Modification Area in moderate numbers. Known and potential habitat for small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) occurs widely within the locality, including within Werakata State Conservation Area which occurs in proximity to the LWB1-B3 Modification Area. The habitats present in the LWB1-B3 Modification Area are not considered to be important for the long-term survival of the species in the local area.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species or populations.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species or the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

7.0 Green-thighed frog (*Litoria brevipalmata*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Although not identified, there is a low possibility that the riparian habitats of the LWB1-B3 Modification Area provide potential habitat for the green-thighed frog (*Litoria brevipalmata*).

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

Based on the subsidence predictions summarised in **Section 4**, it is not likely that the proposed modification will result in the loss or modification of any areas of potential habitat for the green-thighed frog (*Litoria brevipalmata*) and therefore a viable local population of the species will not be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of potential habitat for the green-thighed frog (*Litoria brevipalmata*). It is expected that the proposed modification will result in negligible changes to the habitat characteristics available to this species.

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- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification is expected to have only very minor surface impacts, and will not result in the disturbance to any characteristics of the potential habitat for the green-thighed frog (*Litoria brevipalmata*). Areas of potential habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

- iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The riparian habitats of the LWB1-B3 Modification Area comprise potential habitat for the green-thighed frog (*Litoria brevipalmata*), with most areas of potential habitat being disturbed or modified. The likelihood of this species occurring within these habitats is regarded to be low.

Given that the proposed modification will not involve the removal or modification to any areas of potential habitat for the green-thighed frog (*Litoria brevipalmata*), there will not be an impact on the long-term viability of this species within the locality.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

8.0 Swift parrot (*Lathamus discolor*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The LWB1-B3 Modification Area provides potential habitat for the swift parrot (*Lathamus discolor*), in particular within the Lower Hunter Spotted Gum – Ironbark Forest and the Riparian Cabbage Gum Open Forest which both support winter flowering tree species that are known to be used by this species in the local area. Moderate to high conservation value habitat for this species also occurs in the nearby Werakata State Conservation Area. This highly mobile species is known to forage at a number of suitable locations within the local area in the cooler months, however it has not been recorded in the LWB1-B3 Modification Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. As such, there is very low potential for an impact on the swift parrot (*Lathamus discolor*).

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

There will be no vegetation loss as a result of direct clearing, or as a result of subsidence impacts associated with the proposed modification. There will no removal or modification of potential habitats for the swift parrot (*Lathamus discolor*).

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to have only very minor surface impacts, and will not result in the disturbance to any characteristics of the potential habitat for the swift parrot (*Lathamus discolor*). Areas of potential habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area provides moderate conservation value habitat for the swift parrot (*Lathamus discolor*). Known and potential habitat for the swift parrot (*Lathamus discolor*) is moderately widespread within the locality, including within Werakata State Conservation Area which occurs within 5 km of the LWB1-B3 Modification Area. There are a number of areas of high conservation habitat within the region, only some of which are conserved. The LWB1-B3 Modification Area is not considered to provide important habitat for this species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for the swift parrot (*Lathamus discolor*) or any other threatened species or populations.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The key actions from the swift parrot recovery plan (Swift Parrot Recovery Team 2001) are summarised below:

- Identify and map priority foraging habitats and to identify important breeding sites.
- Implement a strategy to protect priority sites and habitats.
- Identify degraded habitats that have potential to benefit the recovery of the swift parrot.
- Monitor collisions and collision hazards, particularly during the breeding season.
- Monitor the density of the breeding population and the extent and quality of habitat.
- Increase public awareness about the recovery program.
- Involve the community in the recovery.

None of the above recovery actions would be compromised as a result of the proposed modification. However, the proposed modification does have scope to contribute information to some of these actions through the outcomes of ecological surveys and ongoing monitoring programs in potential habitats for the swift parrot (*Lathamus discolor*).

-
- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

9.0 Regent honeyeater (*Anthochaera phrygia*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The LWB1-B3 Modification Area provides suitable habitat for the regent honeyeater (*Anthochaera phrygia*), in particular within the Lower Hunter Spotted Gum – Ironbark Forest and the Riparian Cabbage Gum Open Forest which both support winter flowering tree species that are known to be used by this species. Moderate to high conservation value habitat for this species also occurs in the large remnant of the nearby Werakata State Conservation Area. This highly mobile species is known to forage at a number of suitable locations within the local area in the cooler months.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. As such, there is very low potential for an impact on the regent honeyeater (*Anthochaera phrygia*).

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

There will be no vegetation loss as a result of direct clearing, or as a result of subsidence impacts associated with the proposed modification. There will no removal or modification of potential habitats for the regent honeyeater (*Anthochaera phrygia*).

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to have only very minor surface impacts, and will not result in the disturbance to any characteristics of the potential habitat for the regent honeyeater (*Anthochaera phrygia*). Areas of potential habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area provides moderate conservation value habitat for the regent honeyeater (*Anthochaera phrygia*). Known and potential habitat for the regent honeyeater (*Anthochaera phrygia*) is moderately widespread within the locality, including within Werakata State Conservation Area which occurs within 5 kilometres of the LWB1-B3 Modification Area. There are a number of areas of high conservation habitat within the region, only some of which are conserved. It is not considered that the habitats provided by the LWB1-B3 Modification Area are of particular importance to this species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for the regent honeyeater (*Anthochaera phrygia*) or any other threatened species or populations.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The specific recovery actions from the Regent Honeyeater Recovery Plan (Department of Natural Resources and Environment 1999) are:

- effectively organise and administer the recovery effort
- maintain and enhance habitat
- monitor trends in population size and range
- facilitate strategic research
- maintain and increase community awareness, understanding and involvement and
- maintain the captive population.

None of the above recovery actions would be compromised as a result of the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

10.0 Grey-crowned babbler (*Pomatostomus temporalis temporalis*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The LWB1-B3 Modification Area provides known habitat and a likely resident population of the grey-crowned babbler (*Pomatostomus temporalis temporalis*) within remnant vegetation areas. Moderate to high conservation value habitat for this species also occurs in the large remnant of the nearby Werakata State Conservation Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance to surface and groundwater flow. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is not likely that subsidence will lead to loss of vegetation or modification of habitats. As such, there is very low potential for an adverse impact on grey-crowned babbler (*Pomatostomus temporalis temporalis*) such that a viable local population of the species is placed at risk of extinction.

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**
- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

There will be no vegetation loss as a result of direct clearing, or as a result of subsidence impacts associated with the proposed modification. There will no removal or modification of habitats for the grey-crowned babbler (*Pomatostomus temporalis temporalis*).

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to have only very minor surface impacts, and will not result in the disturbance to any characteristics of the habitat for the grey-crowned babbler (*Pomatostomus temporalis temporalis*). Areas of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area provides moderate conservation value habitat for the grey-crowned babbler (*Pomatostomus temporalis temporalis*). Known and potential habitat for the grey-crowned babbler (*Pomatostomus temporalis temporalis*) is widespread within the locality, including within Werakata State Conservation Area which occurs within 5km of the LWB1-B3 Modification Area. As such the LWB1-B3 Modification Area is not considered of particular importance to this species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for the grey-crowned babbler (*Pomatostomus temporalis temporalis*) or any other threatened species or populations.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

11.0 Varied sittella (*Daphoenositta chrysoptera*)

- a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The LWB1-B3 Modification Area provides known habitat for the varied sittella (*Daphoenositta chrysoptera*), in particular within the areas of remnant vegetation. The LWB1-B3 Modification Area is likely to provide habitat for a resident population of the varied sittella. Moderate to high conservation value habitat for this species also occurs in the large remnant of the Werakata State Conservation Area which is within 5 km of the LWB1-B3 Modification Area.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance to surface and groundwater flow. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. As such, there is very low potential for an impact on varied sittella (*Daphoenositta chrysoptera*).

- b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- iii) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- iv) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- iv) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

There will be no vegetation loss as a result of direct clearing, or as a result of subsidence impacts associated with the proposed modification. There will no removal or modification of habitat available to this species in the LWB1-B3 Modification Area as a result of the proposed modification.

-
- v) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification is expected to have only very minor surface impacts, and will not result in the disturbance to any characteristics of the habitat for the varied sittella (*Daphoenositta chrysoptera*). Areas of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

- vi) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The LWB1-B3 Modification Area provides moderate conservation value habitat for the varied sittella (*Daphoenositta chrysoptera*). Known and potential habitat for the varied sittella (*Daphoenositta chrysoptera*) is widespread within the locality, including within Werakata State Conservation Area which occurs within 5 km of the LWB1-B3 Modification Area. As such the LWB1-B3 Modification Area is not considered of particular importance to this species.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for varied sittella (*Daphoenositta chrysoptera*) or any other threatened species or populations.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

12.0 Grey-headed flying-fox (*Pteropus poliocephalus*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Although it was not recorded, the grey-headed flying-fox (*Pteropus poliocephalus*) has potential to occur in the LWB1-B3 Modification Area and potentially forages within the riparian habitats during periods of eucalypt flowering. No camps that provide breeding habitat for the species were identified during surveys.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance to surface and groundwater flow. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats. The proposed modification will therefore not affect the life-cycle of the grey-headed flying-fox (*Pteropus poliocephalus*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**
- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of potential habitat for the grey-headed flying-fox (*Pteropus poliocephalus*). There will no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area as a result of the proposed modification.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance to potential habitat for the grey-headed flying-fox (*Pteropus poliocephalus*). As such, an area of potential habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises suitable foraging habitat for the grey-headed flying-fox (*Pteropus poliocephalus*). This species could utilise this site for foraging, however suitable breeding and roosting habitat was not identified. It is not considered that the habitats provided are important for this species.

Given that the proposed modification will not involve the removal or modification to any areas of potential habitat for the grey-headed flying-fox (*Pteropus poliocephalus*), there will not be an impact on the long-term viability of this species within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Draft National Recovery Plan for the Grey-Headed Flying-Fox (Department of Environment, Climate Change and Water 2009) lists the following priority actions:

- identify and protect foraging habitat critical to the survival of grey-headed flying-foxes
- enhance winter and spring foraging habitat for grey-headed flying-foxes
- identify, protect and enhance roosting habitat critical to the survival of grey-headed flying-foxes
- significantly reduce levels of deliberate grey-headed flying-fox destruction associated with commercial horticulture
- provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- produce and circulate educational resources to improve public attitudes toward grey-headed flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- monitor population trends for the grey-headed flying-fox
- assess the impacts on grey-headed flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts

-
- oversee a program of research to improve knowledge of the demographics and population structure of the grey-headed flying-fox and
 - maintain a National Recovery Team to oversee the implementation of the grey-headed flying-fox National Recovery Plan.

None of the above recovery actions would be compromised as a result of the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

13.0 Squirrel glider (*Petaurus norfolcensis*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The squirrel glider (*Petaurus norfolcensis*) was recorded in the LWB1-B3 Modification Area, and it is considered that a resident population is likely present, utilising the habitats of the LWB1-B3 Modification Area as part of a wider habitat range in surrounding areas of vegetation.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of the squirrel glider (*Petaurus norfolcensis*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of habitat for the squirrel glider (*Petaurus norfolcensis*). There will no removal or modification of habitat for this species in the LWB1-B3 Modification Area a result of the proposed modification.

-
- ii. **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance to any characteristics of habitat for the squirrel glider (*Petaurus norfolcensis*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

- iii. **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The LWB1-B3 Modification Area comprises known foraging habitat and potential denning habitat for the squirrel glider (*Petaurus norfolcensis*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the squirrel glider (*Petaurus norfolcensis*), there will not be an impact on the long-term viability of this species within the locality.

- e) **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

- f) **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

- g) **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

14.0 Koala (*Phascolarctos cinereus*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

There is an existing Atlas record of the koala (*Phascolarctos cinereus*) from the LWB1-B3 Modification Area. It is considered that this record (if accurate as the Atlas data indicates that the accuracy was within 1000 metres off the coordinates provided (BioNet 2015)) represents a dispersing individual, as a resident population of the species was not recorded during surveys and potential foraging resources for the species were low.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of the koala (*Phascolarctos cinereus*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- iii) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- iv) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community:

iv. the extent to which habitat is likely to be removed or modified as a result of the action proposed

The proposed modification will not lead to the removal or modification of any areas of habitat for the koala (*Phascolarctos cinereus*). There will no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area a result of the proposed modification.

v. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance of habitat for the koala (*Phascolarctos cinereus*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

vi. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises a small amount of very low quality foraging habitat for the koala (*Phascolarctos cinereus*) and a resident population was not identified. Given that the proposed modification will not involve the removal or modification to any areas of habitat for the koala (*Phascolarctos cinereus*) there will not be an impact on the long-term viability of this species within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The 'Recovery plan for the koala (*Phascolarctos cinereus*)' (DECC 2008) is relevant to this species. The proposed action does not contravene with any of the objective or actions listed within this recovery plan.

No threat abatement plans are pertinent to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

15.0 Large-eared pied bat (*Chalinolobus dwyeri*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The large-eared pied bat (*Chalinolobus dwyeri*) was recorded in the LWB1-B3 Modification Area. Due to an absence of appropriate roosting habitat, it is considered that this species would only be utilising the habitats available as part of a larger foraging range.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of large-eared pied bat (*Chalinolobus dwyeri*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- v) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- vi) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- vii. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of foraging or roosting habitat for the large-eared pied bat (*Chalinolobus dwyeri*). There will no removal or

modification of habitat characteristics available to this species in the LWB1-B3 Modification Area a result of the proposed modification.

viii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance of foraging or roosting habitat for the large-eared pied bat (*Chalinolobus dwyeri*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

ix. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises foraging habitat for the large-eared pied bat (*Chalinolobus dwyeri*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the large-eared pied bat (*Chalinolobus dwyeri*), there will not be an impact on the long-term viability of this species within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

16.0 Southern myotis (*Myotis macropus*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The southern myotis (*Myotis macropus*) potentially occurs in the LWB1-B3 Modification Area, and potentially forages and roosts within the riparian habitats present.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of southern myotis (*Myotis macropus*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- vii) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- viii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- x. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of potential habitat for the southern myotis (*Myotis macropus*). There will no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area a result of the proposed modification.

-
- xi. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance of potential habitat for the southern myotis (*Myotis macropus*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

- xii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The LWB1-B3 Modification Area comprises potential foraging and roosting habitat for the southern myotis (*Myotis macropus*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the southern myotis (*Myotis macropus*), there will not be an impact on the long-term viability of this species within the locality.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

17.0 Eastern freetail bat (*Mormopterus norfolkensis*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The eastern freetail bat (*Mormopterus norfolkensis*) potentially occurs in the LWB1-B3 Modification Area, and potentially forages and roosts within the riparian habitats present.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance of surface and groundwater flow patterns. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of eastern freetail bat (*Mormopterus norfolkensis*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- ix) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- x) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- xiii. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of habitat for the eastern freetail bat (*Mormopterus norfolkensis*). There will no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area as a result of the proposed modification.

xiv. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance to potential habitat for the eastern freetail bat (*Mormopterus norfolkensis*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

xv. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises potential foraging and roosting habitat for eastern freetail bat (*Mormopterus norfolkensis*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the eastern freetail bat (*Mormopterus norfolkensis*), there will not be an impact on the long-term viability of this species within the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

18.0 Little bentwing bat (*Miniopterus australis*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The little bentwing bat (*Miniopterus australis*) has potential to occur in the LWB1-B3 Modification Area, and potentially forages and roosts within the riparian habitats present.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance to surface and groundwater flow. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of the little bentwing bat (*Miniopterus australis*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii. **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of potential habitat for the little bentwing bat (*Miniopterus australis*). There will no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area as a result of the proposed modification.

e) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance to potential habitat for the little bentwing bat (*Miniopterus australis*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

i) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality

The LWB1-B3 Modification Area comprises potential foraging and roosting habitat for the little bentwing bat (*Miniopterus australis*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the little bentwing bat (*Miniopterus australis*), there will not be an impact on the long-term viability of this species within the locality.

f) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

19.0 Greater broad-nosed bat (*Scoteanax rueppellii*)

- a) **in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The greater broad-nosed bat (*Scoteanax rueppellii*) was recorded in the LWB1-B3 Modification Area, and potentially forages and roosts within the riparian habitats present.

Subsidence modelling and predictions indicate that the potential for surface cracking and significant deformation of the ground surface is minimal, and therefore the proposed modification will cause very little disturbance to surface and groundwater flow. The secondary impacts (decreased creek bank stability, hydrological changes, tree fall etc) of subsidence typically have greatest impact on riparian areas, and these secondary impacts are also predicted to be minor. There will be no loss of vegetation as a result of direct clearing, and it is very unlikely that subsidence will lead to loss of vegetation or modification of habitats.

It is not likely that proposed modification will result in the loss or modification of any areas of habitat for this species. The proposed modification will not affect the lifecycle of the greater broad-nosed bat (*Scoteanax rueppellii*) such that a viable local population of the species would be placed at risk of extinction.

- b) **in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

Not applicable.

- c) **in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i) **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or**

Not applicable.

- ii) **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

- d) **in relation to the habitat of a threatened species, population or ecological community:**

- i) **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposed modification will not lead to the removal or modification of any areas of habitat for the greater broad-nosed bat (*Scoteanax rueppellii*). There will be no removal or modification of habitat characteristics available to this species in the LWB1-B3 Modification Area as a result of the proposed modification.

-
- ii) **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and**

The proposed modification is expected to result in negligible surface impacts, and will not result in the disturbance to foraging or roosting habitat for the greater broad-nosed bat (*Scoteanax rueppellii*). As such, an area of habitat for this species will not become fragmented or isolated from other areas of habitat (known or potential) as a result of the proposed modification.

- iii) **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The LWB1-B3 Modification Area comprises foraging and potential roosting habitat for the greater broad-nosed bat (*Scoteanax rueppellii*).

Given that the proposed modification will not involve the removal or modification to any areas of habitat for the greater broad-nosed bat (*Scoteanax rueppellii*), there will not be an impact on the long-term viability of this species within the locality.

- e) **whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

The LWB1-B3 Modification Area does not support any critical habitat for this species or any other threatened species, populations or EECs.

- f) **whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan**

There is not currently a recovery plan or threat abatement plan which relates to this species and the proposed modification.

- g) **whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.**

There are two KTPs most relevant to the proposed modification, being 'Alterations due to subsidence associated with longwall mining' and 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands'. Several other KTPs were considered for their relevance to the project: these are discussed in **Section 4.6** of the main report. Given that the predicted surface impacts of the proposed modification will be very minor, the implications of these KTPs are not considered significant.

Conclusion

The proposed modification will not result in a significant impact on any threatened species, populations or EECs recorded or potentially occurring within the LWB1-B3 Modification Area.



APPENDIX F

**Assessments of Significance under the
Environment Protection and Biodiversity
Conservation Act 1999**

Appendix F – Assessment of Significance (EPBC Act)

A search of the Department of the Environment (DotE) Protected Matters Database identified threatened and migratory species (EPBC Act listed) known to occur or considered likely to occur, on the basis of habitat modelling, within a 10 kilometre radius of the LWB1-B3 Modification Area. No EPBC Act listed endangered populations or threatened ecological communities (TECs) are known or have potential to occur within the LWB1-B3 Modification Area.

Given that the proposed modification comprises underground mining that is predicted to have very minor impacts on surface habitats, an assessment was only undertaken for those species regarded to have reasonable potential to occur and reasonable potential to be impacted by the proposed modification. Consequently, six threatened species and one migratory species require assessment. An assessment of the potential impacts of the proposed modification on these species is provided below.

The aim of this assessment is to determine whether the proposed modification is likely to have a significant impact on any EPBC Act matters of national environmental significance (MNES). In this instance, MNES with potential to occur within the LWB1-B3 Modification Area include:

- listed threatened species (including critically endangered, endangered and vulnerable species)
- listed migratory species.

Each category is addressed separately below.

Endangered and Critically Endangered Species

The following EPBC Act listed endangered and critically endangered species respectively are considered in this assessment:

- swift parrot (*Lathamus discolor*)
- regent honeyeater (*Anthochaera phrygia*).

An assessment in accordance with the DotE principal significant impact guidelines (DotE 2013) is provided below for these species.

In this case, a *population* means:

- a geographically distinct regional population, or collection of local populations
- a regional population, or collection of local populations, that occurs within a particular bioregion.

The swift parrot (*Lathamus discolor*) and regent honeyeater (*Anthochaera phrygia*) are not known to occur in the LWB1-B3 Modification Area, however have potential to occur due to the presence of winter flowering eucalypt species and the presence of local records. Both are migratory species, and are known to occur in the locality in the cooler months where they forage on winter-flowering resources such as spotted gum (*Corymbia maculata*) and ironbarks (*Eucalyptus* spp.). It is considered that the habitats provided by the LWB1-B3 Modification Area provide only moderate quality habitat for these species due to the fragmented and modified nature of the woodland habitat available as a result of historic clearing and ongoing grazing practices.

The swift parrot occurs as a single population, although it migrates annually from breeding grounds in Tasmania to the winter foraging grounds on the coastal plains and slope woodlands of mainland eastern Australia (Saunders 2002). Approximately 200 mature birds (10 per cent of the total estimated population) are known to over-winter in the Lower Hunter Region of New South Wales (Saunders 2002). The Modification Area is considered to form part of a regional dispersal route close to important winter foraging areas in the lower Hunter Valley.

Although there appears to be minor behavioural differences between regent honeyeaters in the three main areas inhabited by the species (the Bundarra-Barraba area in NSW, the Capertee Valley in NSW, and north-eastern Victoria), the direction and extent of movements, including evidence of movement between breeding sites, and a lack of discernable genetic differences between the sites suggest that the regent honeyeater occurs as a single, contiguous population (Garnett and Crowley 2000).

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of a *population*; or**

Neither the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) were recorded within the LWB1-B3 Modification Area, however there is potential for both species to occur, in particular in the Lower Hunter Spotted Gum – Ironbark Forest community. As these species are winter migrants, they would utilise the resources of the LWB1-B3 Modification Area as part of a wider foraging range at appropriate times of the year. The proposed modification will not result in

the loss of vegetation as a result of direct clearing or in relation to secondary impacts related to subsidence. The subsidence predictions indicate that any modifications to surface habitats resulting would be minor. As such, there is no potential for the proposed modification to lead to a long-term decrease in the size of a population of swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*).

- **reduce the area of occupancy of the species; or**

Neither the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) were recorded within the LWB1-B3 Modification Area, however it does support potential habitat for both species. Given that surface impacts will be minor, the proposed modification will not reduce the area of potential habitat for these species, and sizeable areas of similar potential habitats for these species are protected within the nearby (within 5 km) Werakata State Conservation Area.

- **fragment an existing population into two or more populations; or**

Neither the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) were recorded within the LWB1-B3 Modification Area, however potential foraging habitat for these migratory species is present. The proposed modification will not result in the loss of vegetation as a result of direct clearing or in relation to secondary impacts related to subsidence. The subsidence predictions indicate that any modifications to surface habitats resulting would be minor. As such, there is no potential for the proposed modification to lead to the fragmentation of an existing population of the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*) into two or more populations.

- **adversely affect habitat critical to the survival of a species; or**

Neither the swift parrot (*Lathamus discolor*) nor regent honeyeater (*Anthochaera phrygia*) were recorded within LWB1-B3 Modification Area. The LWB1-B3 Modification Area is not known to support any areas of critical habitat for either species. The proposed modification will not adversely affect habitat critical to the survival of these species.

- **disrupt the breeding cycle of a population; or**

Potential foraging habitat for the swift parrot (*Lathamus discolor*) and regent honeyeater (*Anthochaera phrygia*) occurs within the LWB1-B3 Modification Area, however there is no known breeding habitat. The proposed modification does not involve any clearing or fragmentation of habitats. As such, the proposed modification will not disrupt the breeding cycle of any population of any endangered species.

- **modify, destroy, remove isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

Potential foraging habitat for the swift parrot (*Lathamus discolor*) and regent honeyeater (*Anthochaera phrygia*) occurs within the LWB1-B3 Modification Area, in particular within the Lower Hunter Spotted Gum – Ironbark Forest community. The proposed modification is underground and will result in minor surface disturbances that are not expected to alter the habitats of the two endangered species. Consequently, the proposed modification will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that these endangered species are likely to decline.

-
- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or**

Given that the proposed modification comprises underground mining and will have minimal surface impacts, it is not expected to result in the establishment of invasive species that are harmful to these endangered species.

- **interfere with the recovery of the species.**

The proposed modification will not lead to the loss, alteration or fragmentation of potential foraging habitats for the swift parrot (*Lathamus discolor*) or regent honeyeater (*Anthochaera phrygia*). As such, the proposed modification will not interfere with the recovery of either species.

Vulnerable Flora Species

The following EPBC Act listed vulnerable flora species are considered in this assessment:

- heath wrinklewort (*Rutidosia heterogama*)
- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)

An assessment in accordance with the DotE principal significant impact guidelines (DotE (2013)) is provided below for these species.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity
- populations that are near the limit of the species range.

Approximately 150 heath wrinklewort (*Rutidosia heterogama*) and 58 small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) were recorded in the LWB1-B3B3 Modification Area. Although these are likely to comprise viable local populations, based upon the above definitions, would not comprise *important populations*. These species are known to occur in substantial numbers throughout the Quorrobolong area, particularly within the nearby Werakata SCA. Based on the above definition, it is not considered that the LWB1-B3B3 Modification Area supports an important population of heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*).

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an *important population* of a species; or**

The LWB1-B3 Modification Area supports known habitat for heath wrinklewort (*Rutidosia heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), however it does not support an important population of either of these species. The proposed modification involves underground mining and as such there will be only minor surface impacts. Based on subsidence modelling and predictions, there will be no alteration to potential habitats of the heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). As such, there is no potential for the proposed modification to lead to a long-term decrease in the size of an important population of these species.

- **reduce the area of occupancy of an *important population*; or**

As described above, the proposed modification will not involve any activities that would alter the known or potential habitats of the heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). As such, there is no potential for the proposed modification to lead to a reduction in the area of occupancy of a population of these species.

- **fragment an existing important population into two or more populations; or**

Given that any surface disturbances associated with the proposed modification would only be minor; there is no potential for known or potential populations of heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the LWB1-B3 Modification Area to become fragmented or isolated.

- **adversely affect habitat critical to the survival of a species; or**

The LWB1-B3 Modification Area does not contain any habitats that are critical to the survival of heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). Regardless, there will not be any modifications to the habitats of these species as a result of the proposed modification.

- **disrupt the breeding cycle of an important population; or**

The proposed modification does not comprise any actions that would disrupt the breeding cycle of heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*).

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The LWB1-B3 Modification Area supports known habitat for heath wrinklewort (*Rutidosia heterogama*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), however it does not support an important population of either of these species. The proposed modification involves underground mining and as such there will be only minor surface impacts. Based on subsidence modelling and predictions, there will be no alteration to known or potential habitats of the heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). As such, there is no potential for the proposed modification to modify, destroy, remove, isolate or decrease the availability or quality of habitat for these species to the extent that they would be likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or**

Given that the proposed modification is underground and will have minimal surface impacts, it is not expected to result in the establishment of invasive species that are harmful to these species.

- **interfere substantially with the recovery of the species.**

The proposed modification will not lead to the loss, alteration or fragmentation of potential habitats for heath wrinklewort (*Rutidosia heterogama*) or small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). As such, the proposed modification will not interfere with the recovery of these species.

Vulnerable Fauna Species

An assessment in accordance with the DoE principal significant impact guidelines (DoE 2013) is provided below for the koala (*Phascolarctos cinereus*), large-eared pied bat (*Chalinolobus dwyeri*) and grey-headed flying-fox (*Pteropus poliocephalus*).

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity
- populations that are near the limit of the species range.

Koala (*Phascolarctos cinereus*)

There is one NSW Atlas of NSW Wildlife record of the koala (*Phascolarctos cinereus*) from within the LWB1-B3 Modification Area, from 2006 that has an accuracy of 1000m (BioNet 2015). Based on the habitats provided by the LWB1-B3 Modification Area it is considered that this record (if accurate), comprised a single individual passing through the LWB1-B3 Modification Area to a more appropriate area of habitat. No evidence of koalas (sightings, scats, scratchings) were observed during surveys undertaken by Umwelt for this assessment. Potential food resources were identified for this species, however these were typically only in low densities and in small areas within a highly fragmented landscape.

The Assessment of Significance for the koala has been prepared with consideration of the EPBC Act Referral Guidelines for the Vulnerable Koala (DoE 2014).

The Referral Guidelines advise that the assessment of significant impacts on the koala is undertaken primarily through the assessment of habitat critical to the survival of the koala and actions that interfere substantially with the recovery of the koala. This approach aims to avoid and address habitat loss as well as promote a streamlined assessment and approval process.

In accordance with the Referral Guidelines, the habitat assessment tool was applied to determine the extent of vegetation that contains at least one known koala food tree within the Hunter-Central Rivers CMA. Koala feed trees for the Hunter-Central Rivers CMA (OEH 2014) that occur in the LWB1-B3 Modification Area include:

Primary Food Tree Species:

- Cabbage gum (*Eucalyptus amplifolia*).

Secondary Food Tree Species:

- Grey box (*Eucalyptus moluccana*)

These species predominantly occur in the Modified Spotted-Gum Ironbark Forest or the Riparian Cabbage Gum Open Forest. Together these areas comprise 36.9 ha of habitat. Although at least one primary food tree species and at least one secondary food tree species were present in the LWB1-B3

Modification Area, these were typically only in low densities and in small areas within a highly fragmented landscape.

Table 1 below applies the Koala Habitat Assessment Tool as outlined in Table 3 of the Referral Guidelines.

Table 1 Assessment of Koala Habitats

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			LWB1-B3 Modification Area Assessment	
Attribute	Score	Inland	Allocated Score	Score Justification
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	+1	Atlas of NSW Wildlife point buffer search identified 1 koala records within the LWB1-B3 Modification Area from 9 years ago. No evidence of the koala was recorded during the Umwelt surveys (call playback, SATT assessment, searches for signs of presence and spotlighting) of the LWB1-B3 Modification Area in 2015.
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.		
	0 (low)	None of the above.		
Vegetation composition	+2 (high)	Has forest or woodland or shrubland with emerging trees with 2 or more known koala food tree species in the canopy. OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	+2	This Referral Area contains known koala feed trees for the Hunter-Central Rivers region including cabbage gum (<i>Eucalyptus amplifolia</i>) and grey box (<i>Eucalyptus moluccana</i>).
	+1 (medium)	Has forest or woodland or shrubland with only 1 species of known koala food tree present in the canopy.		
	0 (low)	None of the above.		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape \geq 1000 hectares.	0	The LWB1-B3 Modification Area is within a degraded agricultural landscape with poor connectivity to proximate habitats. Potential habitat within the LWB1-B3 Modification Area comprises riparian vegetation associated with an unnamed tributary.
	+1 (medium)	Area is part of a contiguous landscape < 1000 hectares, but \geq 500 hectares.		
	0 (low)	None of the above.		

**Koala Habitat Assessment Tool
(Table 3 from DoE 2014)**

LWB1-B3 Modification Area Assessment

Attribute	Score	Inland	Allocated Score	Score Justification
Key existing threats	+2 (low)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence.	1	<p>One BioNet Wildlife Atlas record notes two koala road mortalities since 2002 within 10km of the LWB1-B3 Modification Area</p> <p>It is expected that any local koala populations are substantially affected by the agricultural land uses in the locality that would likely expose any local koala population to dog attack.</p>
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR areas which score 0 for koala occurrence are likely to have some degree of dog or vehicle threat present.		
	0 (high)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.		
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	0	<p>Table 1 of the Draft Referral Guidelines (DoE 2014) prescribes, that for coastal areas, the interim recovery objective(s) are to: <i>“Protect and conserve large, connected areas of koala habitat, particularly large, connected areas that support koalas that are:-of sufficient size to be genetically robust/operate as a viable sub-population OR free of disease or have a low incidence of disease OR breeding and to maintain corridors and connective habitat that allow movement of koalas between large areas of habitat.”</i></p> <p>No clearing of this degraded potential koala habitat is proposed. Subsequently the proposed modification will not cause fragmentation of retained habitats and is not likely to influence the interim recovery objectives.</p>
	+1 (medium)	Uncertainty exists as to whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.		

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			LWB1-B3 Modification Area Assessment	
Attribute	Score	Inland	Allocated Score	Score Justification
				Preferred/primary koala habitat will not be directly impacted by the Project.
TOTAL SCORE			4	≥ 5 indicates habitat critical for the survival of the koala.

As the habitats identified in the LWB1-B3 Modification Area scored less than five using the Referral Guidelines habitat assessment tool, the LWB1-B3 Modification Area is not considered to contain habitat critical to the survival of the koala (DoE 2014).

As the Referral Guidelines indicates that the LWB1-B3 Modification Area does not contain habitat critical to the survival of the koala, the impacts of the proposed modification are not expected to result in substantial interference to the recovery of the koala. Further consideration of the impacts of the Proposed Action is detailed in the Assessment of Significance below.

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity
- populations that are near the limit of the species range.

The koala is known to occur in eucalypt woodlands and forests from north-eastern Queensland, along the eastern coast of NSW, to the south-east corner of South Australia. The vulnerable listing for the koala extends from north-eastern Queensland to the Victoria border. In the Central-Hunter Rivers Catchment of NSW, the koala population is predominantly centred in the Port Stephens LGA, with scattered records located elsewhere throughout the catchment. One single unconfirmed record of this species has not been recorded in the LWB1-B3 Modification Area; however the species has been recorded elsewhere in the locality. This one record from 2006 was recorded by way of community wildlife surveys and its accuracy was very low (i.e. 1000 metres). No evidence of the koala (sightings, scats, scratchings) were recorded in the LWB1-B3 Modification Area during the surveys undertaken for this assessment.

Atlas records indicate approximately 80 known records within 10 kilometres of the LWB1-B3 Modification Area, primarily in areas that provide higher habitat value (due to higher levels of connectivity, less fragmentation and greater diversity of feed tree species) than that of the LWB1-B3 Modification Area. The known records around the LWB1-B3 Modification Area are unlikely to be key source populations for breeding or dispersal, necessary for maintaining genetic diversity or at the limit of the known range of the species. It is unlikely that any potential population occurring in the LWB1-B3 Modification Area constitutes part of an important population that occurs in the Hunter-Central Rivers CMA.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

The Proposed Action will not result in the loss of any of the moderate quality habitat available to this species. Evidence of their previous or current occupation, such as scratches and scats, were not recorded in the LWB1-B3 Modification Area. It is considered that the LWB1-B3 Modification Area contains some marginal habitat for the species, however it is not known to be utilised by the individuals that may occur in the locality. The proposed modification is not expected to lead to a long-term decrease in the size of an important population of the species.

- **reduce the area of occupancy of an important population, or;**

The Proposed Action will not result in the loss of any of the moderate quality habitat available to this species. Evidence of their previous or current occupation, such as scratches and scats, were not recorded in the LWB1-B3 Modification Area. It is considered that the LWB1-B3 Modification Area contains some marginal habitat for the species, however it is not known to be utilised by the individuals that may occur in the locality. The proposed modification is not expected to reduce the area of occupancy of an important population of the species.

- **fragment an existing important population into two or more populations, or;**

The proposed modification will not result in the loss of any of the moderate quality habitat available to this species. Evidence of their previous or current occupation, such as scratches and scats, were not recorded in the LWB1-B3 Modification Area. It is considered that the LWB1-B3 Modification Area contains some marginal habitat for the species, however it is not known to be utilised by the individuals that may occur in the locality.

The proposed modification will not fragment any areas of potential or known habitat for this species.

- **adversely affect habitat critical to the survival of a species, or;**

The proposed modification will not result in the loss of any of the moderate quality potential habitat for the koala present. The habitat available is not considered to be critical to the survival of the species in accordance with the Koala Habitat Assessment Tool outlined in the Koala Draft Referral Guidelines (DoE 2014) (refer to **Table 1** above). The proposed modification will not affect habitat critical to the survival of the species.

- **disrupt the breeding cycle of an important population, or;**

No koalas or evidence of koalas were been recorded in the LWB1-B3 Modification Area during targeted surveys and therefore there is no evidence of breeding or territorial behaviour to indicate the LWB1-B3 Modification Area is important for the breeding cycle of an important population of the koala. It is likely that surrounding records are dispersing individuals from other quality habitats in the wider locality including within Werakata SCA. The proposed modification will not alter habitat available for this species and is subsequently unlikely to disrupt the breeding cycle of an important population of the species.

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- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

The proposed modification will not modify or destroy any of the potential koala habitat in the LWB1-B3 Modification Area. The koala (if present) would be expected to occur in low densities and subsequently the proposed modification is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

No invasive species are likely to become established as a result of the proposed modification that may impact upon any habitat relevant to the koala.

- **introduce disease that may cause the species to decline; or**

The koala is known to contract strains of *Chlamydia* and the koala retrovirus. Chlamydia infections are known to cause reduced female fertility and are expected to reduce the reproductive potential of koala populations. There is potential that at least some of the Hunter-Central Rivers population is infected with Chlamydia. The koala retrovirus can cause a range of conditions including leukaemia and immunodeficiency syndrome. It is estimated that up to 100 per cent of koala populations in Queensland and New South Wales have the koala retrovirus (TSSC 2012).

The proposed modification does not involve any processes that are likely to introduce a disease on site for the koala or that may cause this species to decline.

- **interfere substantially with the recovery of the species.**

The Approved Recovery Plan for the Koala (DECC 2008) contains specific recovery objectives and performance criteria including maintaining existing populations, improving the extent and quality of priority habitat areas, increasing numbers of breeding females, increasing the health of individuals in the wild, expanding the distribution of the species and increasing community reports of sightings.

The proposed modification will not result in the loss of any of the moderate quality habitat provided by the LWB1-B3 Modification Area, which is not an area known to contain a population of the species. No significant effect on the recovery of the koala is expected to occur as a result of the proposed modification.

Conclusion

The proposed modification is unlikely to result in a significant impact on an important population of koala as the proposed modification will not impact habitat critical to the survival for the species as described in the Referral Guidelines (DoE 2014) or as presented in the assessment of significance under the EPBC Act.

Grey-headed Flying-Fox and Large-eared Pied Bat

The grey-headed flying-fox (*Pteropus poliocephalus*) has potential to occur in the LWB1-B3 Modification Area, and this species potentially forages in riparian habitats. No roost sites for this species occur in the LWB1-B3 Modification Area. Based on the definition described above, the LWB1-B3 Modification Area does not support an important population of this species. It is expected

that individuals of this highly mobile species would utilise the resources of the LWB1-B3 Modification Area as part of a wider foraging range, and no populations would rely exclusively on the resources identified in the LWB1 LWB2 Modification Area.

The large-eared pied bat (*Chalinolobus dwyeri*) was recorded using an Anabat Echolocation Detector in the western habitats of the LWB1-B3 Modification Area. No roosting sites for this species occur, however there are appropriate foraging habitats available. This species is likely to be utilising the habitats present in the LWB1-B3 Modification Area as part of a much larger area of habitat. It is subsequently not considered that the LWB1-B3 Modification Area supports an important population of this species.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an *important population* of a species; or**

The LWB1-B3 Modification Area provides potential foraging habitat for the grey-headed flying-fox (*Pteropus poliocephalus*) and known foraging habitat for the large-eared pied bat (*Chalinolobus dwyeri*), however it does not support an important population of these species under the above definition.

The proposed modification involves underground mining and subsidence predictions indicate that there will be minor surface impacts. Any potential loss of foraging resources for the grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*) is expected to be very minor and would not have potential to lead to a decrease in the size of a population of these species.

- **reduce the area of occupancy of an *important population*; or**

The proposed modification will not disturb or modify any areas of habitat for the grey-headed flying fox (*Pteropus poliocephalus*) or the large-eared pied bat (*Chalinolobus dwyeri*). The LWB1-B3 Modification Area does not comprise an important population for these species.

The proposed modification involves underground mining and subsidence predictions indicate that there will be minor surface impacts. Any potential loss of foraging resources for the grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*) is expected to be very minor and would not have potential to lead to a reduction in the area of occupancy of these species.

- **fragment an existing important population into two or more populations; or**

Given that surface disturbances associated with the proposed modification are expected to be minor, there is no potential for any potentially existing population of grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*) to become fragmented or isolated.

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- **adversely affect habitat critical to the survival of a species; or**

The LWB1-B3 Modification Area does not contain any habitats that are critical to the survival of the grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*). The nearby (within 5 km) Werakata State Conservation Area protects a very large area of higher quality habitats compared to those present within the LWB1-B3 Modification Area and the species are known to occur there.

- **disrupt the breeding cycle of an important population; or**

The LWB1-B3 Modification Area does not support any important population for the grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*). Breeding camps/roosting habitat of the grey-headed flying-fox (*Pteropus poliocephalus*) and large-eared pied bat (*Chalinolobus dwyeri*) respectively were not recorded during surveys and the proposed modification is not expected to result in any actions that would disrupt the breeding cycle of the grey-headed flying-fox (*Pteropus poliocephalus*) or the large-eared pied bat (*Chalinolobus dwyeri*).

- **modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or**

The LWB1-B3 Modification Area provides potential foraging habitat for the grey-headed flying-fox (*Pteropus poliocephalus*) and the large-eared pied bat (*Chalinolobus dwyeri*), however it does not support an important population of these species under the above definition.

The proposed modification involves underground mining and subsidence predictions indicate that there will be minor surface impacts. There is no potential for the proposed modification to modify, destroy, remove, isolate, or decrease the availability or quantity of habitat for the grey-headed flying-fox (*Pteropus poliocephalus*) or large-eared pied bat (*Chalinolobus dwyeri*) to the extent that the species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or**

Given that the proposed modification comprises underground mining and is predicted to have minimal surface impacts, it is not expected to result in the establishment of invasive species that are harmful to these vulnerable species.

- **interfere substantially with the recovery of the species.**

The potential foraging habitats for the grey-headed flying-fox (*Pteropus poliocephalus*) and known foraging habitats for the large-eared pied bat (*Chalinolobus dwyeri*) identified within the LWB1-B3 Modification Area are highly modified and not as high quality as those protected in nearby Werakata State Conservation Area. Due to the very minor surface impacts predicted, the proposed modification will not interfere substantially with the recovery of the grey-headed flying-fox (*Pteropus poliocephalus*) or the large-eared pied bat (*Chalinolobus dwyeri*).

Migratory Species

One migratory species, the cattle egret (*Ardea ibis*), has been considered in this assessment.

An assessment in accordance with the DotE principal significant impact guidelines (DotE 2013) is provided below for these species.

An area of *important habitat* is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat utilised by a migratory species which is at the limit of the species range
- habitat within an area where the species is declining.

Only a single cattle egret (*Ardea ibis*) was recorded in the LWB1-B3 Modification Area. The LWB1-B3 Modification Area is not regarded to be *important habitat* for the cattle egret (*Ardea ibis*) based on the above definition.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;**

The proposed modification will not result in the loss of vegetation due to direct clearing or as a result of secondary impacts relating to subsidence. The subsidence predictions indicate that any modifications to surface habitats would be minor. There is no potential for the proposed modification to result in a substantial modification, destruction or isolation of habitats for this migratory species.

- **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or**

Given that the proposed modification relates to underground mining that is predicted to have minimal surface impacts, it is not expected to result in the establishment of invasive species that are harmful to this migratory species.

- **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

The nature of the proposed modification is such that there will be very minor disturbances to surface vegetation and habitats within the LWB1-B3 Modification Area. As such, there is no potential that the lifecycle of this migratory species could be seriously disrupted. There is no potential that an ecologically significant proportion of the population of this migratory species could be affected by the proposed modification.

Conclusion

The proposed modification will not result in a significant impact on any EPBC Act listed threatened species or migratory species.



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