



**AUSTRALIAN
ZIRCONIA LTD**

(A wholly owned subsidiary of Alkane Resources Ltd)

Dubbo Zirconia Project

Terrestrial Ecology Assessment

Prepared by

**OzArk Environmental and Heritage
Management**

August 2013

**Specialist Consultant Studies Compendium
Volume 2, Part 6**

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Terrestrial Ecology Assessment

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FOREWORD

It is noted that following the completion of field survey for the Dubbo Zirconia Project (DZP), the DZP Site boundary was modified to account for a larger mining lease application area. OzArk can confirm that the additional area of the modified DZP Site boundary (357ha) does not include any disturbance and that field survey includes all areas where disturbance is proposed.

The alignment of the Macquarie River Water Pipeline was also modified slightly following the completion of field survey to accommodate a possible future centre pivot for irrigation on the "Mia Mia" property. OzArk can confirm that the realignment would not require any disturbance to remnant native vegetation.

Appendix 18 provides figures comparing the modified DZP Site boundary and Macquarie River Water Pipeline alignment against the boundary and alignment provide at the time of field survey.

As the modification to the DZP Site boundary and Macquarie River Water Pipeline followed the completion of field survey, **Figures 7, 8, 10, 13, 14, 15, 16, 17, 18, 19, 22, 23** and **24** retain the DZP Site boundary as nominated at the time of field survey. OzArk confirm, however, that the assessment and conclusions of this report incorporate the DZP Site Boundary and Macquarie River Water Pipeline as presented on **Figures 2** and **4**.

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EXECUTIVE SUMMARY

Australian Zirconia Ltd (AZL, the Applicant) seeks development consent under Division 4.1 in Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop and operate the Dubbo Zirconia Project (the DZP or the Proposal) near the village of Toongi, approximately 25 kilometres south of Dubbo in the NSW Dubbo Local Government Area (**Figure 1**).

This Terrestrial Ecology Assessment supports an Environmental Impact Statement prepared by R.W Corkery to support the application of AZL for the development and operation of the Dubbo Zirconia Project.

The Proposal would comprise a small scale open cut mine supplying approximately 1Mt of ore containing rare metals (zirconium and niobium) and rare earth elements (REE's) to a processing plant annually. The Proposal also incorporates the following four component areas which are collectively referred to as 'The Application Area':

- The DZP Site.
- Toongi-Dubbo Rail Line and Gas Pipeline Corridor.
- Macquarie River Water Pipeline.
- Public road network (Toongi Road and Obley Road).

The term 'DZP Site assessed area' reflects a very recent change to the DZP Site and Macquarie River Water Pipeline. The DZP Site assessed area includes an area of 2,507 hectares and reflects the DZP Site boundary prior to an enlargement by the Applicant to account for a larger mining lease application area. The DZP Site has been enlarged by an additional 357 hectares (refer to **Figures 1** and **2**), however, it is noted that the DZP Site assessed area includes all areas of proposed disturbance. The alignment of the Macquarie River Water Pipeline has also been modified slightly following the completion of field survey, however, it is noted that the realigned section occurs entirely on previously cleared paddocks (see **Figure 4**). **Appendix 18** shows the relationship between the DZP Site assessed area and the DZP Site.

The terrestrial ecological assessment followed government survey guidelines and methods, including the:

- *OEH Threatened species survey and assessment: Guidelines for developments and activities. Working Draft, November DEC 2004.*
- *OEH Field Survey Methods, DECCW 2009.*
- *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DSEWPaC 1999a).*
- *Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DSEWPaC 1999b).*
- *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals as threatened under the EPBC Act (DSEWPaC 1999c).*
- *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under EPBC Act (DSEWPaC 1999d).*

The net impact of the Proposal on biodiversity values was also considered. A *Biodiversity Offset Strategy* was developed to ensure the biodiversity values of the Application Area are maintained, improved or adequately mitigated. Biodiversity offset development and assessment followed:

- *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012 (DSEWPac, 2012).*
- *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects Approved by the Chief Executive Officer 25 June 2011 (OEH, 2011).*
- *BioBanking Methodology and Credit Calculator Operation Manual (2008).*
- *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012.*

Qualified OzArk ecologists (Phil Cameron and Heidi Kolkert) reviewed previous assessments of the Application Area completed in 2002 and undertook, ground-truthed and / or repeated additional assessment as required to ensure all information in this report is current and data used (excepting Wildlife Atlas records) was no less than six years old.

Ecological work was completed under BioBanking Assessors accreditation numbers 0117 (Cameron) and 0127 (Kolkert), OEH Sci Licence SL101087, DPI Ethics 11/5475. Specialist sub-consultants (Dr Arthur White of Biosphere Environmental Consultants P/L {herpetology} and Dr Gilbert Whyte of Klienfelder Ecobiological {Entomology and soils}) were engaged to assist with management of a local population of Pink-tailed Worm Lizard, a species listed as vulnerable in NSW and nationally. Representatives of the Dubbo Field Naturalists assisted in fieldwork and have an ongoing invitation to participate in future assessments.

Vegetation Recorded

Six *Biometric* vegetation types and three areas that do not meet Biometric vegetation descriptions were mapped within the assessed areas of the DZP Site and on adjacent lands (**Figure 17**):

- CW212 White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270).
- CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267), further categorised as either:
 - CW213 (quality remnants).
 - Derived Grasslands (>50% weeds, rotationally cropped).
- CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201).
- CW143 Heathy shrublands on rocky outcrops of the western slopes.
- CW121 Bullock - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54).
- CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277).

- Cleared / Grazed Crop (remainder).
- White Cypress Pine monoculture.
- Buildings and Infrastructure.

The Dubbo-Molong Rail Line between Dubbo and Toongi was decommissioned in 1987. The rail corridor been heavily invaded by introduced plant species. A Biometric community could not be used to describe this area as it is 'disturbed'.

The Macquarie River Water Pipeline easement is used for cropping agriculture. A Biometric community could not be used to describe this area as it is 'disturbed'.

Nine portions of the Obley Road were identified as requiring realignment. Vegetation within the Obley Road reserve generally contains White Box, Yellow Box, Fuzzy Box Woodland or Inland Grey Box Communities that form part of the State and/or national listed ecological communities.

Endangered Ecological Communities or Populations Recorded

The following TSC Act EECs would be impacted in the DZP Site assessed area (**Figure 18**):

- 47.7 hectares of White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland). The EEC is only represented by CW213 (quality remnants) and excludes any CW213 area mapped as Derived Grasslands (>50% weeds, rotationally cropped).
- 0.1 hectares of CW138 Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions.

The following state listed EECs (TSC Act) would undergo residual effects in the Obley Road Realignment impact footprint:

- 0.1 hectares of CW145 Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.

No threatened flora species, populations or EECs would be disturbed within the proposed Macquarie River Water Pipeline Corridor and Toongi-Dubbo Rail Line and Gas Pipeline Corridor.

Two Threatened Ecological Communities (TECs) listed in the schedules of the EPBC Act were recorded within the assessed areas of the DZP Site (**Figure 18**):

1. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Community.

Within the DZP Site assessed area there are 127.1 hectares of this Critically Endangered Ecological Community (CEEC) that is consistent with the EPBC Act Criteria. The current layout of the proposed activities does not require disturbance to this CEEC. 61.8 hectares of this community is on Applicant owned land and is proposed for inclusion in the Biodiversity Offset Area (BOA).

2. Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia.

Within the DZP Site assessed area there is 1.9 hectares of this EEC consistent with the EPBC Act Criteria. This EEC is located on the 'Grandale' property and would be avoided by the proposed activities (**Section 7**).

Flora Species Recorded

244 plant species were recorded by (GCNRC 2002a and 2002b) surveys within the DZP Site¹ of which 67 (27%) were introduced species. 234 species of vascular flora were recorded during the current assessment. These were conducted as a series of BioBanking plots (in accordance with the BBAM) over the DZP Site. 67 (28%) of all flora recorded were introduced species.

Flora survey was conducted along the decommissioned Toongi-Dubbo Rail Line in November, 2001 (GCNRC 2002b) with additional survey for threatened species and regrowth completed during the current assessment. During the GCNRC (2002b) survey 260 plant species recorded within the corridor including 115 (44%) introduced species. These introduced species account for the majority of the ground covers and biomass.

Flora survey was conducted along the Macquarie River Water Pipeline in May 2002² (GCNRC 2002b) with additional survey of access points completed during the current assessment. The abundance of weeds reflects the clearing, grazing and cultivation which has occurred along the route over the past 150 (plus) years. 94 plant species were recorded within the corridor including 49 (52%) introduced species.

No new or previously unrecorded species were along the Toongi-Dubbo Rail Line or Macquarie River Water Pipeline routes as a result of the current assessment.

Threatened Flora

No threatened species were recorded within DZP Site Component Disturbance Areas. *Philothea ericifolia* (V EPBC Act) was recorded on Dowds Hill in 2001 (GCNRC 2002a). This area is not within, or near an impact footprint. The area is within the proposed Biodiversity Offset Area. A previous record of *Philothea ericifolia* within the DZP Site (one kilometre south of Toongi Siding) was collected in 1964. This is now a cropped paddock and the plant was not relocated in GCNRC (2002a and 2002b) or during the current assessment.

A targeted orchid search in October 2012 did not reveal the presence of *Diuris tricolor* (TSC Act) or *Pterostylis cobarensis* (TSC and EPBC Acts) within the DZP Site assessed area.

The Macquarie River Water Pipeline easement is heavily cleared and ploughed. Potential for extant threatened species is highly unlikely.

Fauna Species Recorded

180 vertebrate fauna species were identified during Goldney (2002) survey of the DZP Site assessed areas.

185 species of vertebrate fauna representing 4 Classes and 69 Families were recorded in the DZP Site assessed areas, as a result of the current survey (**Appendix 5**):

- 117 species of bird, including 12 threatened species (ten listed under the TSC Act, one listed under the EPBC Act and one listed under both the TSC and EPBC Acts).

¹ It should be noted that the boundary of the GCNRC field survey differs from the DZP Site assessed areas.

² There has been some modification to the alignment of the Macquarie River Water Pipeline since November, 2001, however, the vegetation communities traversed remain equivalent.

- 36 species of mammal including six threatened microchiropterans (three listed under the TSC Act and three under both the TSC and EPBC Acts) and five introduced species.
- 23 species of reptile including one species, Pink-tailed Worm-Lizard (*Aprasia parapulchella*) which is listed under both the TSC and EPBC Acts.
- Nine species of amphibian.

No targeted fauna species were trapped during surveys. No hair samples were noted in the hair funnels.

The following TSC and EPBC Act threatened species were recorded by OzArk during the 2012 surveys (**Appendix 5, Figure 16**).

EPBC Protected Matters

- Great Egret (*Ardea alba*), EPBC Act.
- Superb Parrot (*Polytelis swainsonii*), TSC and EPBC Acts.
- Pink-tailed Worm-lizard (*Aprasia parapulchella*), TSC and EPBC Acts.
- Large-eared Pied Bat (*Chalinolobus dwyeri*), TSC and EPBC Acts.
- Greater Long-eared Bat (*Nyctophilus timoriensis / corbeni*), TSC and EPBC Acts.

TSC listed items

- Superb Parrot (*Polytelis swainsonii*), TSC and EPBC Acts.
- Pink-tailed Worm-lizard (*Aprasia parapulchella*), TSC and EPBC Acts.
- Large-eared Pied Bat (*Chalinolobus dwyeri*), TSC and EPBC Acts.
- Greater Long-eared Bat (*Nyctophilus timoriensis / corbeni*), TSC and EPBC Acts.
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), TSC Act.
- Little Eagle (*Hieraaetus morphnoides*), TSC Act.
- Flame Robin (*Petroica phoenicea*), TSC Act.
- Eastern Bentwing Bat (*Miniopterus schreibersii orianae oceanensis*) TSC Act.
- Barking Owl (*Ninox connivens*), TSC Act.
- Brown Tree-creeper (*Climacteris picumnus*), TSC Act.
- Diamond Firetail (*Stagonopleura guttata*), TSC Act.
- Glossy Black Cockatoo (*Calyptorhynchus lathamii*), TSC Act.
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), TSC Act.
- Hooded Robin (*Melanodryas cucullata*), TSC Act.
- Little Pied Bat (*Chalinolobus picatus*), TSC Act.
- Speckled Warbler (*Pyrrholaemus saggitatus*), TSC Act.
- Yellow-bellied Sheath-tail bat (*Saccolaimus flaviventris*), TSC Act.

Additional records for threatened and listed species, populations and communities that do not appear on the database searches - NSW Wildlife Atlas or Atlas of Living Australia (recorded by Goldney [2002]) in the Application Area include:

EPBC protected matters

- Swift Parrot (*Lathamus discolor*), TSC and EPBC Acts.
- Koala (*Phascolarctos cinereus*), TSC and EPBC Acts.

TSC listed items

- Swift Parrot (*Lathamus discolor*), TSC and EPBC Acts.
- Koala (*Phascolarctos cinereus*), TSC and EPBC Acts.
- Spotted Harrier (*Circus assimilis*), TSC Act.
- Square-tailed Kite (*Lophoictinia isura*), TSC Act.

An additional six threatened fauna species have been recorded nearby and are considered likely to occur at some stage in the Application Area:

EPBC protected matters

- Rainbow Bee-eater (*Merops ornatus*), EPBC Act.

TSC listed items

- Black-chinned Honeyeater (*Melithreptus gularis gularis*), TSC Act.
- Masked Owl (*Tyto novaehollandiae*), TSC Act.
- Grey Falcon (*Falco hypoleucos*), TSC Act.
- Painted Honeyeater (*Grantiella picta*), TSC Act.
- Varied Sittella (*Daphoenositta chrysoptera*), TSC Act.

Impacts to Vegetation Communities

DZP Site

Up to 807.5 hectares would be directly disturbed by the various activities and operations of the DZP Site assessed area (**Table 9**).

A significant proportion of this disturbance is located on agricultural land mapped as Derived Grassland and Cleared Land. Proposed disturbances will impact:

- Derived Grassland (>50% weeds, rotationally cropped), 414 hectares.
- Cleared Land, 313 hectares.
- 43.7 hectares of CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267), {CW213 quality remnant}.
- 27.1 hectares of CW212 White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270).
- 9.6 hectares of White Cypress Pine monoculture.
- 0.1 hectares of CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201).

An area of 129 hectares has been allocated to soil stockpiles. The actual area required is likely to be significantly less than this (between 50 and 100 hectares). Progressive clearing and progressive rehabilitation within the DZP Site assessed area would mean that only a proportion of the total vegetation would be removed at any one time. The area of woodland vegetation within the DZP Site would be maintained and “Grassy Woodlands”. Its area of occupancy will be increased in the long term as a result of the rehabilitation program and the implementation of the *Biodiversity Offset Strategy* (**Section 8.2**).

Macquarie River Water Pipeline

No trees would be impacted by the installation of the water pipeline. The alignment is outside the drip line of older mature trees.

The water intake area is approximately 50 x 50 metres and is located in an area that is devoid of native vegetation.

Obley Road

The realignment of nine portions of Obley Road would impact 1.08 hectares of CW145 *Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions* (Benson 76).

Toongi-Dubbo Rail Line

White Box (*Eucalyptus albens*) and Fuzzy Box (*E. conica*) trees have regenerated within the Toongi-Dubbo Rail Line Corridor since 1987. Due to the high degree of invasion by introduced species and the spacing and numbers of trees there are no sections of the corridor that could be classed as meeting the description of a Biometric community (**Table 9**).

Summary of Impacts to Listed Flora and Fauna Species

Pink-tailed Worm-Lizards (*Aprasia parapulchella* EPBC Act and TSC Act) is the only listed species directly impacted by the Proposal. Targeted field assessments (between March 2012 and March 2013) have mapped the current known extent of the local population (the “Toongi population”).

By March 2013, Pink-tailed Worm-Lizards were found in 30 sites in or within five kilometres of the DZP Site. This is the largest known population in NSW. None of the populations known area of extent is within an area currently managed for conservation.

Pink-tailed Worm-Lizards have been found within the DZP Site assessed areas on or near Hills 1, 2, 3, 4 and 6 (**Figure 20**). The landscape context of these areas comprises a weathered trachyte outcrop. Most lizards were found in areas around the base of the outcrops where exfoliated slabs of trachytes lie loosely scattered across open woodland or grassland (**Appendix 13, Figure 7**). Additional surveys are planned for the future so that all of the trachyte-dominated landscapes within a 15 kilometre radius can be assessed (pending access).

The potential impact of the DZP on this species was referred to DSEWPaC. It was determined as a Controlled Action (EPBC Ref: 2012/6625).

The action will result in disturbance to one sub-population which occurs over the trachyte ore body to be mined (on Hill 1). Implementation of a *Biodiversity Offset Strategy* offers the opportunity to conserve and enhance the wider Toongi population. Without active management of feral animals, particularly pigs (invaded Dowds Hill in 2011), the Toongi population remains

at risk of decline. Without implementation of a Biodiversity Offset Area the largest known population in NSW will remain unmanaged and will be at risk of unassisted decline.

Dr Arthur White, a noted herpetological expert has written a *Pink-tailed Worm-lizard Plan of Management* (**Appendix 13**). Other team members and contributors were Dr Gilbert Whyte (Entomologist) and Mr Phillip Cameron (principal ecologist based in Dubbo NSW). The Plan of Management is a 'living document'. As work is still in progress the document is updated after each field work session. Pink-tailed Worm-lizard habitat has been mapped on the DZP Site and immediate surrounds. Mapping is based on habitat identification, assessment and evaluation methodology described in **Appendix 13**. A map has been provided as **Figure 10** in **Appendix 13**. The map shows:

- 107.8 hectares of high quality habitat.
- 179.2 hectares of medium quality habitat.
- 367.3 hectares of low quality habitat.

The DZP Component Disturbance Areas include.

- 25.5 hectares of high quality Pink-tailed Worm-lizard habitat .
- 9.8 hectares of medium quality Pink-tailed Worm-lizard habitat.

The Biodiversity Offset Area would protect in perpetuity and manage for conservation:

- 82.3 hectares of high quality Pink-tailed Worm-lizard habitat (76.3% of all mapped high quality habitat / 3.2 times larger than the size of the area to be affected).
- 114.7 hectares of medium quality Pink-tailed Worm-lizard habitat (64% of all mapped medium quality habitat / 11.7 times larger than the size of the area to be affected).
- 42 hectares of low quality Pink-tailed Worm-lizard habitat (11.43% of all mapped low quality habitat). This quality category is not affected by the activity.

It is unlikely that any migratory species would have their potential to occur reduced in the Application Area due to the Proposal. It would not impede transient individuals of the more selective species from temporarily visiting the area in times of suitable environmental conditions.

Biodiversity Offset Strategy

NSW Offsetting

BioBanking Assessment Methodology (2008) has been used to transparently quantify the nature and extent of offsets required the Biodiversity Offset Area for impacts within the Application Area (the BBAM 'Development Site'). The BBAM credit calculator was used to generate a Development Site credit report and a BioBank Site (Biodiversity Offset Area) credit report.

Development and Offset Site credit matching was undertaken to determine if the Proposal meets Tier 1 (Improve or Maintain standard), Tier 2 (Negotiating a 'No Net Loss' outcome) or Tier 3 (Negotiating a 'Mitigated Net Loss' outcome) standard.

The Proposal has not met Tier 1 “Improve or Maintain” standard for two reasons.

- Red flag³ assets are to be cleared outside the rules allowed by the BBAM.
- The amount and type of offsetting secured is inconsistent with the requirements of the BBAM credit calculator.

The one vegetation community exception is CW212 "White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270)" which met Tier 1 requirements.

Species credits for the Development Site and outstanding credits for species identified in the Biobank Site species credit report have been provided on **Table 17**. Species offset matching shows all species except for three raptors met requirements.

Tier 2 Negotiating a 'No Net Loss' outcome

'No Net Loss' is attained when it is proposed to clear red flags outside the variation rules permitted by the BBAM, but all impacts are to be fully offset in accordance with the BBAM requirements.

CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201) meets the Tier 2 criterion.

The Proposal does not meet the “No Net Loss” standard for the remaining vegetation communities (see Tier 3 discussion below).

Tier 3 Negotiating a 'Mitigated Net Loss' outcome (ecosystem credits)

“Mitigated Net Loss” occurs when red flag assets are to be cleared and this clearing is considered acceptable under the requirements set out for no net loss; and the amount and type of offsetting proposed is inconsistent with the requirements of the BBAM credit calculator. In Tiers 1 and 2 ecosystem credits per hectare are used to demonstrate the value of the remnant available for offsetting⁴. In Tier 3 ecosystem credits per hectare are not used, offsetting is managed by replacing effected vegetation in hectares at a 2:1 ratio.

The following vegetation types within the DZP Site assessed areas does not satisfy the amount and type of offsetting proposed and are inconsistent with the requirements of the BBAM credit calculator (**Table 16**).

- CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267).

³ BBAM identified a Red Flag as an Endangered Ecological Community or a community with greater than 70% cleared within the affected catchment.

⁴ Tier 1 uses a dividing factor value of 9.3 while Tier 2 uses a dividing factor value of 6. The difference in the value of the dividing factor between Tier 1 and Tier 2 reflects the conservation value of the vegetation to be effected i.e. dividing 1000 credits by 9.3 (Tier 1) = 107.52 hectares, dividing 1000 credits by 6 (Tier 2) = 166.6 hectares. More hectares are required to offset EECs and vegetation types >70% cleared in the CMA (Tier 2 communities).

- CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76).

Variation of the Offset Rules (main considerations of the NSW Offsets Policy) and other considerations in the BioBanking Certification Methodology (February 2011, hereafter 'BCAM') provides a structured approach to determining how Proposals may, in lieu of meeting the 'improve or maintain standard', meet one of two alternative standards established under the interim policy.

Surplus ecosystem credits for allowable vegetation types were allocated to the CW213 deficit.

221 surplus ecosystem credits from CW138 and 374 surplus ecosystem for CW112 are 'allowable types' for transferring credits. Both communities match CW213 as all three belong to Grassy Woodlands Vegetation Formation [CW]. The remaining 3,260 unallocated ecosystem credits from CW143, CW212 and CW121 are from 'not allowable' vegetation types (Vegetation Class and Formations do not match CW213).

Transfer of allowable vegetation type surplus ecosystem credits reduced the CW213 deficit from 2240.7 by 595 to 1645.7. Further application of the 'variation of rules' was applied.

- Species ecosystem credit report shows a substantive surplus of credits. These can be used to eliminate the 1645.7 ecosystem credits debt for CW213 and will meet the Tier 3 variation rules (if the surplus species credits can be used to offset the ecosystem credit deficit).
- Areas mapped Derived Grasslands (requiring 8,010 ecosystem credits / 828 hectares required at 2:1 ratio) are >50% weedy and rotationally cropped. This community does not have the ability to improve under existing management regimes. There are 306.5 hectares of CW213 (quality remnants) in the proposed BOA of which 84.7 hectares would be required to meet existing obligations. The remaining 221.8 hectares of CW213 (quality remnant) (306.5 – 84.7) plus the 306.80 hectares of Derived Grassland (>50% weeds, rotationally cropped) is considered an adequate offset.
- This offsetting strategy requests OEH to convert outstanding ecosystem credits requirements to the value of a regional conservation priority as identified in a regional conservation plan or similar.
- The CW213 deficit can be alternatively met by the proposed management of the local population of Pink-tailed Worm-lizard (*Aprasia parapulchella* V TSC Act, EPBC Act) in the Biodiversity Offset Area. This conservation outcome is consistent with the National Recovery Plan and Threat Abatement and Recovery criterion and the NSW OEH Priority Actions and Listed Activities to assist the Pink-tailed Worm-lizard (**Section 8.4, Appendix 13**).

Tier 3 Negotiating a 'Mitigated Net Loss' outcome (species credits)

Raptors were the only species that have species credit deficits:

- Grey Falcon (*Falco hypoleucos*).
- Little Eagle (*Hieraaetus morphnoides*).
- Square-tailed Kite (*Lophoictinia isura*).

A request for variation criterion for mitigated loss 'point e' is made to waive the requirements for species credits because:

- Ecosystem credits in the most productive habitats have been achieved as Tier 1 and Tier 2.
- Creating a 1,021 hectare Biodiversity Offset Area and reinstating 'Grassy Woodlands' will attract favoured prey species. Listed raptors are more likely to benefit from proposed land management as seen on all operational and derelict mines sites in the western region where there is a high degree of habitat complexity.

Commonwealth Offsetting

Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012 (hereafter the 'EPBC Offset Policy') was followed as residual effects to Pink-tailed Worm-lizard was subject to a species specific Referral to DSEWPaC and subsequently determined as a 'Controlled Action'. The EPBC Policy was followed to address its five key aims:

1. To ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
2. To provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
3. To deliver improved environmental outcomes by consistently applying the policy;
4. To outline the appropriate nature and scale of offsets and how they are determined; and
5. To provide guidance on acceptable delivery mechanisms for offsets.

The EPBC publication "*How to use the Offsets Assessment Guide*" was used to populate the Offsets Assessment Guide Credit Calculator (October 2012).

The 1,021 hectare Biodiversity Offset Area would protect and manage in perpetuity for conservation:

- 82.3 hectares of high quality habitat (76.3% of all mapped high quality habitat).
- 114.7 hectares of medium quality habitat (64% of all mapped medium quality habitat).
- 42 hectares of low quality habitat (11.43% of all mapped low quality habitat).

The Offsets Assessment Guide credit calculator (October 2012, Appendix 9) was used to determine that:

- The quantum of the impact was 31.77 hectares.
- The net present value of the offset is 50.39 hectares.
- The percentage of the impact offset is 158.6%.
- The direct offsets are adequate.

Mitigation

Recognising the relatively large impact footprint of the Proposal, the Applicant has followed the principles of 'avoid, minimise, mitigate' to reduce the impact of the Proposal on local biodiversity values. The remaining impacts are 'residual effects' reflecting a design where a balance has been obtained to achieve mining, environmental and agricultural outcomes.

These measures would be formalised within a Landscape and Rehabilitation Management Plan to be prepared following the granting of development consent. This plan would outline and describe all measures to minimise the potential impacts on terrestrial biodiversity and should incorporate the *Biodiversity Offset Strategy* and *Pink-tailed Worm-lizard Plan of Management*. It should include adaptive management measures, including monitoring (**Appendix 13**), to manage, protect and enhance vegetation and fauna habitat within the DZP Site Boundary and its surrounds. A Integrated Land Management Plan (ILMP) would also form a key component of this plan which would identify final land use objectives for the DZP Site and detail the progressive rehabilitation methods according to the rehabilitation strategy.

Conclusion

Environmental assessments undertaken since 2001 have fine-tuned the locations of proposed impacts to minimise, to the fullest extent, impacts associated with the Proposal on the environment.

Surface facilities have been shifted and all attempts have been made to locate these over previously cleared agricultural land and predominantly on CW213 (Derived Grassland >50% weeds, rotationally cropped).

On the basis of the proposed measures to avoid, mitigate and offset impacts, and with reference to the legislative requirements of the EP&A Act, TSC Act, EPBC Act, relevant regulations and various NSW and Commonwealth policies and guidelines, it is concluded that the DZP could be developed and operated in such a way as to maintain and improve the biodiversity values of the DZP Site, wider Application Area and surrounds.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Australian Zirconia Ltd (AZL) seeks development consent under Division 4.1 in Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to develop and operate the Dubbo Zirconia Project (the DZP or the Proposal) near the Village of Toongi, approximately 25 kilometres south of Dubbo in the NSW Dubbo Local Government Area (**Figure 1**).

OzArk Environmental & Heritage Management (OzArk) has been commissioned by RW Corkery & Co Pty Limited (RWC) on behalf of AZL to prepare a terrestrial ecology impact assessment (Terrestrial Ecology Assessment) in accordance with the Director-General's Requirements (DGRs, **Appendix 1**).

This Terrestrial Ecology Assessment supports an Environmental Impact Statement prepared by R.W Corkery to support the application of AZL for the development and operation of the Dubbo Zirconia Project.

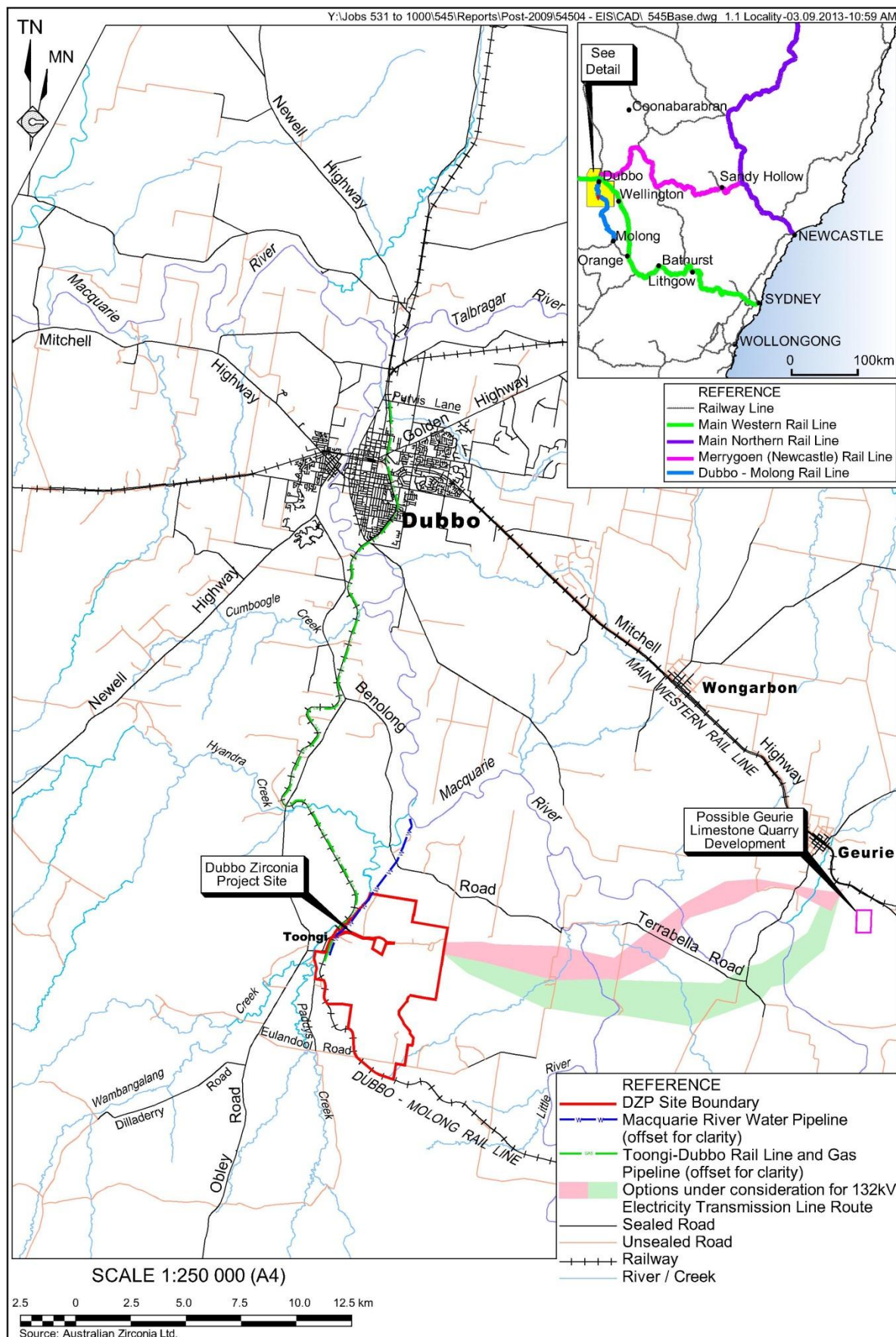
The Proposal would comprise a small scale open cut mine supplying approximately 1Mt of ore containing rare metals (zirconium and niobium) and rare earth elements (REE's) (including hafnium and tantalum) to a processing plant annually (19.5 million tonnes of ore over a period of up to 20 years). The land on which the proposed open cut, processing plant and associated facilities for the management of waste generated by these activities is collectively referred to as the DZP Site. A single Exploration Licence (EL) 5548 covers the entire DZP Site.

The Proposal also incorporates the following four component areas (see **Figures 1 and 2**).

- Upgrade and reactivation of the Toongi to Dubbo Section of the Dubbo-Molong Rail Line. AZL also proposes to construct a pipeline to deliver natural gas from the Central West Pipeline operated by APA Group within the 'Toongi-Dubbo Rail Line and Gas Pipeline Corridor';
- Construction of a water pipeline to deliver up to 4.05GL of water from the Macquarie River to the processing plant (referred to hereafter as the Macquarie River Water Pipeline).
- Upgrades, including minor realignment, creek crossing upgrade and pavement strengthening, of the public road network (Toongi Road and Obley Road).
- Construction of a 132kV electricity transmission line (ETL) from a sub-station to the southwest of Geurie to the DZP Site. The construction of this ETL is to be assessed separately under Part 5 of the EP&A Act.

A more detailed description of the Proposal is provided in **Section 2** of this report.

Figure 1: Locality Plan



1.2 PROJECT SCOPE

The scope of work for the terrestrial ecology (biodiversity) assessment is to ensure that the requirements nominated in the DGRs are addressed, in addition to other relevant environmental assessment requirements of government agencies that were consulted (see **Appendix 1**) which request:

- comprehensive information on the ecological setting;
- accurate estimates of proposed vegetation clearing;
- identification of threatened species or populations and their habitats, endangered ecological communities, and regionally significant remnant vegetation, or vegetation corridors that could be impacted or conserved;
- assessment of the likely impact of the Proposal on any threatened or regionally significant biodiversity;
- recommendations on measures to avoid, reduce or mitigate impacts on biodiversity; and
- details on the development, and assessment against relevant guidelines, of a comprehensive offset strategy to illustrate a maintenance or improvement of biodiversity values as a result of the Proposal.

Application Area specific tasks undertaken to complete this scope of works included the following:

- Baseline studies to determine the presence / absence of flora and fauna (both desktop and field based) were undertaken within the Application Area.
 - A review of current legislation including the Commonwealth Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act) NSW National Parks and Wildlife Act 1974 (NPW Act), NSW Threatened Species Conservation Act 1995 (TSC Act 1995), NSW Fisheries Management Act 1994 (FM Act 1994) and the EP&A Act.
 - A search of the Office of Environment and Heritage (OEH), Department of Primary Industries - Fishing and Aquaculture (DPI Fisheries), Department of Sustainability Environment, Water, Population and Community (DSEWPac) online databases and NSW Wildlife Atlas to identify items within the Dubbo LGA and Central West Catchment Management Authority (CMA) that are protected within the schedules of the TSC Act, FM Act and the EPBC Act.
 - A review of relevant literature including previous consulting reports, academic theses, articles and available works on the ecology, flora, fauna, of the Dubbo region.
 - Field survey and assessment, focusing on the proposed areas of impact within the DZP Site and other components of the Application Area.
- Consultation with OEH Threatened Species Unit, as required, or the Royal Botanic Gardens Botanical Information Service of New South Wales.
- Seven-part Tests / Assessments of Significance to determine the significance of impacts to listed species, populations and communities and the formulation of appropriate management strategies.

- Input of field data collected in the appropriate format to the BioBanking Credit Calculator to quantify impacts of the Proposal and development and assessment of an offset strategy with reference to relevant NSW and Commonwealth offset policies.
- Completion of documentary evidence (e.g. updates for the OEH Wildlife Atlas) for any species located during the survey for the notification of the relevant authorities.

1.3 DEFINITIONS

Definitions used in the report are shown in **Table 1**.

Table 1: Definitions Used In This Report

Terminology	Abbreviation	Description
Application Area		The Application Area is 2,864 hectares (Figure 1). A single Exploration Licence (EL) 5548 covers the entire Application Area.
Australian Bureau of Meteorology	BOM	
Australian Height Datum	AHD	
BioBanking Assessment Methodology	BBAM	Method of assessing biodiversity under Part 7A of the TSC Act following BioBanking Assessment Methodology and Credit Calculator Operation Manual (2009). BBAM provides a streamlined biodiversity assessment process for development, and is accompanied by a rigorous and credible offsetting scheme.
Biodiversity Offset Area	BOA	Area(s) identified by the Applicant as suitable to offset impacts of the Proposal in accordance to the BioBanking Assessment Methodology. Potential areas have been identified in Figure 21 .
<i>Biodiversity Offset Strategy</i>	BOS	The BOS is the strategy in which the Applicant intends to implement the BOA. This includes the BOA and relevant or additional management/compensatory measures proposed by the Applicant
Catchment Management Authority	CMA	The Central West CMA is the relevant CMA.
Component Disturbance Areas		An area that would be mechanically destroyed, disturbed or altered to construct infrastructure associated with the Project encompassed within the DZP Site. The Component Disturbance Areas are identified in Figure 2 and collectively known as the DZP Site.
Development		Has the same meaning as in the EP&A Act, i.e. the nature of the proposed development is described in Section 2.
Director General's Requirements	DGRs	Schedule 2 of the EPA Regulation sets out the matters which an Environmental Impact Statement (EIS) must address and how the EIS should be prepared. This includes the need for the Applicant to apply to the Director-General of Planning for any Director-General's environmental impact assessment requirements, the need to abide by any guidelines issued by the Director-General of Planning, the requirement for a description of the measures proposed to mitigate the effect of the development on the environment, and a justification for the project which addresses the principles of ecologically sustainable development.

Terminology	Abbreviation	Description
DZP Site assessed area		The preceding project site boundary containing 2,507 hectares. This area was entirely assessed. The Application Area is now 2,864 hectares, an additional 357 hectares. Figure 2 shows the Application Area, Appendix 18 shows the relationships between the assessed areas of the DZP Site and the Application Area. The additional 357 hectares remain unassessed and will not be affected by the Proposal'.
Ecologically Sustainable Development.	ESD	The EPBC Act sets out the principles of ecologically sustainable development which apply to certain decisions made under the Act. These principles are: The need to integrate economic, environmental, social and equitable considerations; <ul style="list-style-type: none"> • The precautionary principle; • The principle of inter-generational equity; • The conservation of biological diversity. • Improved valuation, pricing and incentive mechanisms.
Endangered Ecological Community	EEC	An ecological community specified in Part 3 of Schedule 1 of the TSC Act.
Endangered population		A population as specified in Part 2 of Schedule 1 of the TSC Act.
Environmental Impact Statement	EIS	Describes the positive and negative environmental effects of a proposed action.
(Commonwealth) Environment Protection and Biodiversity Conservation Act 1999	EPBC Act	Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
(NSW) Environmental Planning and Assessment Act 1979	EP&A Act	Provides the legislative framework for land use planning and development assessment in NSW.
Final landform		Final rehabilitated surface area at the completion of the Proposal.
(NSW) Fisheries Management Act 1994	FM Act	
Greenfield		New industry. The term that informs the reader the proposal would result in a change of land use i.e. from agriculture to mining.
Likely		Taken to be a real chance or possibility (NPWS 1996).
Likelihood of listed species being recorded		<p>"Yes" = the species was or has been observed on the site.</p> <p>"Likely" = a medium to high probability that a species uses the site.</p> <p>"Potential" = suitable habitat for a species occurs on the site, but there is insufficient information to the species as likely to occur, or unlikely to occur.</p> <p>"Unlikely" = a very low to low probability that a species uses the site.</p> <p>"No" = habitat on-site and in the vicinity is unsuitable for the species.</p>

Terminology	Abbreviation	Description
Liquid Residue Storage Facility	LRSF	Series of HDPE lined terraced cells constructed to hold waste water from the processing plant (that cannot be recycled or reused) and promote the evaporation of the water and crystallisation of salt. The LRSF would be designed and managed to withstand 1:100,000 year flooding events.
Local Environmental Plan	LEP	A type of planning instrument made under Part 3 of the EP&A Act.
(NSW) Local Government Act 1993	LG Act	
Local Government Area	LGA	
Local population		The population that occurs within a given Study Area, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (NPWS 1996). In this instance a local population are those that occur within the Application Area.
Low condition (BBAM Definition)		Native woody vegetation is in low condition if: the over-storey percent foliage cover is <25% of the lower value of the over-storey percent foliage covers benchmark for that vegetation type. AND <50% of groundcover vegetation is indigenous species, or >90% of the area is ploughed or fallow, or 90% of the groundcover vegetation is regrowth but not protected regrowth. Remnant native vegetation and protected regrowth cannot be cleared if it is a vegetation type that is >70% cleared and NOT in low condition.
Locality		Area within a 50km radius of the Application Area.
Matters of National Environmental Significance.	MNES	The Matters of NES as identified in the EPBC Act which require assessment and approval to be addressed by the Commonwealth include: <ul style="list-style-type: none"> • World and National heritage areas. • Ramsar wetlands. • nationally listed threatened species and ecological communities • internationally listed migratory species • all nuclear actions • Commonwealth areas and Commonwealth marine areas.
(NSW) Mining Act 1992	Mining Act	
DZP Site		Collectively, the Component Disturbance Areas. Encompasses all land within the defined boundary that includes the proposed mining, processing and waste management activities of the Proposal.
Mining Lease	ML	
(NSW) National Parks and Wildlife Act 1974	NPW Act	
(NSW) Native Vegetation Act 2003	NV Act	

Terminology	Abbreviation	Description
(NSW) Noxious Weeds Act 1993	NW Act	
NSW Office of Water	NOW	The NSW Office of Water is a key agency in the consultation of development Proposals including the State significant assessment system for State Significant Development (SSD) under Part 4 (Division 4.1).
Office of Environment and Heritage.	OEH	The Office of Environment and Heritage (OEH) and the Environment Protection Authority (EPA) support the Premier, the Minister for the Environment and the Minister for Heritage in performing their executive and statutory functions. OEH develops and leads policy, reform and education in sustainability, biodiversity and native vegetation, coastal protection and Aboriginal cultural heritage.
Open Cut		The area that will be excavated to recover the ore containing rare metals and rare earth elements (REE's).
Residue		The remaining uneconomical material after processing operations.
Residual Effects		Impacts after all 'Avoid and Mitigate' options have been exhausted and the impact would still affect listed species, populations or communities.
Application Area		Encompasses all land to which the Development Consent with apply.
Regional Environmental Plan.	REP	A type of planning instrument made under Part 3 of the EP&A Act.
Solid Residue Storage Facility	SRSF	Above ground, double HDPE lined, structure, constructed as three separate and adjoining cells from the solid residue waste produced by the processing operations. The LRSF would be designed and managed to withstand 1:100,000 year flooding events.
(NSW) Rural Fires Act 1997	RF Act	
Soil		The shallow organic layer of material used for plant growth (includes both topsoil and subsoil).
State Conservation Area	SCA	
State Environmental Planning Policy	SEPP	A type of planning instrument made under Part 3 of the EP&A Act.
State Environmental Planning Policy (Infrastructure) 2007.	Infrastructure SEPP	The aim of this Policy is to facilitate the effective delivery of infrastructure across the State. Consultation with council or other agencies in regards to impact on listed species, communities or populations is required under Part 2, Division 1 of the Infrastructure SEPP.
State Environmental Planning Policy No.14 – Coastal Wetlands	SEPP 14	The aim of this policy is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

Terminology	Abbreviation	Description
State Environmental Planning Policy No.44 – Koala Habitat	SEPP 44	<p>This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:</p> <ul style="list-style-type: none"> • by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and • by encouraging the identification of areas of core koala habitat, and • by encouraging the inclusion of areas of core koala habitat in environment protection zones.
State Forest	SF	
The Proposal		The subject of the development consent, i.e. the proposed development to be undertaken by the Applicant as detailed in Section 2 of this report.
Threatened species		A species specified in Schedule 1 Part 1 (endangered species), Part 4 (presumed extinct) and Schedule 2 (vulnerable species) of the TSC Act, within the schedules of the FM Act or within the Schedules of the EPBC Act.
(NSW) Threatened Species Conservation Act 1995	TSC Act	
Threatened Ecological Communities	TEC	<p>Three categories exist for listing threatened ecological communities under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). An ecological community may be categorised:</p> <ul style="list-style-type: none"> • Critically endangered, If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future. • Endangered, if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future. • Vulnerable, if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

1.4 LOCATION

The Dubbo Zirconia Project is a greenfield site contained entirely within the Dubbo LGA.

The DZP Site covers an area of 2,864 hectares and is located approximately 25 kilometres south of Dubbo within EL 5548 (**Figures 1 and 2**).

The Toongi-Dubbo Rail Line and Gas Pipeline Corridor run within a new rail siding to be constructed on the DZP Site and the East Dubbo Junction. This is situated within the Main Western Rail Line (for the Toongi-Dubbo Rail Line – a distance of 27 kilometres) and Purvis Lane where the APA Group Central West Pipeline traverses the Merrygoen (Newcastle) Rail Line (for the Gas Pipeline, a distance of approximately 30 kilometres).

The Macquarie River Water Pipeline would be aligned within an easement created between the processing plant on the DZP Site and the Macquarie River on the “Mia Mia” property to the north (a distance of 7.6 kilometres).

1.5 OZARK INVOLVEMENT / REPORT AUTHORSHIP

Fauna survey was undertaken by Phillip Cameron (BSc, Ass Dip App Sc) and Heidi Kolkert [BA, BSc (Hons)] under NSW Primary Industries (DPI) Ethics Approval No 07/1601 & NSW Scientific Research Licence 11194. Assessment in accordance with the BioBanking Assessment Methodology (BBAM) was undertaken by accredited BioBanking Assessors Heidi Kolkert (no. 0127) and Phillip Cameron (no. 0117) under Part 5 of the TSC Act. Phillip Cameron undertook survey of the Toongi-Dubbo Rail Line and mapped vegetation along Obley Road. Both Phillip and Heidi are Practising Regional Members of the NSW Ecological Consulting Association.

The assessment has expanded on those surveys previously undertaken by Geoff Cunningham (of Geoff Cunningham Natural Resource Consultants Pty Ltd) and Dr David Goldney (of Central West Environmental Services) for the DZP. The surveys were completed in 2001 and 2002 with draft reports issued to the Applicant in 2002. Additional flora and fauna surveys undertaken by OzArk were completed to ground truth the results of these earlier surveys, expand the study area where relevant and re-evaluate the ecological values of the Application Area.

Dr Arthur White (herpetologist / ecologist) of Biosphere Environmental Consultants P/L was commissioned to undertake targeted surveys for the NSW and Commonwealth listed threatened reptile, *Aprasia parapulchella* (Pink-tailed Worm-lizard⁵) and to develop a *Pink-tailed Worm-lizard Plan of Management* (PoM). Dr White also contributed to the species lists compiled over the Application Area.

Dr Gilbert Whyte (entomologist / ecologist) of Ecobiological was commissioned separately to undertake studies on the symbiotic relationship between ants, soil profiles and the occurrence of the Pink-tailed Worm-lizard as a component of the Pink-tailed Worm-lizard PoM.

The Dubbo Field Naturalists (DFN) have participated in field work to assist in the detection of the Pink-tailed Worm-lizard and other species, managed by Dr Arthur White and assisted by Phillip Cameron and Heidi Kolkert of OzArk. The DFN were engaged to participate in searches for this species over the DZP Site, focussing on the proposed open cut and surrounding potential habitat sites in March 2012. Approximately 20 DFN team members participated over two days.

Phillip Cameron presented an update on the Proposal to the DFN on 16 October 2012 and extended an invitation for ongoing field work and monitoring for the Pink-tailed Worm-lizard from October 2012 in accordance with the Pink-tailed Worm-lizard PoM.

This report was written by Heidi Kolkert and Phillip Cameron and reviewed by Phillip Cameron and Ben Churcher (OzArk).

⁵ *Aprasia parapulchella* is also recognised by the common name Pink-tailed Legless Lizard

1.6 DATE OF THE ASSESSMENTS AND CLIMATIC CONDITIONS

As OzArk is a Dubbo based company field assessments could be undertaken in the best time possible to detect a given listed species. This increased the likelihood of detection of threatened fauna / flora, summer migratory species and seasonally flowering orchid species. **Table 2** presents the survey effort within the Application Area completed by OzArk and associated consultancies (between February 2012 and May 2013), as well as the survey efforts preceding OzArk's involvement.

Weather during OzArk's February and March 2012 survey period can be described as hot and humid with evening storms influenced by the La Niña weather phenomenon. NSW received above average rainfall and above average maximum and minimum temperatures during February and March resulting in major flooding in parts of the state (BOM 2012). This was reflected by field conditions, described as wet underfoot with abundant grass cover, arguably the 'best season' possible for native species natural recovery. These rains increased the likelihood of shallow semi-permanent wetlands or ponds forming on alluvial terraces or impermeable soils.

September 2012 weather conditions consisted of cool nights and warm days (approx. 20°C) following a particularly dry August. Again, this was reflected by abundance of dry grasses in the field. The lack of winter rains is a possible reason that terrestrial orchids were not as abundant as expected as new rosettes are normally produced following soaking autumn and winter rains (Threatened Species Scientific Committee 2008).

Dubbo also experienced a dry October in 2012 associated with the positive Indian Ocean Dipole event that has affected NSW rainfall during winter to spring. Temperatures were above average maximums (14.8°C to 33.5°C) and below average minimum temperatures (1.8°C to 15.9°C) for the month of October.

Assessments undertaken in November 2012 were hot with temperatures in the high thirties to early forties. Although not ideal conditions for detecting threatened species (such as the Pink-tailed Worm-lizard that will retreat down ant galleries during high temperatures), the weather is reflective of the temperature range experienced in Dubbo NSW.

Table 2: Survey Effort per Type of Survey Across the Application Area

Date	Survey Effort	Type of survey	Study Area	Comments	Personnel	Weather conditions
February 4 th 2012	0830 to 1030 (Two hours)	Opportunistic <i>Aprasia parapulchella</i> . Reptile / bird / threatened plants.	Open Cut	Open Cut, approx. 1ha. Half in tree canopy, half in grassy open area. 250 to 300 rocks turned.	OzArk: Phil Cameron, Benn Bryant, Alex Cameron	Warm 25°C. Raining every day for the week prior to assessment.
February 11 th 2012	830 to 1130 (Three hours)	Opportunistic <i>Aprasia parapulchella</i> . Reptile / bird / threatened plants.	Open Cut	Open Cut, approx. 1ha. Half in tree canopy, half in grassy open area. 500 rocks turned	OzArk: Danielle Soole, Hanna Soole, Addy Watson, Phillip Cameron	Warm 28°C. Heavy rain preceded survey two days prior. 4.2mm of rain on morning of assessment.
February 15 th and 16 th 2012	Two days	Targeted survey for <i>Aprasia parapulchella</i> .	DZP Site	Assistance provided by Phil Cameron (OzArk).	Dr Arthur White	Hot: 33.7°C
February 18 th 2012	830 to 1000 (1.5 hours)	Opportunistic <i>Aprasia parapulchella</i> . Reptile / bird / threatened plants.	Open Cut	Open Cut, approx. 1ha. Half in grassy open area. 200 to 250 rocks turned.	OzArk: Phillip Cameron, Alex Cameron. Leslie Hyland (Property Owner)	High humidity, dry for past week, warm to hot: 25°C to 30°C
February 25 th 2012	One day	Ecological survey.	Initial realignment of the Water Pipeline		OzArk: Phil Cameron	Hot: 29.6°C. Few millimetres of rain on Sunday six days prior
February 25 th 2012	830 to 1100 (2.5 hours)	Reptile / bird / threatened plants, pick up bat gear and lay hair traps.	Open Cut	Open Cut and lower slopes of deposit in grassy woodland areas. 350 rocks turned.	OzArk: Benn Bryant, Phil Cameron, Lisa Minner, Jenn McGhee, Martin McLeod	Hot: 29.6°C. Few millimetres of rain on Sunday six days prior.
March 21 st to 25 th 2012	Five days	Fauna survey.	DZP Site		Heidi Kolkert (OzArk). Phil Cameron (OzArk).	Warm to hot: 25°C to 29°C with cool nights. No rain.
March 21 st to 25 th 2012	5 days	Targeted ecological	Spot checks of the Water Pipeline and Gas Pipeline.		Heidi Kolkert (OzArk). Phil Cameron (OzArk).	Warm to hot: 25°C to 29°C with cool nights. No rain.
March 24 th and 25 th 2012	2 days	Targeted survey for <i>Aprasia parapulchella</i>	Open Cut	DFN joined the ecological team and assisted with opportunistic fauna and flora sightings on the Open Cut.	DFN Heidi Kolkert (OzArk). Phil Cameron (OzArk).	Warm: 21°C to 25°C with cool nights. No rain.
March 22 nd to 26 th 2012	5 days	Targeted survey for <i>Aprasia parapulchella</i>	DZP Site DZP Site		Dr Arthur White	Warm to hot: 25°C to 29°C with cool nights. No rain.

Date	Survey Effort	Type of survey	Study Area	Comments	Personnel	Weather conditions
September 6 th to 10 th 2012	5 days	Targeted survey for <i>Aprasia parapulchella</i>	DZP Site DZP Site		Dr Arthur White	Warm: 25°C with cool nights. No rain.
September 11 th to 14 th 2012	4 days	BBAM	DZP Site DZP Site	Additional floristic assessment under the BBAM and targeted ecological searches over areas of disturbance on the DZP Site including targeted orchid survey.	Heidi Kolkert (OzArk)	Cool to Warm: 17°C to 26°C. 1.6mm of rain on Friday.
October 12 th to 15 th 2012	4 days	Targeted survey for <i>Aprasia parapulchella</i> Data collection of artificial habitat.	DZP Site		Dr Arthur White Assistance provided by Phil Cameron (OzArk).	Warm to 25°C with cool nights. No rain.
October 12 th to 15 th 2012	4 days	Targeted orchid survey.	DZP Site	Targeted orchid survey was undertaken by Phil Cameron concurrently during trips to the Application Area to assist Dr Arthur White in surveying for the Pink-tailed Worm-lizard.	Phil Cameron (OzArk).	Warm: 25°C with warm nights. No rain.
November 17 th and 18 th of 2012	2 days	Targeted survey for <i>Aprasia parapulchella</i> Data collection of artificial habitat.	DZP Site		Dr Arthur White Assistance provided by Phil Cameron (OzArk).	Hot: 35°C. No rain.
November 17 th and 18 th of 2012	2 days	Targeted orchid survey	DZP Site	Targeted orchid survey was undertaken by Phil Cameron concurrently during trips to the Application Area to assist Dr Arthur White in surveying for the Pink-tailed Worm-lizard.	Phil Cameron (OzArk).	Hot: 35°C. No rain.
November 31 st to December 2 nd 2012	3 days	Targeted survey for <i>Aprasia parapulchella</i> . Data collection of artificial habitat	DZP Site		Dr Arthur White Assistance provided by two DFN members and Rowan Murphy (OzArk)	Extremely Hot. Friday: 41°C Saturday: 41°C Sunday: 38°C
December 3 rd and 4 th 2012	2 days	Entomologist / soil sampling	At known Pink-tailed Worm-lizard populations	For Pink-tailed Worm-lizard PoM.	Dr Gilbert Whyte (Kleinfelder Ecobiological) Assistance provided by Phil Cameron (OzArk).	Monday hot: 35°C, 1.9mm rain Tuesday: 27°C.

SPECIALIST CONSULTANT STUDIES

Part 6: Terrestrial Ecology Assessment

AUSTRALIAN ZIRCONIA LTD

Dubbo Zirconia Project

Report No. 545/05

Date	Survey Effort	Type of survey	Study Area	Comments	Personnel	Weather conditions
December 21 st 2012	8.30 to 10.30 (2 hours)	BBAM road corridor (benchmark condition of communities)	Obley Road		Heidi Kolkert (OzArk) Phil Cameron (OzArk).	Hot: 33°C.
February 31 st 2013	4.00 to 9.00 (5 hours)	ground truthing / checking veg maps	Application Area.		Phil Cameron (OzArk).	Very Hot: 36°C.
March 14 th to 17 th 2013	4 days	Targeted survey for <i>Aprasia parapulchella</i> . Data collection of artificial habitat	Open Cut Hill 2 and Dowds Hill.	For Pink-tailed Worm-lizard PoM.	Dr Arthur White	Mild to warm: 28°C.
April 9 th 2013	1 day	Entomologist / soil sampling	Seven plots described in the Pink-tailed Worm-lizard PoM.	For Pink-tailed Worm-lizard PoM.	Dr Gilbert Whyte (Kleinfelder Ecobiological)	Mild to warm: 28°C.
April 9 th 2013	1 day	Vegetation / habitat descriptions (in accordance with BBAM benchmark establishment data requirements).	Seven plots described in the Pink-tailed Worm-lizard PoM.	For Pink-tailed Worm-lizard PoM.	Phil Cameron (OzArk).	Mild to warm: 28°C.
May 7 th to 10 th 2013	3 days	Targeted survey for <i>Aprasia parapulchella</i> . Data collection of artificial habitat	Open Cut Hill 2 and Dowds Hill, other areas with potential	For Pink-tailed Worm-lizard PoM.	Dr Arthur White	Mild to warm: 25°C.
May 12 th 2013	1 day	Vegetation checks (what grasslands mapped in 2012 had been cropped)	Application Area.		Phil Cameron (OzArk).	Mild to warm: 22°C.
Previous Ecological Survey in the Mine Boundary						
8 th to 11 th November, 2001.	4 days	Flora	Rail Line	Spot assessments	Geoff Cunningham	Not detailed in the report.
November 11 th and 14 th 2001	4 days	Flora	Water pipeline	Spot assessments	Geoff Cunningham	As above
April 10 th and 11 th 2001	2 days	Flora	Mine Boundary	A field inspection of the area was carried out on 10th and 11th April, 2001. Traverses were made by four-wheel drive vehicle and on foot where the timber cover, fencing and topography prevented driving.	Geoff Cunningham	As above

Date	Survey Effort	Type of survey	Study Area	Comments	Personnel	Weather conditions
October 10 th 2001	1 day	Flora	Mine Boundary Dowds Hill	Further traverses were made basically on foot on 10th October, 2001 in the Outcrop area and on Dowds Hill to ascertain whether or not any threatened flora species were present.	Geoff Cunningham	As above
Between April and October 2001	1 day	Flora	Mine Boundary	An additional observation was made in the pasture paddock north-west of Wychitella woolshed on land that was an addition to the Application Area between the April and October inspections.	Geoff Cunningham	As above
August 19 th to 22 nd 2002	4 days	Flora (Vegetation mapping)	Dowds Hill and associated Remnants		Geoff Cunningham	As above
April 22 nd to 25 th 2001	4 days	Fauna	DZP Site		David Goldney , Centwest Environmental Services	As above
November 4 th to 11 th 2001	10 days	Fauna	DZP Site		David Goldney , Centwest Environmental Services	As above
December 17 th to 20 th 2001	4 days	Fauna (targeted reptile surveys)	DZP Site		David Goldney , Centwest Environmental Services	As above

1.7 STATUTORY AND PLANNING FRAMEWORK

1.7.1 NSW Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and assessment of development applications.

The Proposal is classified as State Significant Development (SSD) under Schedule 1, Clause 10 of the State Environmental Planning Policy (State and Regional Development) 2011 for which approval is required in accordance with Division 4.1 of the EP&A Act. The following provides a summary of the key aspects of Division 4.1 of the EP&A Act as relevant to the Proposal

- As SSD, a development application is required to be accompanied by an Environmental Impact Statement 'prepared by or on behalf of the Applicant in the form prescribed by the regulations'. Schedule 2 of the *Environmental Planning and Assessment Regulations 2000* (EP&A Regs) sets out the requirements of an EIS and requires that the content of an EIS is 'subject to the environmental assessment requirements that relate to the EIS'. Sections 89J and 89K of the EP&A Act outline authorisations that are not required for State significant development authorised by a development consent, and authorisations that cannot be refused if necessary for carrying out State significant development that is authorised by a development consent.
- Development applications for SSD will be lodged with the Department of Planning and Infrastructure. The Proposal also requires the consent of Dubbo City Council under Part 4 of the EP&A Act as the Proposal falls within the provisions of State Environmental Planning Policy (Infrastructure) 2007

Various legislation and instruments, such as the NSW *Threatened Species Conservation Act 1995* (TSC Act), *Fisheries Management Act 1994* (FM Act) and *Rural Fires Act 1997* (RF Act) are integrated with the EP&A Act.

This report provides for the ecological assessment component required to enable the Proposal to be assessed under Part 4.1 of the EP&A Act.

1.7.2 Commonwealth Environmental Protection and Biodiversity Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) for proposed 'actions that have the potential to significantly impact on matters of national environmental significance (NES) or the environment of Commonwealth land'. The Matters of NES as identified in the EPBC Act which require assessment and approval to be addressed by the Commonwealth include:

1. World and National heritage areas;
2. Ramsar wetlands;
3. nationally listed threatened species and ecological communities;
4. internationally listed migratory species;
5. all nuclear actions; and
6. Commonwealth areas and Commonwealth marine areas.

These are considered in **Section 6.2** of this report

The purpose of the referral is to allow a decision to be made as to whether an action requires approval on a Commonwealth level. If an action is declared a “controlled action”, then Commonwealth approval is required.

Under the EPBC Act, listed migratory species are one of the matters of NES. Japan-Australia, Republic of Korea- Australia and China-Australia Migratory Bird Agreements (JAMBA, ROKAMBA & CAMBA) are bilateral agreements for the protection of migratory birds in danger of extinction and their environment. These agreements are enforced by the Government of Australia (Department of Foreign Affairs and Trade) and the Governments of Japan, The Republic of Korea and China, respectively.

Species considered to be affected by the Proposal have had an Assessment of Significance completed in order to properly characterise the threat (see **Appendix 10**). Under Section 20 of the EPBC Act, a person must not take an action that has or will have a significant impact upon a listed migratory species, or is likely to have a significant impact on a listed migratory species, in both cases known as a “controlled action”, unless the approval of the Federal Minister for the Environment is obtained.

1.7.3 Other Relevant Legislation & Guidelines

Further NSW legislation and planning policies that are relevant to the protection of biodiversity include the following.

- Threatened Species Conservation Act 1995.
- National Parks and Wildlife Act 1974.
- Water Management Act 2000.
- Water Act 1912.
- Fisheries Management Act 1994.
- Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006.
- SEPPs:
 - State Environmental Planning Policy 44 – Koala Habitat Protection;
 - State Environmental Planning Policy No 55 – Remediation of Land; and
 - State Environmental Planning Policy (Infrastructure) 2007.
- NSW State Groundwater Dependent Ecosystems Policy (DLWC (NSW), 2002).
- Dubbo Local Environment Plan 1997.
- Dubbo Development Control Plans, rural and urban.
- Central West Catchment Action Plan 2011 to 2021.

For the development of offsetting strategies for the Proposal, the following documents were considered:

- NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects Approved by the Chief Executive Officer 25 June 2011 (OEH, 2011).

- EPBC Act environmental offsets policy. Policy guiding the use of offsets under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012).

1.7.4 Director-General's Requirements

The Proposal has been confirmed as SSD in accordance with Schedule 1(5) of State Environmental Planning Policy (SEPP) (State and Regional Development) 2011, by the NSW Department of Planning & Infrastructure (DP&I). Director-General's Requirements (DGRs in accordance with the requirements in Part 2 in Schedule 2 to the *Environmental Planning & Assessment Regulation 2000* (EP&A Regs), were issued by the DP&I on 4 May 2012.

A preliminary analysis indicated that the Proposal would have a significant impact on the Pink-tailed Worm-lizard and as such was referred to the Minister (Referral 20012/2265). DSEWPaC responded on the 4 January 2013 informing the Applicant that the Proposal has been determined as a 'Controlled Action' as '*It will result in the clearance of habitat for the Pink-tailed Worm-lizard (Aprasia parapulchella) listed as vulnerable under the EPBC Act*'. Subsequently, the DP&I then issued Supplementary DGRs on 1 March 2013.

The DGRs and additional Environmental Assessment Requirements (EARs) of the relevant consulted government agencies and authorities have been received from the DP&I and have been addressed as relevant to the Proposal. These investigations relate primarily to the Pink-tailed Work Lizard.

The specific assessment requirements of the DGRs and EARs relevant to ecological assessment are presented in **Appendix 1** along with the section in which each are addressed.

2. DESCRIPTION OF THE PROPOSAL

2.1 INTRODUCTION

The Application Area for the Proposal incorporates four distinct areas:

- the DZP Site.
- Toongi-Dubbo Rail Line and Natural Gas Pipeline Corridor.
- Macquarie River Water Pipeline.
- public road network (Toongi Road and Obley Road).

The following provides an overview of the activities to be undertaken within each of these areas.

2.2 DZP SITE OPERATIONS

The following provides an overview of principal components and activities to be undertaken on the DZP Site (and illustrated on **Figure 2**).

- Extraction of approximately 19.5Mt of ore at a maximum rate of 1Mt per year from a shallow open cut developed to a maximum depth of 32m (355m AHD) (remaining above the groundwater table). At the proposed rate of mining, the open cut design proposed would provide for a mine life of 20 years.
- Extraction and placement of approximately 3.5Mt of waste rock (weathered material or rock containing insufficient grades of rare metals or REEs for processing) within a small waste rock emplacement (WRE) to the southwest of the open cut.
- Haulage of ore to a Run-of-Mine (ROM) Pad for crushing and grinding.
- Processing of the crushed and ground ore by:
 - Sulphation roast of ore and leaching to dissolve sulphated metals.
 - Solvent extraction, precipitation, thickening, washing and drying of the various rare metal and REE products.

The sulphuric acid required as part of the sulphation process would be manufactured within the DZP processing plant from imported raw sulphur.

- Construction and operation of a rail siding from the Toongi-Dubbo Rail Line and a Rail Container Laydown and Storage Area for the unloading and temporary storage of reagents and loading of products for despatch.
- Other reagents would be transported to the DZP Site via the public road network, with sections of Obley Road and Toongi Road to be upgraded to accommodate the proposed increase in heavy vehicle traffic.
- Mixing of solid residues produced by the processing of the ore with crushed and washed limestone and transportation via conveyor to a Solid Residue Storage Facility (SRSF).

- Pumping of water used in the processing operations, which cannot be recycled, to a Liquid Residue Storage Facility (LRSF), comprising a series of terraced and lined crystallisation cells.
- Recovery and disposal of an estimated 6.7Mt of salt which would accumulate within the LSRF within a series of Salt Encapsulation Cells adjoining the WRE and SRSF.
- Other ancillary activities including equipment maintenance, clearing and stripping of the areas to be disturbed and rehabilitation activities.

The maximum development footprint on the DZP Site would be approximately 807.7ha (within the DZP Site of 2,864 hectares; see **Figure 2**). The Component Disturbance Areas include:

- Open Cut Mine – 40.3 hectares.
- Waste Rock Emplacement Area – 20.4 hectares.
- ROM Pad – 4.2 hectares.
- Processing Plant and DZP Site Administration Area (incorporating the processing plant and associated reagent storage areas, rail siding and container laydown areas and site offices and administration complex) – 43.3 hectares.
- Solid Residue Storage Facility – 102.8 hectares.
- Liquid Residue Storage Facilities (Evaporation Ponds) – 425.4 hectares.
- Salt Encapsulation Cell – up to 34.6 hectares.
- Soil Stockpile Areas – up to 129.4 hectares.
- Internal Haul Roads – 7.3 hectares.

The ore body to be mined is a roughly elliptical stock in shape with outcrop dimension of 600 metres by 400 metres. Exploration completed by AZL has identified the ore body extends below a thin veneer of soil and recent sediments to be approximately 900m (east-west) x 500 metres (north-south) (surface area of 36ha) and appears to be a near vertical body of indeterminate depth.

While there is limited scope to modify the area of impact associated with the open cut, in order to minimise the impact of the mining operations, the Applicant has designed the mining sequence such that the initial 10 year mine plan develops the western half of the open cut with the eastern half developed and mined during the second 10 year mining period (see **Figure 2**).

The size and location of the other components of the DZP Site has been the subject of more detailed review, with impact minimisation a key consideration. In particular, avoiding impacts on areas of remnant native vegetation and areas of known or potential Pink-tailed Worm-lizard habitat was identified as an objective (discussed in **Section 5.5.4** of this report and **Appendix 13**).

After OEH adequacy review in July 2013 the DZP Site Boundary was extended. **Figure 2** represents the extended area. Many Figures in the report show the Assessed Area (the former Project Boundary). The relationship between the former and current DZP Site Boundary is shown in **Appendix 18**. All areas to be impacted by the Proposal have been assessed.

2.3 TOONGI-DUBBO RAIL LINE AND NATURAL GAS PIPELINE CORRIDOR

The Applicant has identified the upgrade and use of the Toongi to Dubbo section of the currently disused Dubbo-Molong Rail Line as an opportunity to reduce the volume of traffic on the public road network.

Figure 3 provides the proposed alignment of the Toongi-Dubbo Rail Line, the key features of which are as follows:

- Upgrade of the Toongi to Dubbo section of the Dubbo-Molong Rail Line to a Class 1 track (92t gross/67t pay load capacity).
- Replacement or upgrade of steel bridges, culvert structures, and timber bridges.
- Reinstatement, civil works and installation back to the required standard at each of the 26 level crossings. Of these, seven are major crossings (of local roads), four of which occur in Dubbo (Wingewarra Street, Cobra Street, Boundary Road and Macquarie Street) and three (Cumboogle, Glengarra and Toongi) between the Macquarie River and the proposed DZP Rail Siding.

Figure 3 also identifies the proposed natural gas pipeline between the Central West Pipeline (of APA Group) at Purvis Lane, Dubbo, and the DZP Site which would deliver up to 970TJ/year of natural gas for the heating of various circuits within the processing plant.

2.4 MACQUARIE RIVER WATER PIPELINE

The Applicant proposes to source up to 4.05GL of water annually from a point on the Macquarie River approximately 7.6 kilometres northwest of the processing plant. The water would be transferred to the DZP Site by the water pipeline.

Figure 4 provides the proposed alignment of the Macquarie River Water Pipeline, the key features of which are as follows.

- A pumping station which incorporates a dual water inlet, wet well and vertical mounted axial flow pump configuration.
- A 400 to 450 millimetre diameter HDPE pipeline within an embedded trench.

The easement to be created for the Macquarie River Water Pipeline Corridor would be approximately 15.2 hectare (20 metre x 7.6 kilometre), although the actual area of disturbance within this corridor would be much less. An area not exceeding 2 000m² would be disturbed on the river frontage of the “Mia Mia” property to allow for the construction of the pumping station for water from the Macquarie River.

2.5 PUBLIC ROAD NETWORK

The Proposal would require significant quantities of materials to be delivered by road. This would occur via the Newell Highway, Obley Road and Toongi Road. To accommodate the proposed heavy vehicle traffic associated with this transport, the alignment and pavement depth of the two roads would be improved in several locations, with a number of creek crossings, rail level crossings and intersections to be upgraded. **Figure 5** provides the locations of these works.

A more detailed description of the Proposal is provided by Section 2 of the EIS, of which this assessment forms Part 6 of the accompanying Specialist Consultant Studies Compendium.

Figure 2: DZP Site Layout

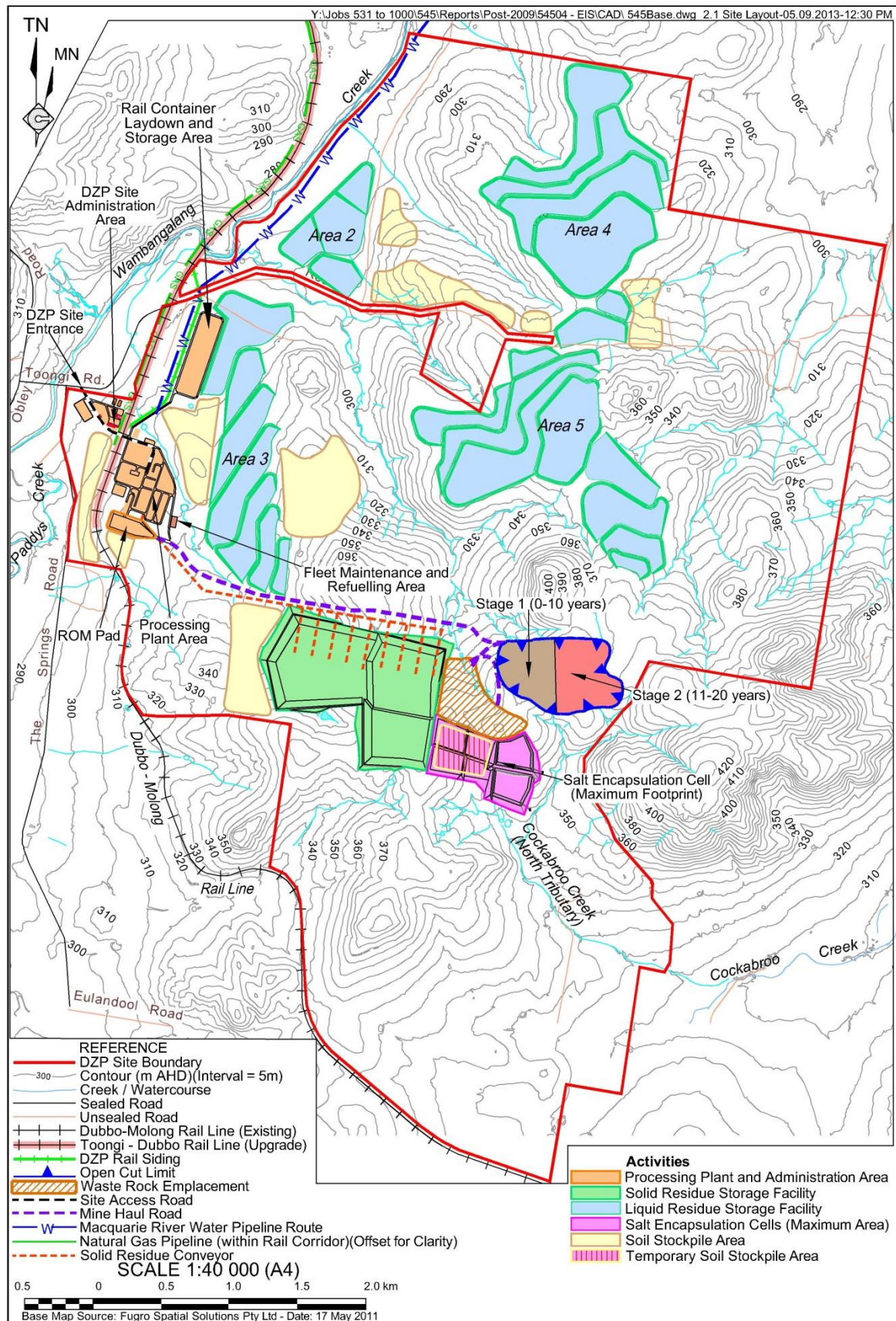


Figure 3: Toongi – Dubbo Rail Line and Gas Pipeline Corridor

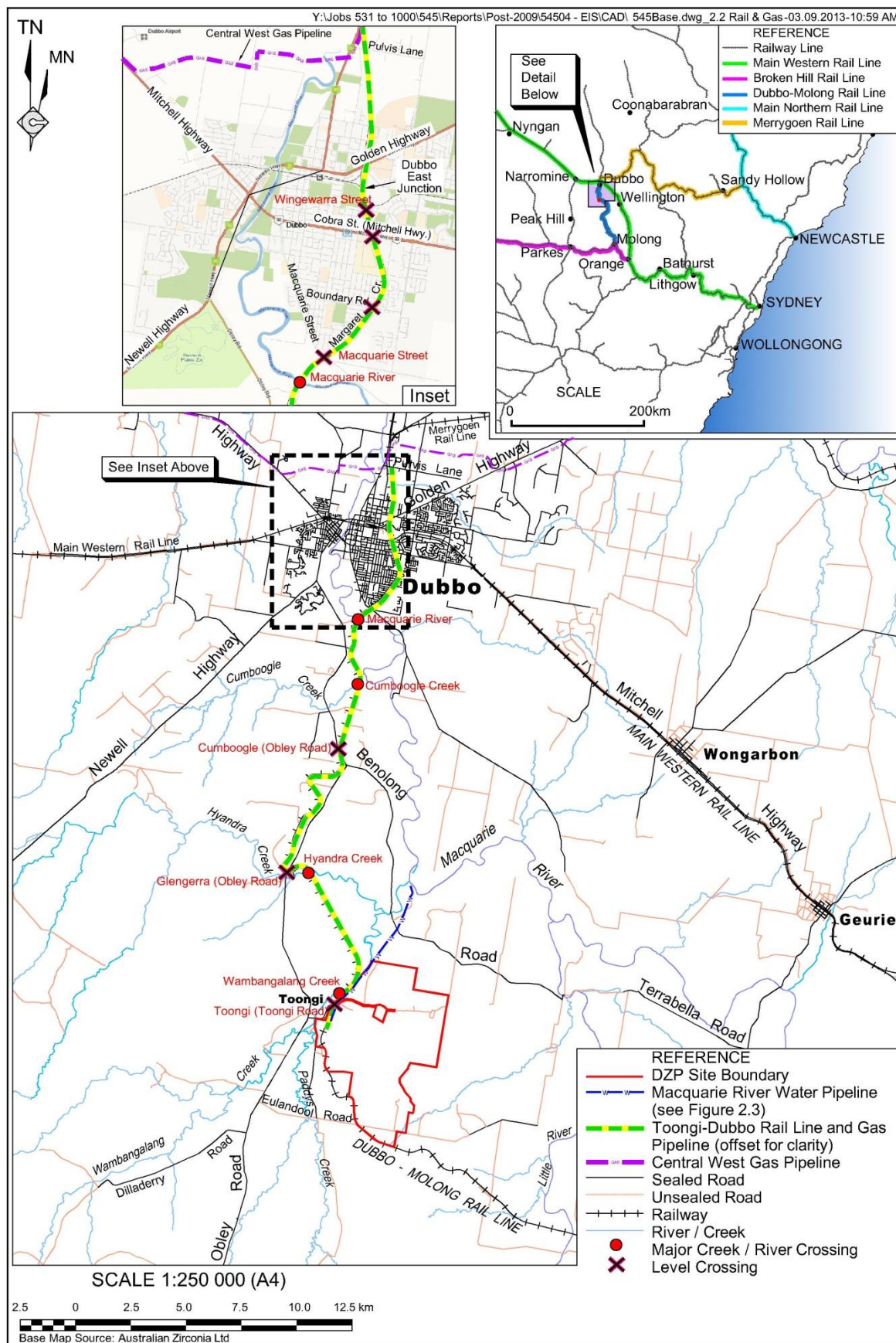


Figure 4: Macquarie River Water Pipeline and Pump Station

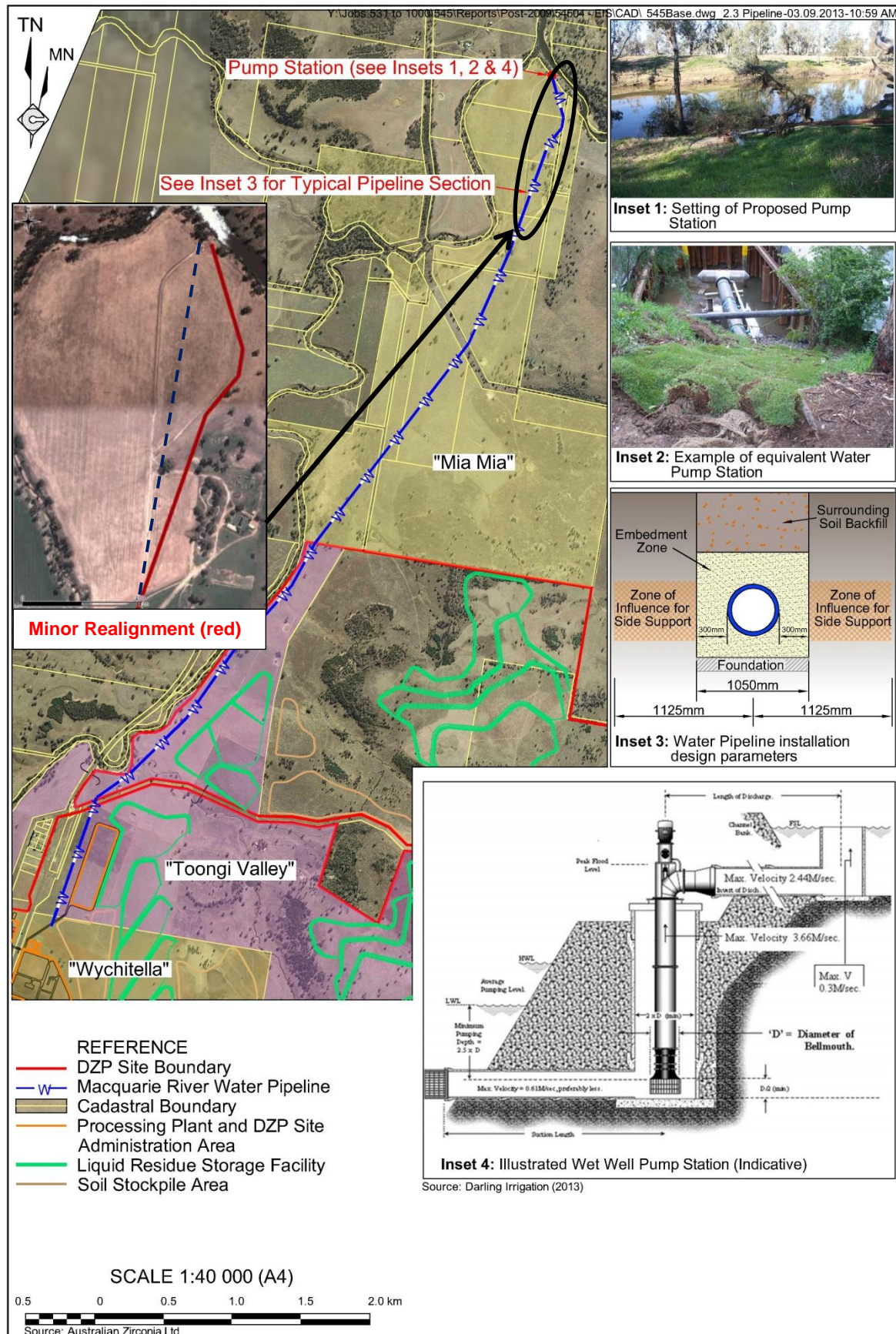
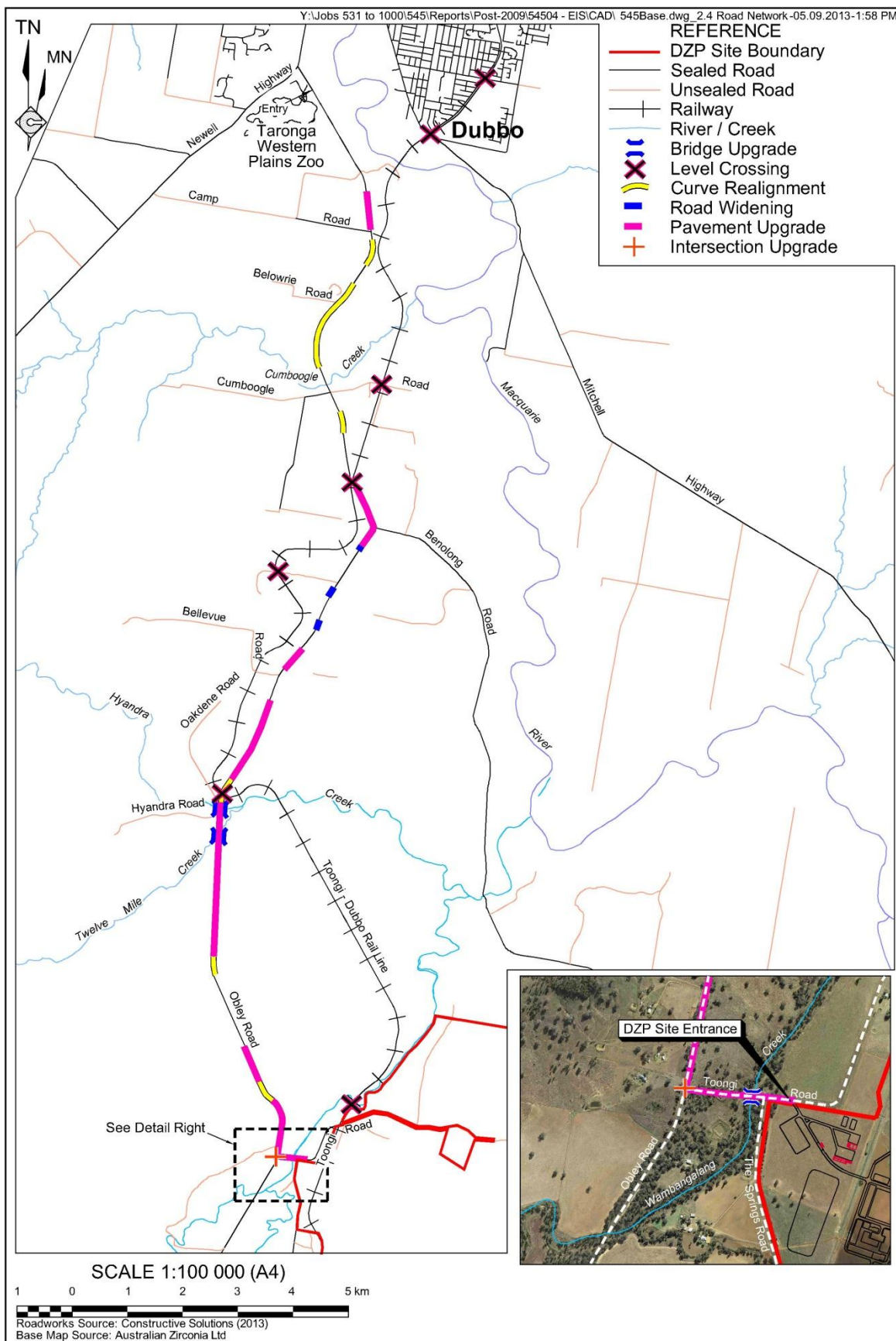


Figure 5: Public Road Network



'OR' = Obley Road.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 LAND OWNERSHIP

The majority of the land within the DZP Site is freehold (or perpetual leasehold which can be converted to freehold). There are no Commonwealth Native Title or State Aboriginal Land Rights issues. The DZP Site affects parts of six farming properties and negotiations have been successfully completed or are continuing with each owner to purchase the entire property or that part of the property to be disturbed by the Proposal. Road reserves for Toongi Road and Obley Road are local (Shire) roads managed and maintained by Dubbo City Council.

3.2 HYDROLOGY

3.2.1 Creeks and Catchments

The Application Area is situated within the Central West CMA across two subregions (Upper Slopes and Talbragar).

Several waterways cross the area, including:

- Wambangalang Creek: is an ephemeral but relatively regularly flowing creek which in part forms the western boundary of the DZP Site (in the northern area near the turn off from Toongi Road). Wambangalang Creek flows into the Macquarie River approximately four kilometres north of the DZP Site. The Toongi Road crossing of Wambangalang Creek is proposed to be upgraded as part of the Proposal (**Figure 6**).
- Macquarie River: a watercourse that is part of the Macquarie–Barwon catchment within the Murray–Darling basin, is one of the main inland rivers in New South Wales. The river rises in the central highlands of NSW near Oberon and travels generally northwest past Bathurst, Wellington, Dubbo, Narromine, and Warren to the Macquarie Marshes. The Macquarie Marshes (when overtopped) drain into the Darling River via the lower Barwon River.
- Cockabroo Creek: is an ephemeral creek which is located immediately south of the DZP Site and flows into the Little River to the east of the DZP Site.
- Little River: a perennial river which flows through Yeoval to the south of the DZP Site and joins the Macquarie River approximately 7.3 kilometres to the east of the DZP Site.
- Paddys Creek: is an ephemeral tributary of Wambangalang Creek which is located immediately west and south of the DZP Site.
- Hyandra Creek: is an ephemeral tributary of the Macquarie River which is traversed by Obley Road.
- Cumboogle Creek: is an ephemeral tributary of the Macquarie River which is traversed by Obley Road.

These waterways within the DZP Site occur within three main local catchments:

1. Wambangalang Creek catchment that flows into the Macquarie River.
2. Cockabroo Creek catchment that flows into the Little River immediately upstream of the confluence of the Little and Macquarie Rivers.
3. A catchment of unnamed drainage channels flowing into the Macquarie River.

The following sections provide an overview of these three catchments, however, for further detail on the local hydrological setting, please refer to the Surface Water Assessment completed as Part 4 of the *Specialist Consultant Studies Compendium* (SEEC, 2013).

3.2.2 Wambangalang Creek Catchment

The Wambangalang Creek catchment drains north-northeast before joining the Macquarie River approximately four kilometres north of the DZP Site. The catchment drains an area of approximately 34,500 hectares (which represents approximately 0.5% of the Macquarie River catchment) and the DZP Site is located in the lower 10% of the catchment (near the confluence point with the Macquarie River).

Major creeks draining into Wambangalang Creek (also identified on **Figure 4**) include the Belowrie, Glennie and Tanners Creeks from the upper western side of the catchment. The Emmagool and Meadows Creeks drain the upper central section of the catchment and Paddys and Springs Creeks drain the upper south-eastern area of the catchment. All flows are ephemeral but may have some degree of subsurface flow through unconsolidated alluvium.

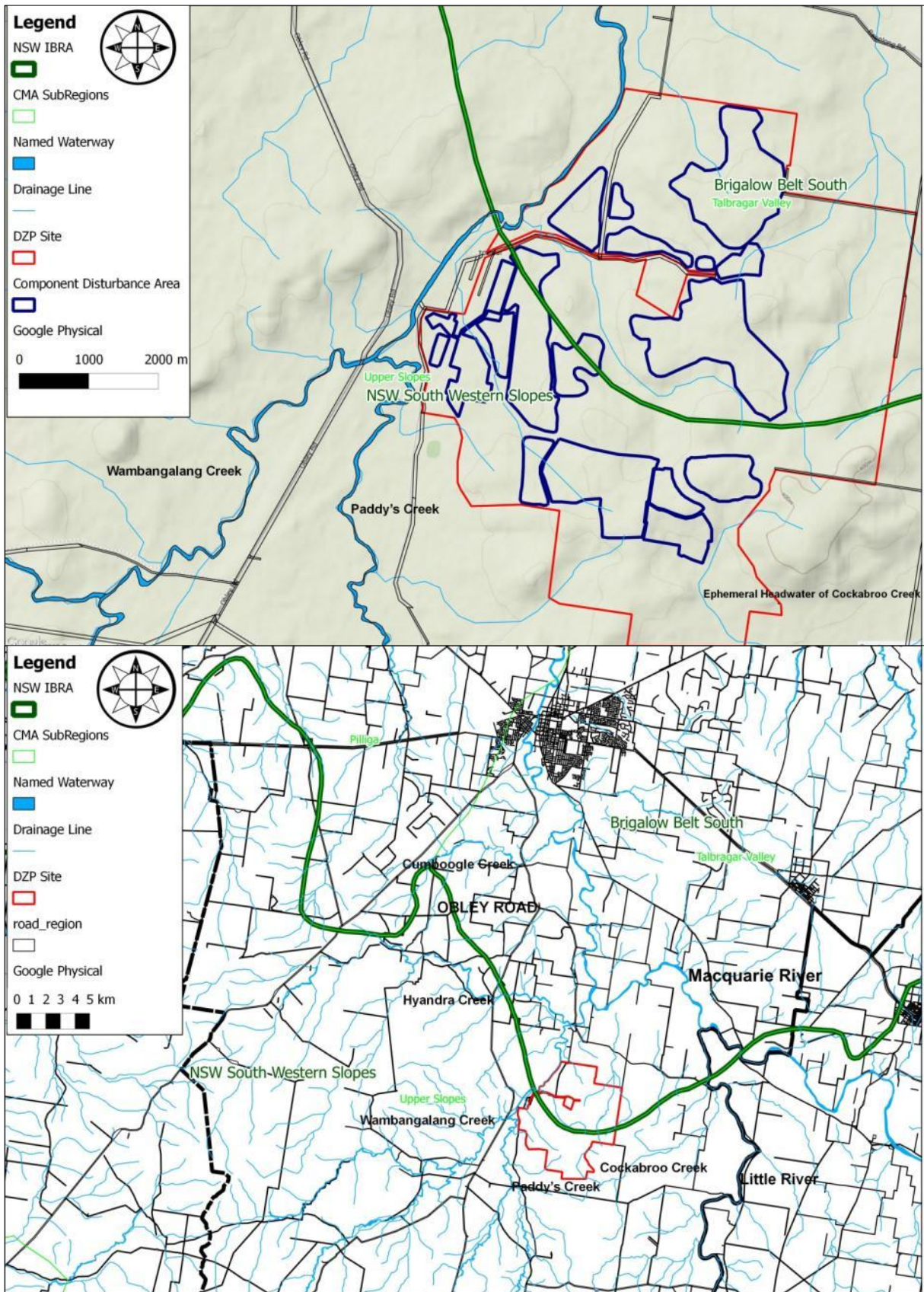
3.2.3 Cockabroo Creek Catchment

The Cockabroo Creek catchment drains to east before joining the Little River approximately four kilometre's east of the DZP Site (**Figure 6**). This small catchment of 4,240 hectares drains surface flows off a local high point, Dowds Hill, and other rockier, densely vegetated areas of the local setting.

3.2.4 Macquarie River (Undefined) Catchment

Water from a small section of the DZP Site, predominantly on the "Ugothery" property, flows via several ephemeral channels directly into the Macquarie River (approximately seven kilometres north). While the catchment is bound by several isolated hills up to 385m AHD, the elevation is generally below 320m AHD.

Figure 6: Hydrology of the Application Area



Note: Lower image presents the DZP Site assessed area.

3.3 LANDFORM

Several landforms occur on the DZP Site reflecting the diversity of the underlying geology. The majority of land can be described as gently undulating basalt low hills, foot slopes and trachyte hills of rock pavements and scarps. More recent alluvial deposits occur along the floodplain associated with Wambangalang Creek.

Local topography is steep to undulating with granite tors, pavements and rocky outcrops occurring. Igneous intrusions (such as Turtle Hill) form high hills and knolls rising up to 620 metres AHD above the surrounding land. Dowds Hill is the most significant local feature rising to 440 metres AHD, approximately 165 metres above the Macquarie River.

3.4 GEOLOGY AND SOILS

Geology and Soil Landscapes within the DZP Site have been described by Sustainable Soils Management (2012) (Part 10 of the *Specialist Consultant Studies Compendium*) and were generally correlated with the underlying geology in the following way:

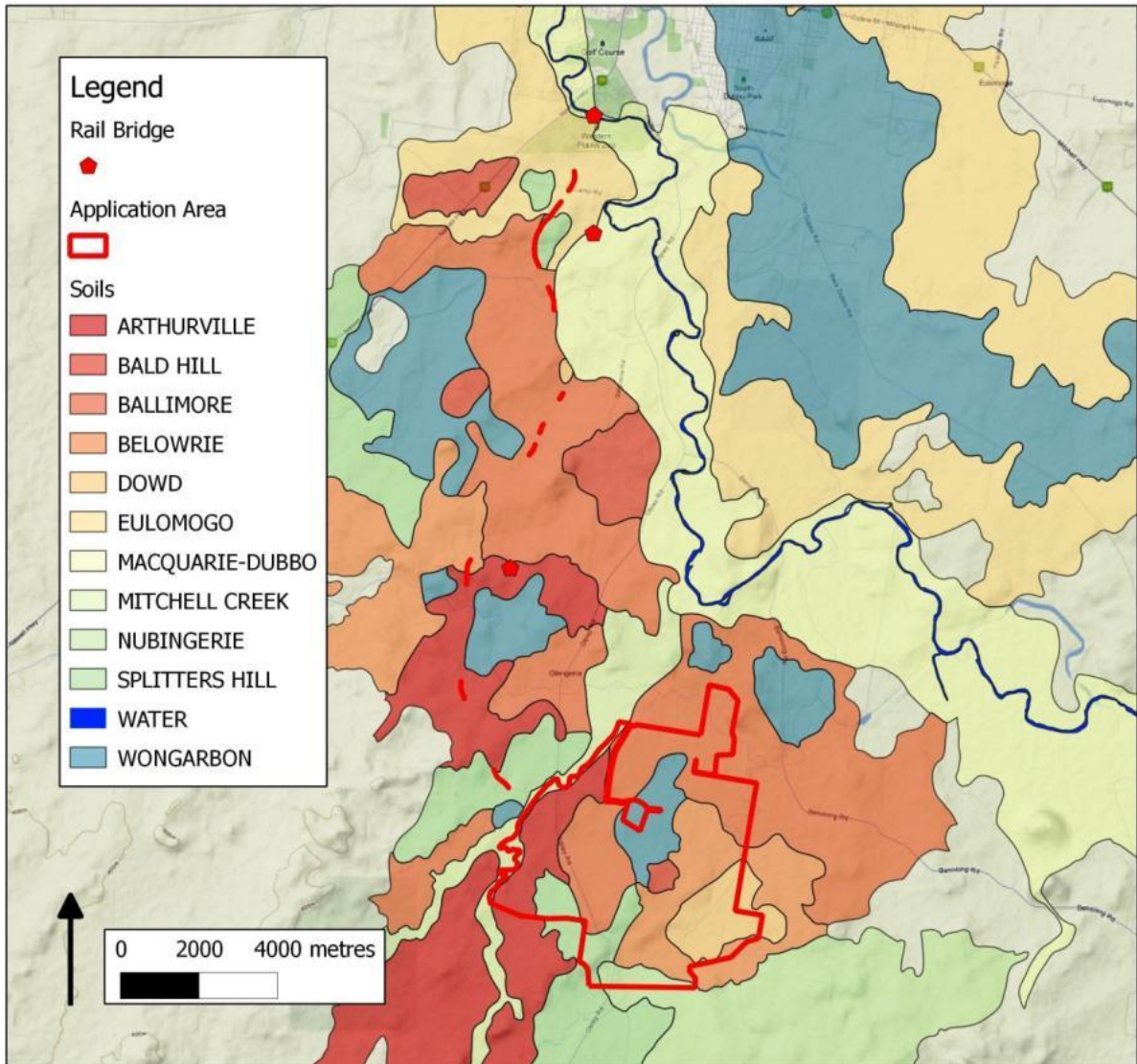
- Felsic rocks in the oldest Silurian geology supported the Arthurville landscape, while less felsic geology of the same age supported the more clayey and productive.
- Nubingerie landscape. Shale in the Silurian geology supported Splitters Hill landscape.
- Napperby Formation supported Ballimore landscape, while more sodic rock of similar age supported Turkey Range landscape.
- Basaltic rocks supported well drained Bald Hill and clayey Wongarbon landscapes.
- Trachyte rocks supported shallow, unstable soil of the Belowrie landscape, and the rocky Dowd landscape.
- Recent alluvial deposition has formed the Mitchell Creek landscape.

Specifically nine landscapes were identified:

- Arthurville Landscape on Silurian Geology.
- Splitters Hill Landscape on Silurian Geology.
- Dowd Landscape on Weathered Trachyte.
- Belowrie Landscape on Weathered Trachyte.
- Wongarbon Landscape on Basaltic Outcrops.
- Bald Hill Landscape on Basalt Outcrop.
- Mitchell Creek Landscape on Quaternary Alluvium.
- Turkey Range Landscape on Jurassic Purlewaugh Formation.
- Ballimore Landscape on Triassic Napperby Formation.

The open cut is situated on the Toongi intrusive, a Jurassic aged trachyte plug intruded into a flat lying sequence of inter-bedded Triassic sandstone, siltstone and basalt (see **Figure 7**).

Figure 7: Geology and Soils within the DZP Site



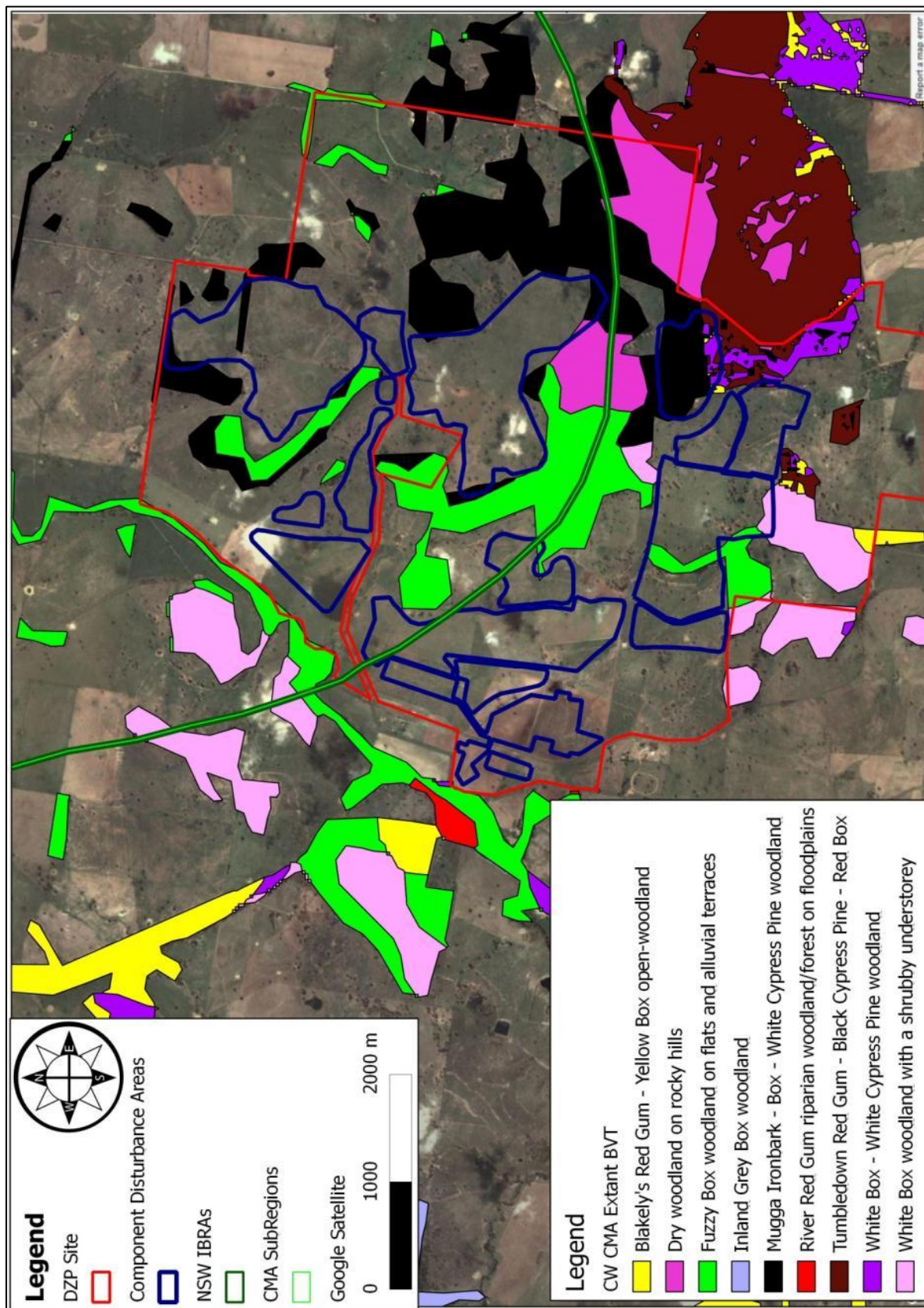
Note: Image presents the DZP Site assessed area.

3.5 VEGETATION

Broad Vegetation Types (BVT) previously mapped by the CW CMA are shown in **Figure 8**. The DZP Site is predominantly agricultural land, followed by derived grasslands (>50% weedy, rotationally cropped). Areas of remnant vegetation support a mosaic of Grassy Woodland Formations. River Red Gum along with scattered River Oak with Rough Barked Apple and Apple Box occurs along Wambangalang Creek with Yellow and Inland Grey Box found on outer edges of the floodplain.

Derived grasslands (>50% weedy, rotationally cropped) is the main vegetation community to be affected by the activity.

Figure 8: Broad vegetation types and wildlife corridors in the Application Area (Source: Google Earth© Base map, Central West CMA extant shape file).



Note: Image presents the DZP Site assessed area.

3.6 BIODIVERSITY LINKS

3.6.1 Habitat Connectivity

Fauna wildlife corridors are usually associated with waterways, wetlands and riverine environments or specific continuous habitats (for example escarpments, woodlands). Regionally the Application Area is likely to provide a movement pathway or stepping stone habitat for large scale migrations along vegetated areas on a north / south alignment floodplain areas associated with the Macquarie River (a State biodiversity link, **Table 20**) and Wambangalang Creek (Regional biodiversity link, **Table 20**). Biodiversity links provide connectivity for migrating and wetland birds between semi-arid rangelands to the west and rainforests to the east. Existing farming practices has seen clearing and ploughing to the top bank of the waterways, thus the width of remnants are generally 'thin'.

Vegetation in the DZP Site provides connectivity with the Macquarie River (a State biodiversity link, **Table 20**) and large areas of remnant native vegetation including Dowds Hill (a local biodiversity link, **Table 20**, adjacent to the open cut), Goobang National Park (30 kilometres southwest) and Momo State Forest (20 kilometres west) via remnant vegetation associated with Obley Road reserve (a local biodiversity link, **Table 20**), Wambangalang Creek (a regional biodiversity link, **Table 20**).

Obley Road is the most notable habitat interruption to this corridor between Wambangalang Creek and the vegetated hills to the south. Obley Road itself, however, has a wide vegetated road reserve where Travelling Stock Routes were once located. Remnant native vegetation associated with Dowds Hill adjacent to the proposed open cut area is one of the largest privately owned native vegetation remnants in the Dubbo LGA measuring approximately 600 to 800 hectares. Dowds Hill is effectively an 'island' remnant within an agricultural landscape (see **Figure 8**). This area of remnant vegetation has further connectivity with smaller remnants along fence lines, creek lines, roads and tree clumps connecting to the Macquarie River. The Applicant proposes to link Dowds Hill to the Wambangalang Creek through planting and native vegetation protection in a proposed 'green corridor', and improve linkages in a similar manner to the remnant native vegetation corridors of Benolong Road to the north and Eulandool Road to the south.

Biodiversity links and connectivity in the Application Area are shown in **Figures 8** and **22**.

Ground dwelling species have physical barriers preventing dispersal (i.e. cropped paddocks) and are further affected by the impacts of habitat removal from feral pig and fox populations. Ground dwelling animals within the Critical Weight Range (500g to 5.5kg) would have safe opportunities for dispersal in the region within intact vegetation portions or established tussock grasslands. This would change in more disturbed areas in the Application Area due to the lack of ground debris. Cleared agricultural land (mainly on flat arable floodplains) within the DZP Site provides a degree of restriction to fauna movement.

3.6.2 Koala Movement Corridors

Koala populations have declined in the central west, but are sporadically recorded around Dubbo. This species has potential to occur within the DZP Site where White Box (SEPP 44 feed tree species) is known to occur as part of the tree canopy species. Koalas are more likely to occur outside the DZP Site within the River Red Gum community along Wambangalang Creek and the Macquarie River. It is unlikely that Koalas would move east from preferred feed trees associated with these riparian corridors to drier open country in the DZP Site.

3.7 EXISTING LEVELS OF DISTURBANCE

All areas assessed have been historically and currently disturbed by agricultural regimes and changes of fire regimes.

Agriculture has had a cumulative impact in modifying the DZP Site. Land with higher agricultural potential is associated with valley floors. All privately owned land in these areas has been selectively cleared to provide extensive grassy grazing paddocks or areas for cultivation.

The lower portions of the DZP Site consist of alluvial plains and foot slopes and are used predominantly for cropping. When left fallow these areas may be colonised by derived native grasses with variable weedy components depending on soils, landscape position and hydrology. Many of these areas are mapped in this report as Derived Grasslands (>50% weeds, rotationally cropped).

Cropping and grazing is the dominant land use. Extensive vegetation modification has preceded broad acre cultivation. It has altered surface drainage on a local scale. Soil surface layers have been continuously displaced, particularly in broad-acre cultivation. Some of the more elevated and rockier areas may have been cleared in the past. These remain largely undeveloped for agriculture and are accessed for occasional grazing. **Figure 9** provides an interpretation provided by the Applicant, following consultation with local landowners, of current and recent land use over the DZP Site.

Due to the geology of the hills within the DZP Site, loose surface rocks are common. Collected rocks piles litter the Application Area on the slopes. This activity has removed reptile habitat and microclimates in any area that could be ploughed.

Much of the ground layer within those areas of the DZP Site to be developed for the purpose of the Proposal has been invaded by weeds. Some remnant vegetation is consistent with the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland*.

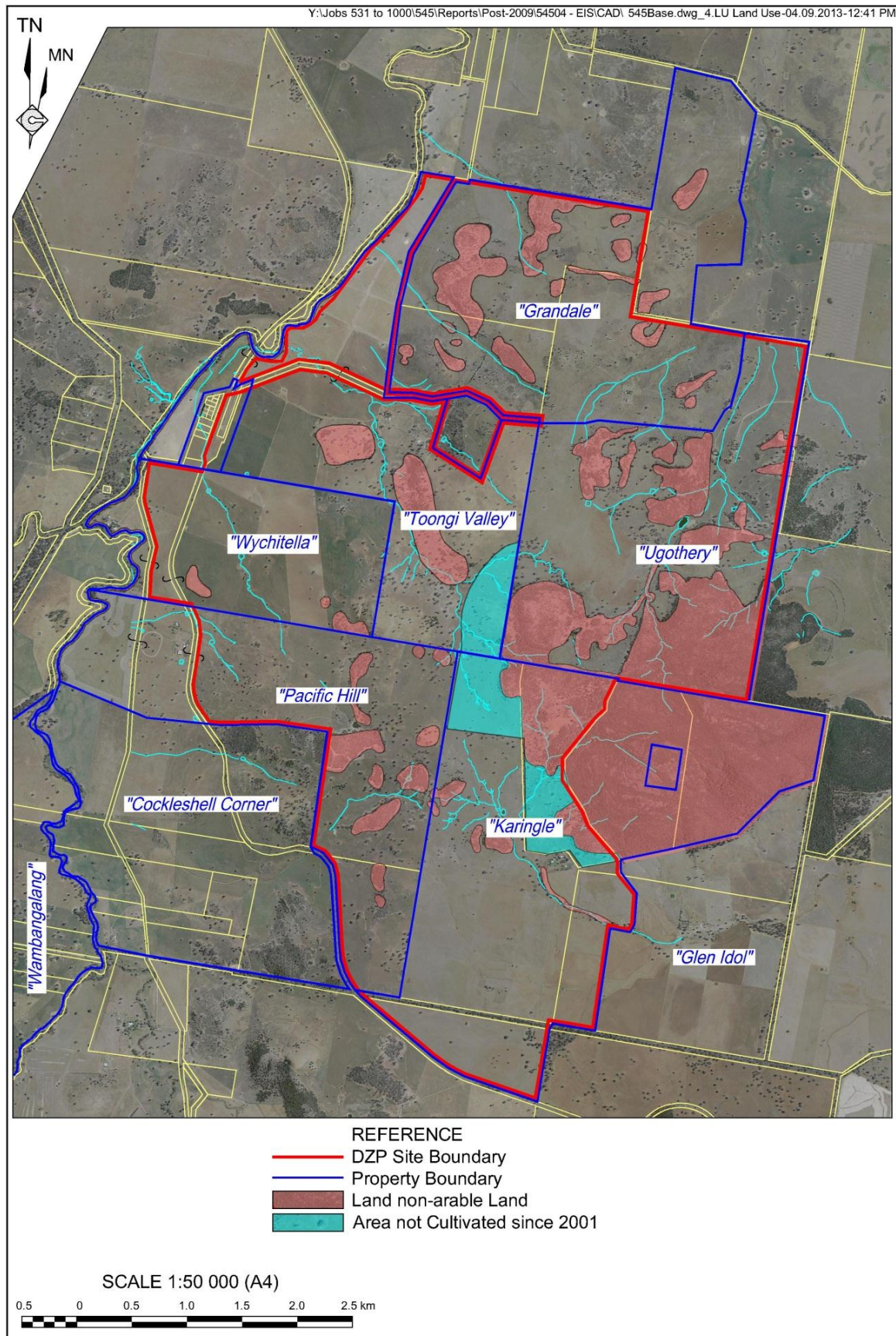
Existing remnant vegetation is highly fragmented or removed in cropped areas. Habitat availability for native fauna is modified and consequently unsuitable for those species unable to adapt.

The diversity and density of native species has been compromised. Many listed species are susceptible to the impacts associated with rotational cropping followed by grazing. The risk of predation as a result of habitat disturbance has increased with a notable reduction in roosting / breeding opportunities for those species requiring anything larger than a small tree hollow.

In sections of the DZP Site where cultivation is not prevalent, the size and structural integrity of remnant vegetation communities and biodiversity is greater. These areas are generally outside of those areas of the DZP Site to be developed for the purpose of the Proposal and as such have been targeted for biodiversity offsetting.

Dowds Hill and the majority of other wooded areas have dense White Cypress Pine (and some Black Cypress Pine) monocultures. These monocultures have a significantly lower level of biological diversity. Pine thinning (to stimulate natural recruitment of mid and ground stratum species) will form part of the rehabilitation and biodiversity improvement strategies of the Proposal.

Figure 9: Current Land Use of the DZP Site (Source: AZL).



4. METHODOLOGY

4.1 PRELIMINARY DESKTOP ASSESSMENTS

4.1.1 Project Ecological Background

Flora and fauna survey and vegetation mapping was undertaken over portions of the Application Area in 2001 and 2002, with several draft reports prepared (GCNRC 2002a, b & c; Goldney 2002) before the development application process for the Proposal was placed in hiatus.

Additional flora and fauna survey and vegetation mapping of the DZP Site was undertaken or managed by Ozark during 2012 and 2013. Vegetation communities recorded by Geoff Cunningham in 2001 were transcribed into 'best fit' *Biometric* Vegetation Communities and incorporated into the vegetation map for the DZP Site (see **Figures 11** and **12**). Results from these assessments are further discussed in **Section 4.1.2** of this report. All vegetation communities were ground-truthed during the OzArk surveys.

4.1.2 Information Sources

Preliminary assessment drew on a number of information sources including previous the previous survey and draft reports of Cunningham (2002a, b and c) and Goldney (2002) as well as information held on government databases and archives. Data gathered during preliminary assessment was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Preliminary assessment utilised a number of information sources, including:

- Aerial Photograph Interpretation of the landscape and existing vegetation maps.
- Literature reviews to determine vegetation and species habitat within the site including review of the Flora of the Dubbo Region (Hoskin 2012).
- Review of flora records contained in the OEH Threatened Species Database and EPBC Protected Matters Search.
- NSW Wildlife Atlas/ Bionet GIS data request.
- NSW Wildlife Atlas/ Bionet GIS website.
- Australia Museum records.
- Royal botanical Gardens (Plantnet NSW Flora Online).
- NSW Atlas of Living Australia records.
- Birds Australia Atlas.
- The local knowledge of the DFN invited to participate in field survey.

The background searches enabled a predictive model of threatened flora and fauna occurrence to be developed for the Application Area (see **Section 4.2**).

4.1.3 Desktop and Background Database Search Results

4.1.3.1 Preliminary Database Search Results

Table 3 presents a summary of databases searches conducted for TSC Act, FM Act and EPBC Act listed species, ecological communities and populations. Copies of the OEH threatened species database search (TSC Act), Bionet Wildlife Atlas database search (TSC Act), DPI records viewer (FM Act) and DSEWPac Protected Matters (EPBC Act) threatened species database searches have been provided as **Appendix 2**.

Table 3: Desktop Database Search Results

Name of database searched	Date of search	Area searched	Comment
NSW Government Wildlife Atlas: http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp	27.7.2012 5.9.2012	Central West - Talbragar Valley CMA Central West - Upper Slopes CMA	Licensed Report of all Valid Records of Threatened (listed on TSC Act), CAMBA listed, JAMBA listed or ROKAMBA listed Animals and Plants in Central West - Talbragar Valley and Central West - Upper Slopes CMA cut by national Bioregion Subregion. Search returned a total of 279 records of 45 species within the Talbragar Valley subregion. Search returned a total of 1161 records of 111 species within the Upper Slopes subregion. Appendix 1 . Within a 10km radius centred on the DZP Site, the following species recorded: <ul style="list-style-type: none"> • Two records of the Brown Treecreeper (eastern subspecies) • Two records of the Rainbow Bee-eater • Two records of the Grey-crowned Babbler (eastern subspecies) • Two records of the Superb Parrot.
Office of Environment and Heritage (OEH) Threatened Species online database: http://www.threatenedspecies.environment.nsw.gov.au/index.aspx	22.8.2012	Combined geographic and habitat search in Central West (Upper Slopes).	104 items predicted or known to occur. Includes 52 species of threatened fauna, 10 species of threatened flora, three EEC and 32 threats. Appendix 2 .
DSEWPac Register of Critical Habitat: http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl	22.8.2012	National search: Register of Critical Habitat	No habitats listed as 'Critical' are within the Application Area.
Office of Environment and Heritage – Critical Habitat Register: http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm	22.8.2012	NSW Critical Habitat Register	No habitats listed as 'Critical' are within the Application Area
Office of Environment and Heritage (OEH) Threatened Species online database: http://www.threatenedspecies.environment.nsw.gov.au/index.aspx	30.8.2012	Combined geographic and habitat search in Central West (Talbragar Valley)	94 items predicted or known to occur. Includes 48 species of threatened fauna, 10 species of threatened flora, three EECs and 33 threats. Appendix 2 .
NSW Trade and Investment (Department of Primary Industries, DPI)	31.8.2012	Declared 'Noxious Weeds' in the Dubbo LGA	97 Noxious Weeds are listed as occurring in the Dubbo LGA. It is likely that any of these noxious weeds would have the opportunity to be present in response to disturbance and fluctuating rainfall.

Name of database searched	Date of search	Area searched	Comment
Dubbo LEP	31.8.2012	Local Environmental Plan	Nothing relevant to the ecology of the Application Area
Important Bird Areas (IBA): http://www.birdlife.org/datazone/geomap.php?r=i&c=13	31.8.2012	Application Area	No IBA are located within the Application Area. The Application Area is situated directly north of the <i>South West Slopes IBA</i> and south of the <i>Goonoo IBA</i>
DSEWPac Protected Matters (EPBC Act) Database: http://www.environment.gov.au/erin/ert/epbc/index.html	31.8.2012	Dubbo LGA	Threatened Ecological Communities: 5 Threatened Species: 23 Migratory Species: 17 Commonwealth Lands: 8 Listed Marine Species: 17 Places on the RNE: 22 State and Territory Reserves: 7 Invasive Species: 14
Atlas of Living Australia	31.8.2012	5km radius centred on the Open Cut.	<ul style="list-style-type: none"> • 11 records of the Pink-tailed Worm-Lizard within Application Area on the Open Cut and Dowds Hill. • One record of the Brown Treecreeper In the Application Area adjacent to Wambangalang Creek • One record of the Varied Sittella In the Application Area adjacent to Wambangalang Creek • One record of the Glossy Black Cockatoo (south of Application Area) • One record of the Painted Honeyeater In the Application Area adjacent to Wambangalang Creek • One record of the Rainbow Bee-eater In the Application Area adjacent to Wambangalang Creek • One record Diuris tricolor (south of Application Area) • Four records of <i>Philothea ericifolia</i> in the Application Area near Wambangalang Creek • One record of the Diamond Firetail in the Application Area near Wambangalang Creek • One record of the Superb Parrot in the Application Area near Wambangalang Creek • Two records of the Grey-crowned Babbler in the Application Area near Wambangalang Creek
NSW Department of Industries and Investment – Fishing and Aquiculture Records Viewer: http://www.dpi.nsw.gov.au	31.8.2012	Dubbo LGA	Freshwater Catfish, Murray Cod and Trout Cod have been previously recorded in the Dubbo LGA.
TSC Act Key Threatening Processes: http://www.environment.nsw.gov.au/threatenedspecies/KeyThreateningProcessesByDoctype.htm	31.8.2012	Key Threatening Processes.	36 KTPs are currently listed under the TSC Act. An assessment of these 36 KTPs for the Project is listed in. Appendix 1 . It is likely that seven KTPs will be exacerbated by the Proposal.
EPBC Act Key Threatening Processes: http://www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl	31.8.2012	Key Threatening Processes	19 KTPs are currently listed under the EPBC Act. An assessment of these 19 KTPs for the Project is listed in. Appendix 2 . It is likely that the KTP 'Land clearance' will be exacerbated by the Proposal.

Name of database searched	Date of search	Area searched	Comment
FM Act Key Threatening Processes: http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-at-current	31.8.2012	Key Threatening Processes	Eight KTPs are currently listed under the FM Act. It is likely that one KTP will be exacerbated by the Proposal and one KTP will be reduced in the Application Area. An assessment of these KTPs for the Proposal is listed in Appendix 2 .
NSW Legislation website: SEPP 44 Koala Habitat Protection: http://www.legislation.nsw.gov.au	10.3.2013	Schedule 1 Local government areas (Clauses 5 (1), 11 (1), 12, 15).	Dubbo LGA is not listed in SEPP Schedule 1 of the SEPP. Thus, SEPP 44 does not apply. Koalas are, however, known to occur in the Dubbo LGA and White Box and River Red Gum are Schedule 2 listed feed tree species. As such, SEPP 44 does not apply, however, Koala habitat will be considered.

Threatened flora and fauna identified previously during the 2001 and 2002 surveys of Cunningham (2002a, 2002b & 2002c) and Goldney (2002) have been incorporated in the Wildlife Atlas Results (see **Figure 10**).

The voucher specimen lodged with the Australian Museum by Goldney in 2001 was identified as Flinders Range Worm Lizard (*Aprasia pseudopulchella*), EPBC Act. This voucher specimen upon request was re-assessed by Museum staff in March 2012 and subsequently identified as the Pink-tailed Worm-lizard. It should be noted that the records for the Flinders Range Worm Lizard, have been amended on the Atlas of Living Australia to show the Pink-tailed Worm-lizard (V TSC Act, EPBC Act).

4.1.3.2 Available Vegetation Mapping / Flora Descriptions

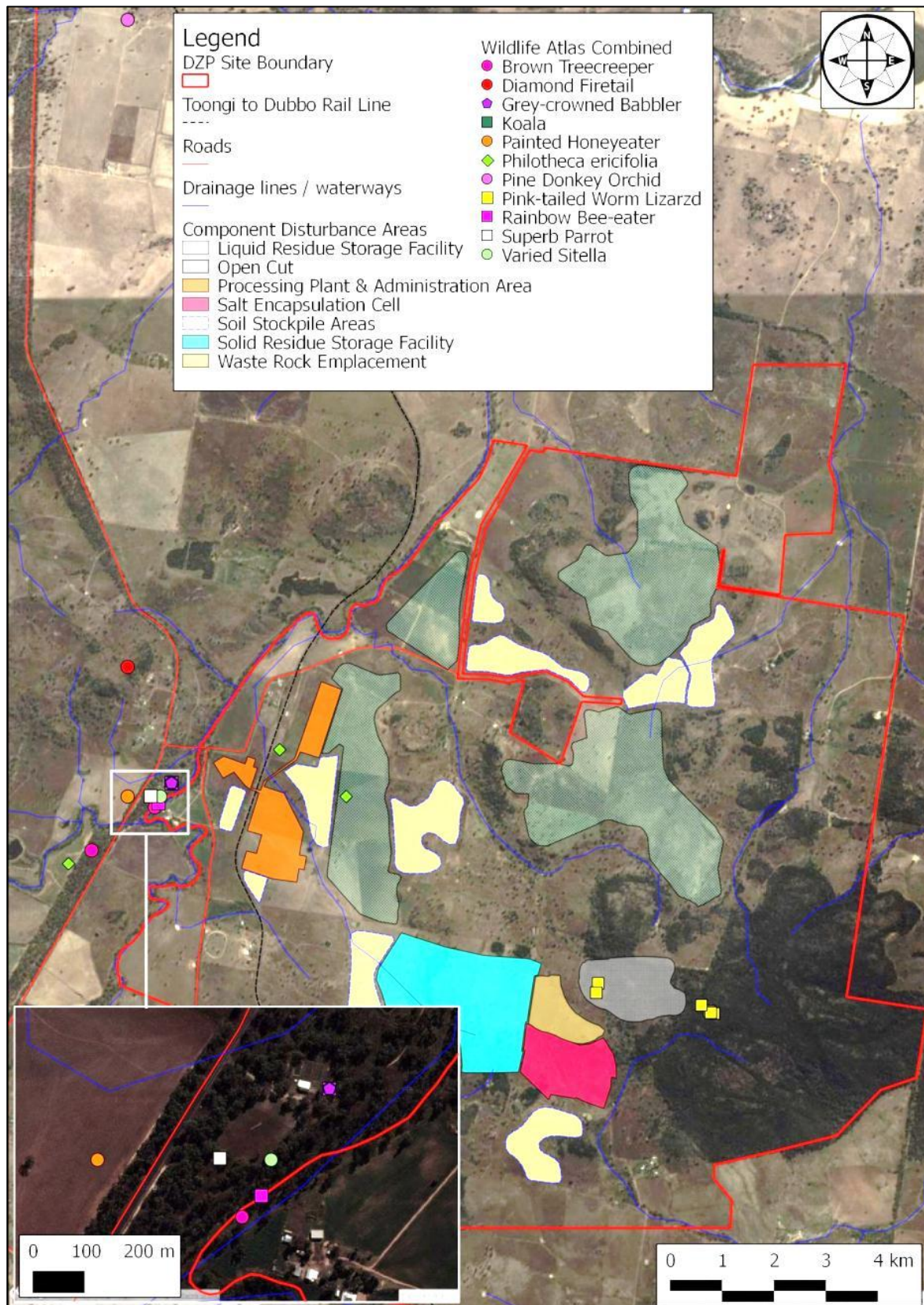
Local Assessments

Flora survey and vegetation mapping by GCNRC was undertaken over the Application Area in 2001 and 2002. Several draft reports were prepared (GCNRC 2002a, b and c) before the Project was placed in hiatus.

GCNRC (2002a, b and c) recorded six vegetation communities over the original DZP Site (**Figures 11 and 12**):

- Community 1 – Cleared Cultivation and Grazing Country with Scattered Trees and Tree Clumps.
- Community 2 – Black Cypress Pine (*Callitris endlicheri*) - Tumbledown Gum (*Eucalyptus dealbata*) – White Cypress Pine (*Callitris glaucophylla*) Community.
- Community 3 – White Box (*Eucalyptus albens*) - Grey Box (*Eucalyptus microcarpa*) - White Cypress Pine (*Callitris glaucophylla*) Community.
- Community 4 – Black Cypress Pine (*Callitris glaucophylla*) - Red Stringybark (*Eucalyptus macrorhyncha*) Community.
- Community 5 – Open Rocky Heath Community.
- Community 6 – Fuzzy Box (*Eucalyptus conica*) - Yellow Box (*Eucalyptus melliodora*) - River Red Gum (*Eucalyptus camaldulensis*) Community.

Figure 10: Threatened Flora and Fauna in proximity to the DZP Site (Source: NSW Bionet - Wildlife Atlas / Atlas Of Living Australia).



Note: Image presents the DZP Site assessed area.

Figure 11: Mapped Vegetation Over The DZP Site Provided By GCNRC 2002c

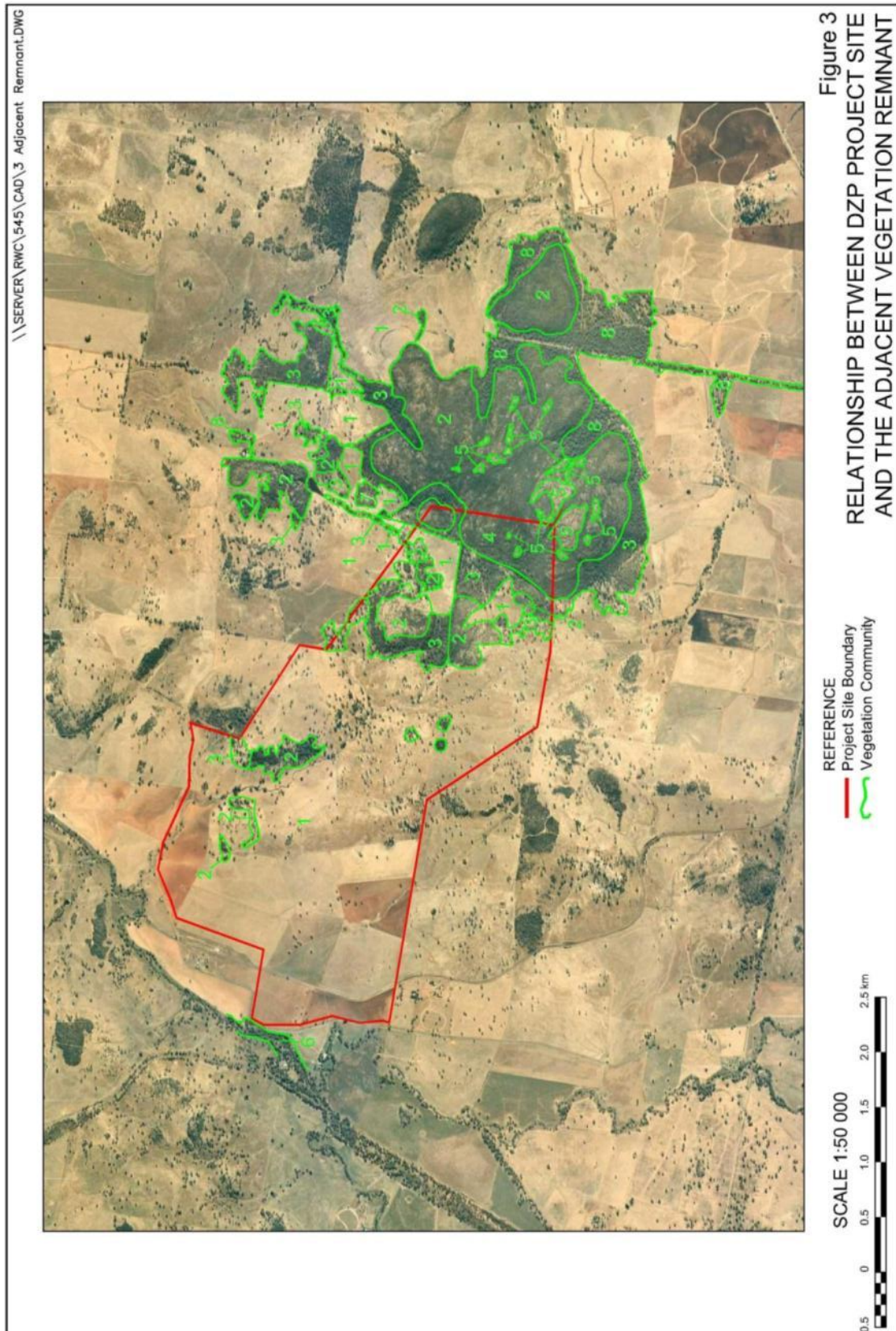
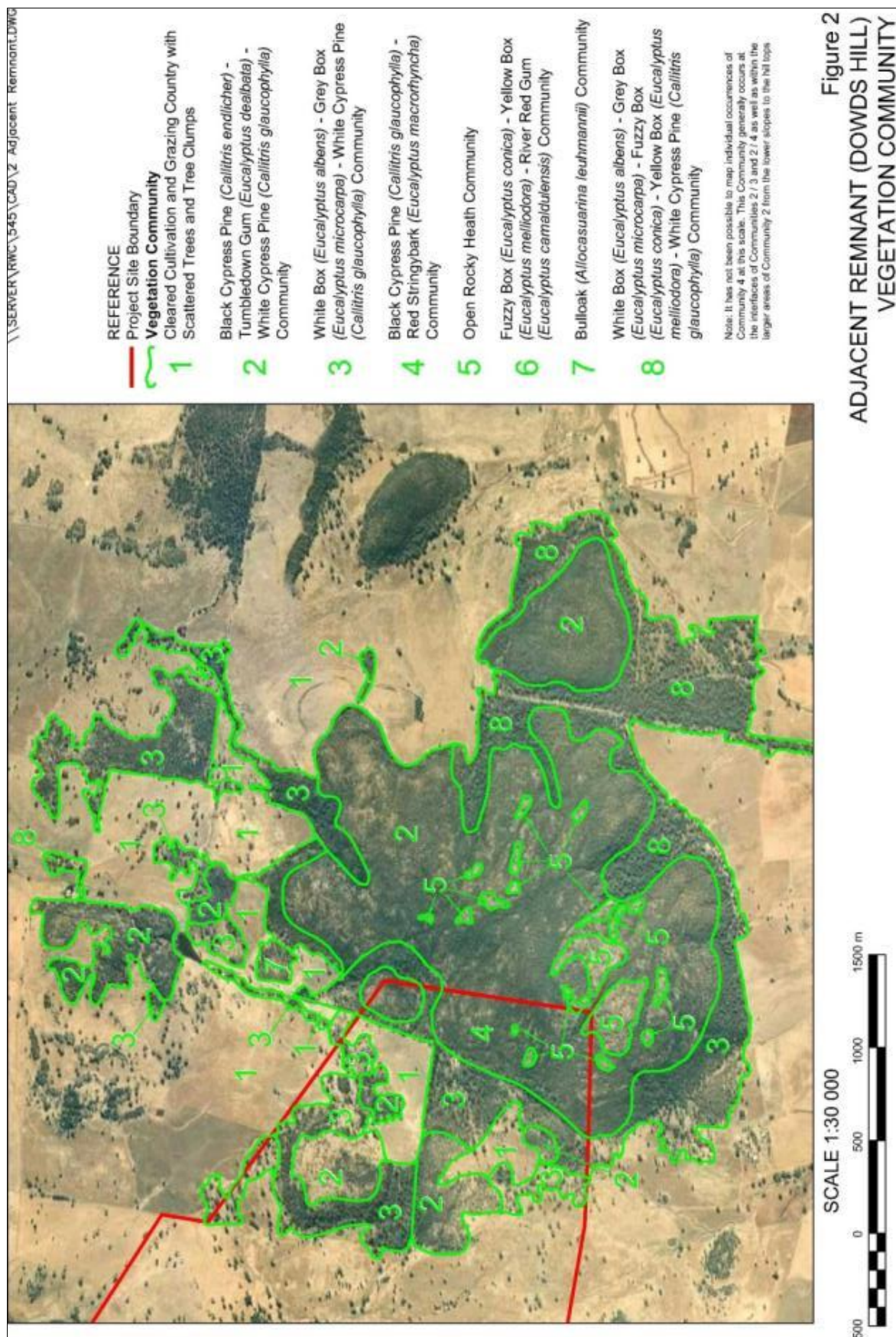


Figure 12: Mapped Vegetation over the DZP Site Provided by GCNRC 2002c



Box-gum Woodland (White Box community) listed as critically endangered in the EPBC Act and as endangered in the TSC Act was identified surrounding the disturbance areas.

Two additional vegetation communities were identified within the adjacent remnant vegetation (Dowds Hill) to the original DZP Site (GCNRC 2002a):

- Community 7 – Bulloak (*Allocasuarina luehmannii*) Community.
- Community 8 – White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus microcarpa*), Fuzzy Box (*Eucalyptus conica*), Yellow Box (*Eucalyptus melliodora*), White Cypress Pine (*Callitris glaucophylla*).

Other notable flora descriptions relevant to the Application Area include:

- Several OzArk projects undertaken in the Dubbo LGA.
- A floristic list compiled by Mike Sutherland (unpublished) of the DZP Site following numerous visits to the site during a range of seasons in the period 2000 to 2001.
- A floristic list compiled within remnant vegetation at Taronga Western Plains Zoo site near Dubbo compiled in 2000 (Lewer, unpublished).
- A floristic list published by DFN for the Dubbo Area (Hosking 2012).

Regional and Bioregional Assessments

Several broader studies have described and mapped vegetation of the locality. Morgan and Terry (1992) first described the vegetation within the Brigalow Belt South Bioregion (BBSB) in their publication 'Nature Conservation in Western New South Wales'. Thackaway & Cresswell (1995) revised Morgan and Terreys (1992) boundaries and broadly mapped the vegetation of the BBSB. Survey and mapping also of the BBSB was undertaken by NSW NPWS as part of Stage 1 of the Joint Vegetation Mapping Project for the BBSB Western Regional Assessment (WRA) (Planning NSW 2002). The Joint Vegetation Mapping Project for the BBSB WRA (Stage 2) was undertaken by the Department of Planning Infrastructure and Natural Resources (now DPI) and National Parks and Wildlife Service (now OEH).

Six map sheets were completed to Department of Land and Water Conservation (DLWC) Native Vegetation Mapping Program (NVMP) technical standards as set out in the Guidelines for mapping native vegetation (Sivertsen and Smith, 2001).

The Central West CMA (DEC NSW 2006) commissioned a vegetation mapping study of the catchment "Reconstructed and Extant Distribution Native Vegetation in the Central West Catchment," to show the extent and importance of native vegetation. **Figure 8** shows the CMA broad vegetation types (BVTs) mapped across the Application Area.

More recently, Keith (2004) mapped the vegetation formations in NSW and the ACT. A Vegetation Formation is the highest level of the classification hierarchy and relates to broad groups distinguished by structural and physiognomic features (rough statistical correlations between physical features). During recent years OEH has been conducting extensive mapping and research within the bioregion aimed at describing and recording many of the natural assets (Gibbons *et al.* 2005). Benson *et al.* (2006) and Benson (2008) have reviewed all previous published and much unpublished work to compile a comprehensive list and descriptions of the plant communities of the NSW western plains as part of a major project, the NSW Vegetation Classification and Assessment Project (NSWVCA), to classify the vegetation of NSW. The vegetation communities recognised by Benson *et al.* (2006) are from the basis of a standard vegetation classification for NSW. Accordingly, the Benson *et al.* (2006)

classification has been adopted in this report to describe the vegetation of the Application Area (NSWVCA is referred to as the BioMetric database in this report).

4.1.3.3 Previous Fauna Assessments

Fauna survey of the proposed mining and original processing operations areas (within the DZP Site) were undertaken by David Goldney of Centwest Environmental Services in 2001 and 2002 (Goldney 2002).

180 vertebrate fauna species were identified during the 2002 vertebrate fauna survey in the DZP Site (Goldney 2002). These can be broken down into:

- 115 species of bird, including eleven threatened species listed under the TSC Act and two under the EPBC Act.
- 31 species of mammal, including 20 native and 11 exotic mammals including three (3) threatened microchiropterans and seven introduced species.
- 21 species of reptile.
- Ten species of amphibian.
- Three species of fish (in Wambangalang Creek).

During the 2001 survey the Pink-tailed Worm-lizard (V TSC Act, EPBC Act) was collected. This was the first and only record of this species in the Dubbo LGA at that time. In 2012, with the impending development of this site as a mining precinct, the Applicant commissioned additional fauna and flora surveys including targeted Pink-tailed Worm-lizard survey to better determine the distribution and abundance of this species within the DZP Site. Biosphere Environmental Consultants Pty Ltd (Biosphere) was commissioned to complete the targeted Pink-tailed Worm-lizard surveys and several reports have subsequently been produced. Biosphere has also prepared a *Pink-tailed Worm-lizard Plan of Management* for the Proposal (**Appendix 13**).

Other notable fauna assessments relevant to the Proposal include:

- Dubbo Bird List, prepared by the DFNCS and last updated October 2010 (Hosking et al. 2010).
- Ecological Overview of three reserves: Jones Creek Reserve, Cumboogle Flora Reserve, and Wongarbon Tank Reserve, Dubbo Local Government Area, NSW (OzArk 2009).
- Status of vertebrate fauna and their habitat in the Central West Catchment (Goldney, Kerle and Fleming 2007).
- Report on preliminary fauna survey of the Pilliga and Goonoo Forests November 1999 to January 2000 (NSW NPWS 2000).
- Community data search and biodiversity survey of the Brigalow Belt South Bioregion Stage 1 (NSW NPWS 2002).

Systematic surveys of fauna and flora in the Goonoo State Conservation Area (SCA) and Little Beni SCA have also been undertaken by NSW NPWS in 2000 and 2002. These provide a good baseline of fauna species that have the potential to occur in the Application Area based on habitat available. Several targeted species surveys i.e. for the Glossy Black Cockatoo have

also been undertaken by DFN around the Dubbo LGA, with Toongi a popular fauna spotting location for the DFN.

4.2 PREDICTIVE MODEL FOR THREATENED ITEMS

The concepts of the modelling formed the basis of the methodology designed for the current assessment. These reflect the predominant patterns of threatened species distribution as elicited from prior survey work.

Remnant patch size of native vegetation is the primary factor appearing to determine the location of threatened plants and animals in the region and to a lesser degree in disturbed habitats (i.e. Derived Grasslands >50% weeds, rotationally cropped) and proximity to a permanent water supply. Predictive modelling for EECs in the locality is fairly straight forward as it can be summarised as likely to be any native vegetation left in the valley floor and on the undulating hills which is unsuitable for cropping or grazing agriculture.

An assessment of likelihood of occurrence was made for threatened species of flora, fauna, populations, ecological communities and migratory species identified from the database searches identified in **Section 4.1**. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the DZP Site and wider Application Area, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- “Yes” = the species was or has been observed on the site.
- “Likely” = a medium to high probability that a species uses the site.
- “Potential” = suitable habitat for a species occurs on the site, but there is insufficient information to the species as likely to occur, or unlikely to occur.
- “Unlikely” = a very low to low probability that a species uses the site.
- “No” = habitat on-site and in the vicinity is unsuitable for the species.

The ecology and habitat requirements of threatened species, populations, and endangered ecological communities and the likelihood of those occurring within the Application Area are detailed in **Appendix 3**.

The BioBanking Credit Calculator incorporates its own databases on the distribution of threatened species and threatened ecological communities. It assumes the occurrence of threatened species based on the CMA, vegetation types recorded and habitat features in the Development Site (Application Area) but also requires confirmation of the presence of other threatened species predicted to occur (see **Appendix 3**). Therefore, reviewing previous records of threatened species for a development area was conducted to confirm the presence/absence of threatened species in an area, in addition to targeted surveys.

As the BioBanking Assessment does not address requirements under the EPBC Act, an EPBC Act Protected Matters Search (DSEWPaC 2013) was conducted (see **Appendix 2**). A preliminary assessment of any potentially occurring threatened species or communities listed under the EPBC Act was undertaken as part of this study and is incorporated with all threatened species predicted to occur (see **Appendix 3**). This preliminary assessment indicated that there is likely to be a significant impact to one Matter of National Environmental Significance, the Pink-tailed Worm-lizard (V TSC Act, EPBC Act).

A summary of species / communities known or considered likely to occur is provided in **Section 4.3, Table 4**. A full list of all species considered in the predictive modelling process can be found in **Appendix 3**.

Table 4: Threatened Items Considered to have the Potential to Occur in the DZP Site

No	Common Name	Scientific Name	TSC Act	EPBC Act	Likelihood
Ecological Communities					
1	Fuzzy Box EEC	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	EEC		Yes
2	Grasslands EEC	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland		CE TEC	No
3	Inland Grey Box EEC	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	EEC		Yes
4	Inland Grey Box and Derived Grasslands EEC	Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia		TEC	Yes
5	Box Gum Woodland CEEC	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		CE TEC	Yes
6	Box Gum Woodland EEC	White Box Yellow Box Blakely's Red Gum Woodland	EEC		Yes
Flora					
7	Ausfeld's Wattle	<i>Acacia ausfeldii</i>	V		Unlikely
8	Lobed Blue-grass [3153]	<i>Bothriochloa biloba</i>		V	Potential
9	Pine Donkey Orchid	<i>Diuris tricolor</i>	V	Not Listed	Potential
10	Philotheca ericifolia	<i>Philotheca ericifolia</i>	Not Listed	V	Yes
11	Small Purple-pea	<i>Swainsona recta</i>	E	E	Potential
12	Silky Swainson-pea	<i>Swainsona sericea</i>	V		Potential
13		<i>Tylophora linearis</i>	V	E	Unlikely
14	Scant Pomaderris	<i>Pomaderris queenslandica</i>	E		Potential
15	Keith's Zieria	<i>Zieria ingramii</i>	E	E	Unlikely
Fauna (birds)					
16	Magpie Goose	<i>Anseranas semipalmata</i>	V		Unlikely
17	Regent Honeyeater	<i>Anthochaera phrygia</i>	C E	E	Potential
18	Fork-tailed Swift	<i>Apus pacificus</i>		Migratory	Potential
19	Great Egret, White Egret	<i>Ardea alba</i>		Migratory	Potential
20	Cattle Egret	<i>Ardea ibis</i>		Migratory	Potential
21	Australasian Bittern	<i>Botaurus poiciloptilus</i>	E	E	Potential
22	Glossy Black-cockatoo	<i>Calyptrorhynchus lathami</i>	V	E (Only South-Australian)	Yes

No	Common Name	Scientific Name	TSC Act	EPBC Act	Likelihood
				Sub-species).	
23	Speckled Warbler	<i>Chthonicola sagittata</i>	V		Yes
24	Spotted Harrier	<i>Circus assimilis</i>	V		Yes
25	Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V		Yes
26	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V		Potential
27	Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E		Unlikely
28	White-fronted Chat	<i>Epthianura albifrons</i>	EP		Potential
29	Grey Falcon	<i>Falco hypoleucos</i>	E		Potential
30	Little Lorikeet	<i>Glossopsitta pusilla</i>	V		Yes
31	Painted Honeyeater	<i>Grantiella picta</i>	V		Potential
32	Brolga	<i>Grus rubicunda</i>	V		Unlikely
33	Black-breasted Buzzard	<i>Hamirostra melanosternon</i>	V		Unlikely
34	Little Eagle	<i>Hieraaetus morphnoides</i>	V		Potential
35	White-throated Needletail	<i>Hirundapus caudacutus</i>		Migratory	Yes
36	Swift Parrot	<i>Lathamus discolor</i>	E	E	Potential
37	Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>	V		Potential
38	Square-tailed Kite	<i>Lophoictinia isura</i>	V		Potential
39	Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V		Yes
40	Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V		Potential
41	Turquoise Parrot	<i>Neophema pulchella</i>	V		Potential
42	Barking Owl	<i>Ninox connivens</i>	V		Potential
43	Powerful Owl	<i>Ninox strenua</i>	V		Unlikely
44	Blue-billed Duck	<i>Oxyura australis</i>	V		Potential
45	Scarlet Robin	<i>Petroica boodang</i>	V		Potential
46	Flame Robin	<i>Petroica phoenicea</i>	V		Potential
47	Superb Parrot	<i>Polytelis swainsonii</i>	V	V	Yes
48	Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V		Yes
49	Merops ornatus	<i>Rainbow Bee-eater</i>		Migratory	Potential
50	Painted Snipe	<i>Rostratula australis</i>	V	V	Potential
51	Painted Snipe (Australian subspecies)	<i>Rostratula benghalensis australis</i>	E	V & Migratory	Potential
52	Diamond Firetail	<i>Stagonopleura guttata</i>	V		Yes
53	Masked Owl	<i>Tyto novaehollandiae</i>	V		Potential
Fauna (Mammals not including bats)					
54	Eastern pygmy possum	<i>Cercartetus nanus</i>	V		Potential
55	Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	Potential
56	Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	V		Potential
57	Koala	<i>Phascolarctos cinereus</i>	V		Potential
58	Stripe-faced Dunnart	<i>Sminthopsis macroura</i>	V		Potential
Fauna (bats)					
59	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	Yes
60	Little Pied Bat	<i>Chalinolobus picatus</i>	V		Yes

No	Common Name	Scientific Name	TSC Act	EPBC Act	Likelihood
61	Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceanensis</i>	V		Yes
62	Greater Long-eared Bat	<i>Nyctophilus timoriensis</i> (South-eastern form)	V	V	Yes
63	Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V		Yes
Fauna (reptiles and amphibians)					
64	Pink-tailed Worm-lizard	<i>Aprasia parapulchella</i>	V	V	Yes
65	Sloane's Froglet	<i>Crinia sloanei</i>	V		Potential
66	Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	V		Unlikely
67	Broad-headed Snake	<i>Hoplocephalus bungariodes</i>	E	V	Unlikely
68	Little Whip Snake	<i>Suta flagellum</i>	V		Unlikely
Fauna (fish)					
69	Trout Cod	<i>Maccullochella macquariensis</i>	FM Act	E	Unlikely
70	Murray Cod, Cod, Goodoo	<i>Maccullochella peelii peelii</i>	FM Act	V	Unlikely

EEC Endangered Ecological Community

CE Critically Endangered

E Endangered

TEC Threatened Ecological Community

V Vulnerable

4.3 DETERMINATION OF LOCAL THREATENED AND MIGRATORY FAUNA, FLORA AND ECOLOGICAL COMMUNITIES AS SUBJECT SPECIES

Subject species are those threatened species known or considered likely to occur in the habitats present within the study area (DEC, 2004). From the database and document review, 97 threatened species and communities have been previously recorded or are predicted to occur in the DZP Site (**Appendix 2** and **3**). Using the results of the habitat assessment and field surveys, an assessment has been undertaken of the likelihood of each species occurring within the Application Area (**Appendix 3**). Of these 97 species 69 have the potential to occur in the DZP Site (**Table 4**).

Of the 20 threatened plant species assessed in **Appendix 3**, ten species have the potential to occur in the DZP Site, including one known to occur, two likely to occur and seven with potential to occur.

Of the six recorded EECs assessed in **Appendix 3**, three are known to occur.

Of the 71 threatened and/or migratory fauna species assessed in **Appendix 3**, 56 have the potential to occur within the DZP site, including 22 known to occur, six likely to occur and 28 species that may occur.

4.4 FAUNA SURVEY METHODOLOGY GENERAL

The survey methods employed during the field investigations were generally based on the descriptions provided in the following publications and any relevant recovery plans and threat abatement plans for ecological assessment. The following documents have formed the core basis for ecological assessment over the Application Area:

- OEH Threatened species survey and assessment: Guidelines for developments and activities. Working Draft, November 2004 (DEC 2004).
- OEH Field Survey Methods (DECCW 2009).
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DSEWPaC 1999a).
- Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DSEWPaC 1999b).
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals as threatened under the EPBC Act (DSEWPaC 1999c)
- Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under EPBC Act (DSEWPaC 1999d).

Survey within the DZP Site also followed the BioBanking Assessment Methodology (BBAM) which is consistent with these guidelines.

Broadly, the survey methods employed during the field fauna investigations were as follows.

- The direct observation of any fauna species present within, or adjacent to, the areas investigated.
- Live trapping using Elliott (Size A and B) and hair tube traps.
- Dedicated bird and herpetofauna searches.
- Diurnal and nocturnal call identifications, with all calls being identified in the field.
- Spotlighting.
- Call playbacks targeting nocturnal animals.
- Echolocation detection targeting insectivorous bats (microchiropterans).
- The collection, or identification of, scats, including those that contain hair and bone material.
- The identification of any indirect evidence such as tracks/scratching that would suggest the presence of any fauna species.
- Interviews with landholders.

Where required, more detailed descriptions on one or more of these methods are provided in the following sub-sections below (see **Section 4.4.1 to 4.4.9**).

In those instances where live trapping was undertaken, all traps were left open for the entire duration of the evening and checked during the early morning periods.

Visual observations of the captured animal were made, these assisting in species identification (e.g. observing tail length of those rodents caught).

Table 4 presents the method employed, and the survey effort accumulated by the completion of the field investigations.

4.5 FAUNA SURVEY METHODS AND EFFORT

4.5.1 Overview

The following section outlines survey effort within the Application Area (**Table 4** and **Figures 13 to 16**). A review of the consistency of the survey effort with the BBAM and other field survey guidelines is provided in **Appendix 7**. **Sections 4.4.2 to 4.4.9** provide a more detailed description of each of the survey methods implemented.

4.5.2 Echolocation

Anabat SDITM and/or Anabat ZCAITM echolocation detectors were used to identify the presence of any threatened microchiropterans that may be present (**Table 6** and **Figure 13**). The echolocation sites selected, corresponded to habitats likely to be used by microchiropterans during their foraging and dispersal periods (i.e. woodlands, habitat ecotones) or as roosting sites (i.e. hollow-bearing trees where present, rail bridges, rocky outcrops). Emphasis was placed on the Component Disturbance Areas.

The detectors were set prior to dusk and left in place for the entire duration of the evening and collected in the morning.

In instances where rain was predicted, as they are not water proof, either a protective cover was placed over the detector's sensor (in accordance with Engel, Bloomfield and Edwards 2010) or the unit was collected.

Calls were analysed by Lesryk Environmental Pty Ltd using Anabat 6.3 computer software.

4.5.3 Elliot Trapping

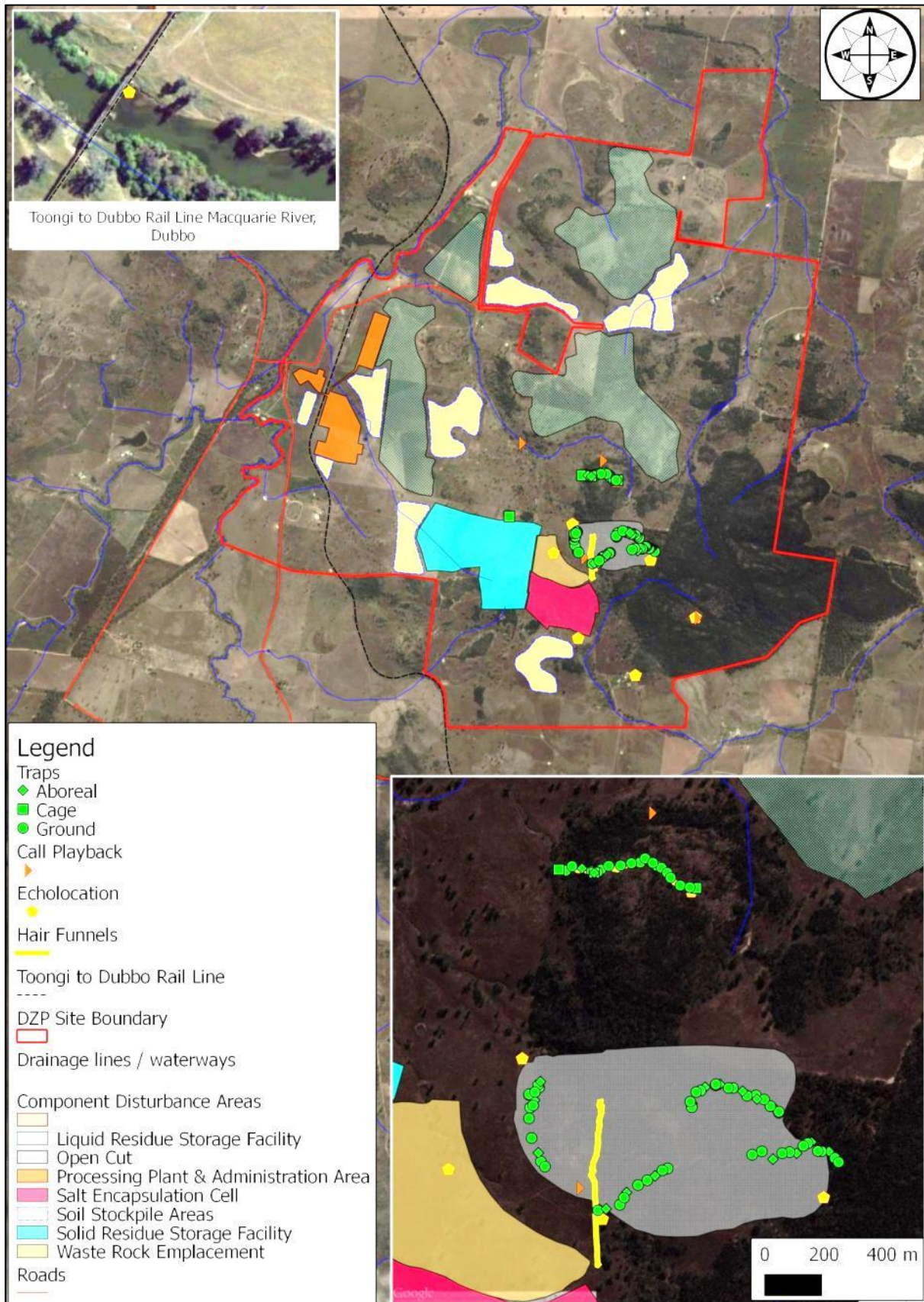
Elliot trapping followed the NSW DPI Policy of *Cage Trapping and the Animal Research Review Panel's Animals Care Guidelines for Wildlife Surveys*. Small ground dwelling animals were targeted using Type A and Type B.

Table 6 shows trapping effort per day of assessment. **Figure 13** shows the location of the traps in the landscape.

Elliot traps were positioned in suitable areas within and outside the proposed areas of disturbance in an attempt to capture an overview of locally occurring fauna including:

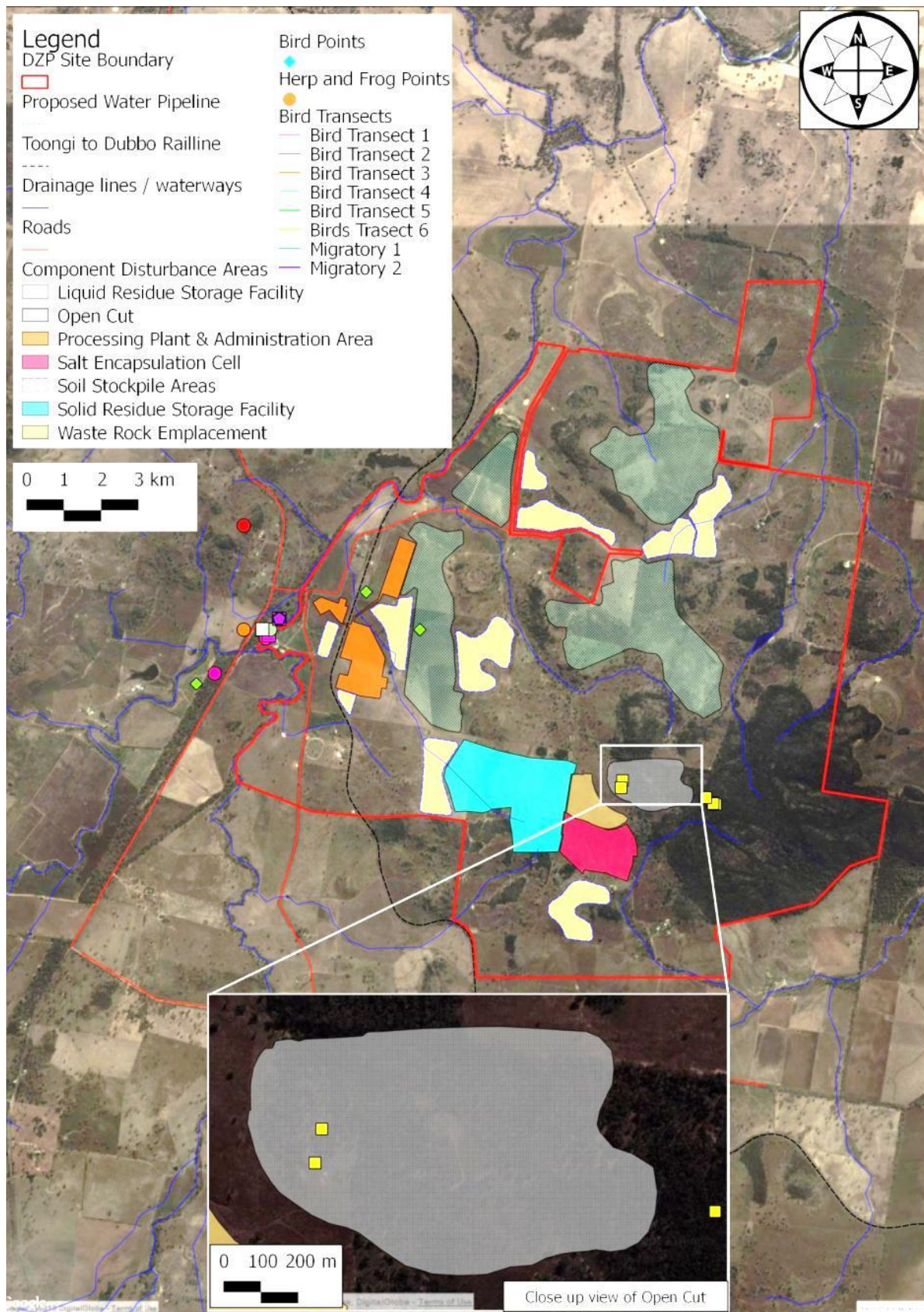
- near the bases of trees in areas with understory and dead wood.
- near runways.
- areas of moderate to good habitat with a larger remnant size (targeted those species reliant on larger patch sizes).
- near drainage lines or predicted habitat features.

Figure 13: Survey effort in the Application Area (echolocation, call playback and traps)



Note: Image presents the DZP Site assessed area.

Figure 14: Survey Effort in the Application Area (Bird and Reptile Searches)



Note 1: Image presents the DZP Site assessed area.

Note 2: Yellow squares show Dr Goldney 2001 Pink-tailed Worm-lizard records.

Figure 15: Survey Effort in the Application Area (spotlighting)

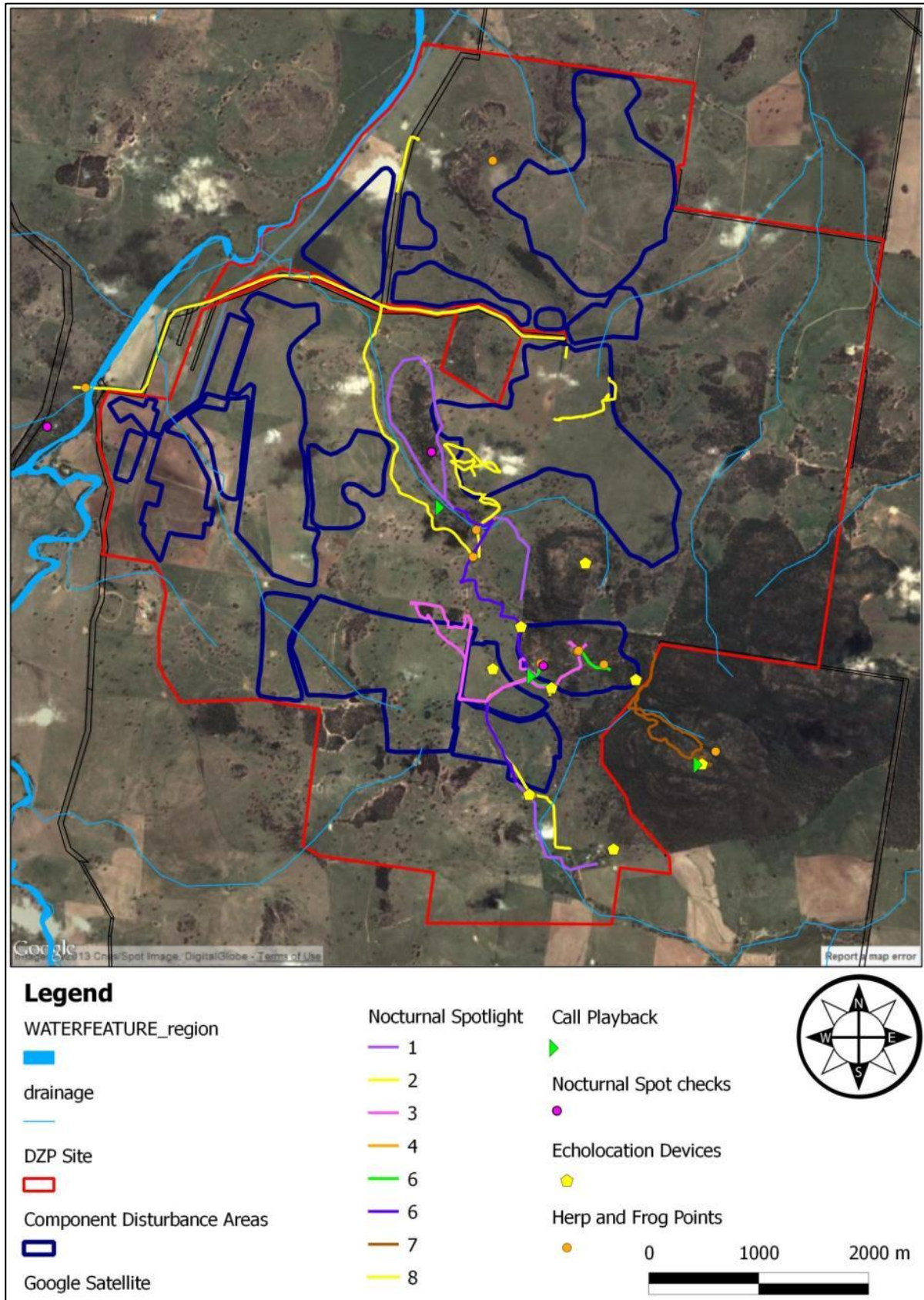


Table 5: Details of Fauna Survey Effort

Type of search	Type of Survey	Component Disturbance Areas	Landscape	Survey Effort			
				Date / Time	Minutes	People	Total Effort
Point	Call Playback 1	South of LRSF	Undulating	20/03/2012	N/A	N/A	1 night
Point	Call Playback 2	Open Cut	Undulating	21/03/2012	N/A	N/A	1
Point	Call Playback 3	B/W LRSF and Soil Stockpile	Undulating	22/03/2012	N/A	N/A	1
Point	Call Playback 4	Dowds Hill	Undulating	23/03/2012	N/A	N/A	1
				TOTAL			4 Nights
Point Search	Bird Point 1	Hill 2 north of Open Cut	Undulating	21/03/2012	15	2	30 minutes
Point Search	Bird Point 2	Open Cut	Undulating	22/03/2012	30	2	60
Point Search	Bird Point 3	Open Cut	Undulating	22/03/2012	10	2	20
Point Search	Bird Point 4	Hill 2 north of Open Cut	Trachyte Hill	22/03/2012	15	1	15
Point Search	Bird Point 5	Open Cut	Undulating	22/03/2012	15	1	15
Point Search	Bird Point 6	B/W RSF and LRSF	Undulating	23/03/2012	15	1	15
Point Search	Bird Point 7	Dowds Hill	Hill Crest	23/03/2012	25	2	50
Point Search	Bird Point 8	East of Open Cut	Undulating	25/09/2012	45	1	45
Point Search	Bird Point 9	Hill 2 north of Open Cut	Trachyte Hill	25/09/2012	60	1	60
Point Search	Bird Point 10	Wambangalang Creek	Undulating	22/03/2012	10	1	10
Point Search	Bird Point 11	LRSF	Gently undulating	26/09/2012	30	1	30
Point Search	Bird Point 12	DZP Site: adjacent to LRSF	Undulating	26/09/2012	60	1	60
Point Search	Bird Point 13	LRSF	Undulating	27/09/2012	30	1	30
Point Search	Bird Point 14	LRSF	Undulating	27/09/2012	30	1	30
Point Search	Bird Point 15	LRSF immediately south	Undulating	27/09/2012	30	1	30
Point Search	Bird Point 16	Adjacent to LRSF	Undulating	28/09/2012	60	1	60
				TOTAL			560 minutes

Type of search	Type of Survey	Component Disturbance Areas	Landscape	Survey Effort			
				Date / Time	Minutes	People	Total Effort
Transect	Diurnal Bird 1	DZP Site	Undulating	20/03/2012	60	2	120 minutes
Transect	Diurnal Bird 2	Open Cut	Trachyte Hill	21/03/2012	60	2	120
Transect	Diurnal Bird 3	DZP Site	Undulating	22/03/2012	60	2	120
Transect	Diurnal Bird 4	DZP Site	Undulating	23/03/2012	60	2	120
Transect	Diurnal Bird 5	DZP Site	Undulating	24/03/2012	60	2	120
Transect	Diurnal Bird 6	Dowds Hill	Trachyte Hill	25/03/2012	60	2	120
Transect	Migratory Bird 1	Water Pipeline	Macquarie River Floodplain	24/03/2012	30	2	60
Transect	Migratory Bird 2	DZP Site	Wambangalang Creek area	24/03/2012	30	2	60
				TOTAL			840 minutes
Transect	Spotlight Transect 1	Open Cut	Trachyte Hill	21/03/2012	60	2	120 minutes
Transect	Spotlight Transect 2	Waste Rock Emplacement (WRE), Open Cut, Salt Encapsulation	Undulating	23/03/2012	60	3	180
Transect	Spotlight Transect 3	LRSF	Undulating	22/03/2012	60	3	180
Transect	Spotlight Transect 4	Dowds Hill	Hill Crest / Slope / Creek gully	24/03/2012	180	5	900
Transect	Spotlight 5	Open Cut	Hill	23/03/2012	180	3	540
Transect	Spotlight 6	Between LRSF and Soil Stockpile	Undulating	23/03/2012	180	3	540
Transect	Spotlight 7	Wambangalang Creek	Riverine	21/03/2012	150	3	450
Transect	Spotlight 8	Between Open Cut and LRSF	Undulating	22/03/2012	150	2	300
Transect	Spotlight Driving Transect 9a	Route A from south Open Cut to Toongi (see 5.2.3)	N/A	21/03/2012 & 23/03/2012	40	2	80
Transect	Spotlight Driving Transect 9b	Route B from south Open Cut to Toongi (see 5.2.3)	N/A	22/03/2012 & 24/03/2012	40	2	80
				TOTAL			3,370 minutes

Type of search	Type of Survey	Component Disturbance Areas	Landscape	Survey Effort			
				Date / Time	Minutes	People	Total Effort
Point Search	Herp 1	East of Soil Stockpile Area	Undulating	21/03/2012	30	2	60 minutes
Point Search	Herp 2	North of Soil Stockpile Area	Undulating	21/03/2012	15	2	30
Point Search	Herp 3	South of Salt Encapsulation	Undulating	21/03/2012	15	2	30
Point Search	Herp 4	Sump / Open Cut	Undulating	23/03/2012	15	3	45
Point Search	Herp 5	Open Cut	Undulating	21/03/2012	20	2	40
Point Search	Herp 6	LRSF	Undulating	21/03/2012	10	2	20
Point Search	Herp 7	Open Cut	Hill	22/03/2012	10	2	20
Point Search	Herp 8	Dowds Hill	Hill Crest	23/03/2012	10	2	20
Point Search	Herp 9	Open Cut	Trachyte Hill	25/2/2012	90	5	450
Point Search	Herp 10	North of Open Cut	Drainage	27/09/2012	30	1	30
Point Search	Herp 11	Hill 2	Drainage Line	27/09/2012	30	1	30
Point Search	Herp 12	Between LRSF	Drainage Line	27/09/2012	30	1	30
Point Search	Herp 13	North of Open Cut	Undulating	22/03/2012	30	1	30
Point Search	Herp 14	Hill 2	Undulating	22/03/2012	30	1	30
Point Search	Herp 15	Between LRSF	Drainage line	27/09/2012	30	1	30
Point Search	Herp 16	Between LRSF	Dam / Drainage line	27/09/2012	30	1	30
Point Search	Herp 17	Between LRSF	Dam / Drainage line	27/09/2012	30	1	30
Point Search	Herp 18	Open Cut	Trachyte Hill	4/2/12	120	3	360
Point Search	Herp 19	Open Cut	Trachyte Hill	11/2/12	180	4	720
Point Search	Herp 20	Open Cut	Trachyte Hill	18/2/12	150	3	450
				TOTAL			2,485 minutes
Point Search	Nocturnal Herp 2	Wambangalang Creek	Riverine	23/03/2012	30	2	60 minutes
Point Search	Nocturnal Herp 1	Sump / Open Cut	Undulating	21/03/2012	30	2	60
				TOTAL			120 minutes

Table 6: Anabat Recording Device Locations

Date	Easting (WGS)	Northing (WGS)	No.	Areas	Landscape Position
22.3.2012	148.629096	-32.478061	8	Near Homestead	Foot slope
24.3.2012	148.636326	-32.472190	6	Dowds Hill	Hill top, rocky areas.
23.3.2012	148.624029		5	Open Cut	Undulating
21.3.2012	148.621528	-32.462726	1	Open Cut	Undulating
22.3.2012	148.626799	-32.458336	7	Hill 2	Hill Side
21.3.2012	148.622204	-32.474299	3	South of Salt Encapsulation Area	Undulating
24.3.2012	148.619231	-32.465634	4	Waste Rock Emplacement	Undulating
23.3.2012	148.630921	-32.466375	2	Open Cut	Undulating
21.2.2012	148.604476	-32.283246	9	Macquarie River	River Bank - Pratt Truss Steel Rail Bridge.

Table 7: Details of Elliot and Hair Funnel Traps

Trap Line	Date Set	Date removed	Location	Number of traps	Effort (trap days)
Elliot Line 1	20.3.2012	25.3.2012	Open Cut	10	50
Elliot Line 2	20.3.2012	25.3.2012	Open Cut	20	100
Elliot Line 3	21.3.2012	25.3.2012	Open Cut	14	56
Elliot Line 4	21.3.2012	25.3.2012	Hill 2 North of Open Cut	20	80
Elliot Line 5	21.3.2012	25.3.2012	Open Cut	10	40
TOTAL EFFORT (trap days)					326
Hair Funnel 1	25.2.2012	24.3.2012	Open Cut	20	560
Hair Funnel 2	25.2.2012	4.3.2012	Hill 2 North of Open Cut	30	300
TOTAL EFFORT (trap days)					860
Cage Trap	21.3.2012	25.3.2012	Open Cut in Elliot Line 4	4	16
Cage Trap	21.3.2012	25.3.2012	DZP Site – pine monoculture	1	4
TOTAL EFFORT (Trap days)					20

The traps were established along linear transects, each trap being between ten metres and 15 metres apart. All traps were baited with a standard mix. This mix includes rolled oats, peanut butter, fish paste and honey mixture rolled into one centimetre sized ball. Each trap was lined with leaf litter.

To minimise disturbing and continually scenting (i.e. with the smell of the researcher) the Elliott traps, only those that were sprung or held captured animals were re-baited. The Elliott traps were left open for a period of four nights.

4.5.4 Hair Tube / Hair Funnel Traps

Hair tube traps (using Faunatech™ traps) were spaced at ten metre intervals in pairs (**Figure 13**). Traps were baited with the standard bait mixture detailed in **Section 4.4.2**. Hairs collected within these traps were sent to Ms Georgeanna Story of “ScatsAbout” (Majors Creek, NSW) for analysis. Feral pigs destroyed approximately five hair traps and disturbed approximately ten.

4.5.5 Call Playback

Nocturnal birds were surveyed through call playback and spotlighting. Call playback followed the methods described by Kavanagh and Peake (1993) and Debus (1995). This method requires an initial listening period of ten to 15 minutes after playing the respective call, followed by a spotlight search for ten minutes to detect any animals in the immediate vicinity, followed by intermittently playing the call for another five minutes and a ten minute listening period. A general search of the immediate environs was then undertaken to see if any non-vocalising birds were present.

Nocturnal birds and marsupials were surveyed through call playback and spotlighting. Use of the playback of pre-recorded CDs (Nature Sound) for the detection of the following threatened species:

- Koala (*Phascolarctos cinereus*, TSC, EPBC Acts).
- Bush Stone Curlew (*Burhinus grallarius*, TSC Act).
- Malleefowl (*Leipoa ocellata*, TSC, EPBC Acts).
- Powerful Owl (*Ninox strenua*, TSC Act).
- Masked Owl (*Tyto novaehollandiae*, TSC Act).
- Barking Owl (*Ninox connivens*, TSC Act).

The playback sessions involved broadcasting characteristic calls through a loud hailer that was connected to an iPod™. Prior to conducting the call playbacks, a ten minute listening period was undertaken to determine if any of these species were present. The calls were then broadcast for five minutes per species. The sequence of the calls broadcast was as noted above, a short listening period occurring between the Koala and owl calls. To detect any responses to the call playbacks, a ten minute listening period was undertaken at the completion of the playback session.

To minimise stressing and disturbing the species targeted, if an animal responded to the call playbacks, calls of this species were not broadcast during subsequent playback sessions (unless those playbacks were proposed to be conducted beyond the limits of the documented habitat range of the target species). In some instances, calls of non-threatened species were broadcast (such as the Owlet Nightjar and Sugar Glider). The purpose of this was to determine the suitability of habitat for associated threatened species.

The locations of the broadcast can be found in **Figure 13**.

4.5.6 Bird Survey (Diurnal and Nocturnal)

An area search method was used to survey for birds. This method includes an observer observing and listening for bird calls from a single point for 30 minutes.

Studies have shown that a 30 minute bird search detects a similar number of species as line transects and point counts, but gives higher estimates of overall bird density. The difference is likely due to the longer survey period and the greater chance of detecting cryptic species.

In addition to those dedicated bird surveys undertaken, any incidental observations or records made whilst traversing the site or conducting additional surveys (e.g. the herpetofauna searches) were noted (**Figure 14**).

All vegetation types were surveyed for bird species. Targeted bird watching was undertaken near any habitat trees to identify possible nesting or roosting areas. Birds were identified via visual observation and characteristic call.

Particular attention was paid to Malleefowl (TSC and EPBC Acts) habitat and calls.

4.5.7 Spotlighting

During the nocturnal surveys, spotlighting (using 163 lumen hand-held spotlights) was undertaken. Spotlighting was undertaken either on foot or by motor vehicle, with tracks, clearings and access ways being targeted. These environments were targeted to reduce the disturbance of those species present (i.e. through adverse noise generated by pushing through vegetation, stumbling over logs or crunching leaf litter and ground debris). The spotlighting sessions lasted from 60 to 120 minutes and were undertaken:

- Concurrently with the call playback sessions (one researcher “working” a separate area whilst the other undertook the call playbacks).
- When traversing between the call playback sites.
- Once the call playback component of that evening’s study had been completed.

Figure 15 shows spotlighting transects undertaken over the Application Area.

4.5.8 Scat and Tracks

All scats and raptor pellets (owls, eagles and hawks) encountered during the course of the field survey were collected and examined to determine species presence. Scats and tracks were identified with the aid of Trigg (2004) and experience.

4.5.9 Reptile Survey (Diurnal and Nocturnal)

Both nocturnal and diurnal reptile surveys were conducted at the same time as the bird surveys and opportunistically during all other activities in the Application Area.

The diurnal component consisted of hand searches for frogs and reptiles under rocks, logs, bark, ground debris and other debris around drainage lines and dams, specifically targeting the freshwater dam sites. The habitat of the Application Area was assessed in terms of its suitability for threatened herpetofauna species.

Specialist targeted assessment for *Aprasia parapulchella* (V TSC Act, EPBC Act) was undertaken by herpetofauna expert Dr Arthur White (of Biosphere) independently of this ecological assessment. Details of survey methodology and results of threatened reptile

species survey are presented in the Pink-tailed Worm-lizard PoM (**Appendix 13**) and records have been included in the results section of this report (**Section 5.5.4**).

Dr Gilbert Whyte of Klienfelder Ecobiological undertook specialist ant assessments which are Pink-tailed Worm-lizard food species (**Appendix 13, Attachment 1**).

4.5.10 Aquatic Habitat Survey

Drainage lines, creeks and water bodies within the DZP Site were assessed for the potential to provide habitat for threatened frogs. It is unlikely that any of the waterways in the DZP Site would provide habitat for threatened fish species. The adjoining Wambangalang Creek and the Macquarie River are known habitats for listed fish species. A separate Aquatic Ecology Assessment has been undertaken by Alison Hunt & Associates Pty Ltd to support the EIS (AHA, 2013) and can be viewed as Part 7 of the *Specialist Consultant Studies Compendium* accompanying the EIS.

4.5.10.1 Frog Survey

Frog surveys were conducted near any water bodies within the DZP Site. Areas of vegetation fringing the water bodies, trees, and general debris (roofing sheets) were overturned and searched to locate sheltering or non-calling frogs. An assessment of each site as potential habitat for threatened frog species was also undertaken.

Tadpoles that were caught were transferred to a clear plastic container, identified using Anstis (2002) and returned to the site of capture. Frog identification was also undertaken using Barker *et al.* 1995. Dr Arthur White assisted for species identification when on site.

4.5.10.2 Opportunistic Sightings

Wetland & Migratory Birds

A wetland and migratory bird census was undertaken in the component disturbance areas associated with the Wambangalang Creek floodplain, Toongi-Dubbo Rail Line, Gas Pipeline Corridor and the Macquarie River Water Pipeline floodplain area. The census included a meandering walk for visual observations and acoustic noting of bird calls. All opportunistic sightings were recorded. The methods described in 'Platypus' below aided in the detection of Rainbow Bee-eater burrows along river / creek banks.

Platypus

A platypus census was not undertaken as platypus do not have habitat within the DZP Site. Platypuses are, however, known to occur in Wambangalang Creek and the Macquarie River outside the area of impact. Survey included inspection of areas of river bank which may be impacted by the installation of the Water Pipeline and any waterway crossings (refurbishment of the Pratt Truss Steel Rail Bridge over the Macquarie River). Survey included a general assessment for likely habitat in potential platypus habitat areas and a survey of banks for burrow structures in the River/creek outside the Application Area. Opportunistic sightings were also documented.

4.5.11 Species Identification, Observation and Analysis

All fauna was readily identified through the use of available standard references, where required (Strahan, R. [ed.] 1983. Groves *et al.* 2005).

4.5.12 Habitat Assessment

An assessment of the relative value of the habitat of the Application Area was undertaken. This assessment focused on the identification of specific habitat types and resources on the site favoured by known threatened species from the region.

Where areas had a combination of key habitat elements which were more likely to provide an environment in which a threatened plant would be recorded, it was given closer inspection.

Aquatic habitats (existing storage dams, creeks and drainage lines) for aquatic species were assessed separately.

Terminology used to describe the size of tree hollows includes⁶:

- Small – suitable for species up to the size of a microchiropteran.
- Medium - suitable for species larger than a microchiropteran up to the size of a Squirrel Glider and a small parrot.
- Moderate - suitable for species larger than Squirrel Glider such as Brushtail Possum and or a large parrot such as a Galah.
- Large – suitable as a nesting location for an owl.

4.6 FLORA METHODOLOGY

4.6.1 Systematic Flora Survey

Flora survey and vegetation mapping was undertaken over the identified within the DZP Site in April and October 2001, Macquarie River Water Pipeline and Toongi-Dubbo Rail Line in 2002 (GCNRC 2002a, 2002b & 2002c). Additional flora survey and vegetation mapping of the DZP Site was undertaken by OzArk in October 2012 in accordance with the BioBanking Assessment Methodology (BBAM). The alignment of the Macquarie River Water Pipeline, realignment of Obley Road and spot survey of various points along the proposed Toongi-Dubbo Rail Line was also undertaken by OzArk during autumn, spring and summer 2012 and the minor realignment of the terminal section at Macquarie River reassessed in winter 2013.

The purpose of the additional survey undertaken by OzArk over the Macquarie River Water Pipeline easement, Obley Road realignment portions and Toongi-Dubbo Rail Line was to locate rare or threatened plants identified in the NSW Wildlife Atlas database (OEH 2012a) or those being predicted to occur by OEH (OEH 2012b) or DSEWPaC (DSEWPaC 2012) for the Application Area (**Figure 10**).

4.6.1.1 Minimum Flora Survey Requirements

Survey was undertaken in accordance with the BBAM. Due to the homogeneity of the vegetation types within the Application Area, plots have been extrapolated and modelled where appropriate. Additional plot data undertaken by Geoff Cunningham in 2001 has been

⁶ It is duly noted that these criteria are subjective. It is neither practical nor time efficient to measure the size of hollows in centimetres.

used to indicate the quality of vegetation where plots were not undertaken in 2012. Biometric benchmark data has also been utilised in areas where plots were not undertaken. This has greatly overestimated the quality and thus impact to native vegetation communities in these areas. **Figure 16** provided a map showing the location of BioBanking plots and Rapid Data Points (refer to **Section 4.6.2.6** for discussion of RDP methodology).

4.6.2 Quadrats and Plot Information

4.6.2.1 DZP Site

Within the DZP Site, a total of 24 sample sites were described during the April 2001 inspection and another eleven were inspected and described at the October 2001 inspection undertaken by GCNRC (GCNRC 2002a).

At each of these sites the species composition and species abundance data was recorded.

At these selected sites, 50 by 50 metre square quadrats were examined to record the occurrence and abundance ratings of all ground cover species present based on the modified Braun-Blanquet 6-point scale (Poore, 1955. <1%.1 – 5%.6 – 25%.26 – 50%.51 – 75%.76 – 100%).

The general 2012 flora survey also included 24 (20 by 20 metre) quadrats, and 24, 50 metre transects throughout the native vegetation within the site in accordance with the BioBanking Methodology, as well as approximately 30 hours of Random Meanders in line with methodology identified as the “Random Meander Technique” by Cropper (1993) (**Appendix 8**).

OzArk re-evaluated mapping of ‘grasslands / grazing land / agricultural land’. Derived grasslands are problematic to manage or classify, particularly in the DZP Site as grasslands on site may be fallow for several years then cropped when environmental conditions are favourable. For transparency the following classification of grasslands was employed:

- Areas intensively ploughed and not allowed to go fallow were assessed as ‘cropping’. These areas were on alluvial soils.
- Paddocks that are left fallow were assessed using BBAM to capture plot data. These areas were on the lower slopes and undulating hills.
 - Any plots with greater than 50% native ground stratum species were incorporated into EECs or communities they were derived from. These areas are mapped as CW213 (quality remnants).
 - Any grassland areas that were more than 50% weedy were mapped as ‘Derived Grasslands’ (>50% weeds, rotationally cropped), indicating all are in Low Condition. Many of the assessed areas in March 2012 (late summer / early autumn) were returned to cropping by winter 2012. For the purposes of this report they have been managed as assessed in March 2012. **Appendix 4** details all species recorded in each plot and provides a summary of:
 - Total number of species recorded.
 - Number of native plant species.
 - No of native ground cover species.
 - Number of ground cover weeds.
 - Percentage of weeds in the ground stratum.

4.6.2.2 Dubbo-Molong Rail Line

The railway reserve was divided into twelve sections for the purpose of the flora survey undertaken by GCNRC (GCNRC 2002b).

These sections were:

- From the Bend in the Railway Line South of the Processing Plant Area to the Railway Crossing at Toongi Village. (Point A to Point B).
- From the Railway Crossing at Toongi Village across Wambangalang Creek to the Railway Crossing on an Old Road north of the Creek. (Point B to Point C).
- From the Railway Crossing on an Old Road north of the Wambangalang Creek to the Railway Crossing on 'Yengola'. (Point C to Point D).
- From the Railway Crossing on 'Yengola' to the Railway Crossing on the Dubbo - Obley Road Just North of Hyandra Creek. (Point D to Point E).
- From the Railway Crossing on the Dubbo - Obley just north of Hyandra Creek to the Railway Crossing on the 'Bellevue' Access Road (Point E to Point F).
- From the Railway Crossing on the 'Bellevue' Access Road to the Railway Crossing on the 'Wilbertree' Access Road (Point F to Point G).
- From the Railway Crossing on the 'Wilbertree' Access Road to the Railway Crossing on the Dubbo - Obley Road North of the Benolong Road Junction. (Point G to Point H).
- From the Railway Crossing on the Dubbo - Obley Road North of the Benolong Road Junction to the Railway Crossing at the old Cumboogle Railway Siding (Point H to Point I).
- From the Railway Crossing at the old Cumboogle Railway Siding to the Point Where the Railway and Obley Road Converge About 1km North of Morris Park (Point I to Point J).
- From the point where the railway and Obley Road Converge about 1km North of Morris Park to the Macquarie River at 'Dundullimal'. (Point J to Point K).
- From the Macquarie River at 'Dundullimal' to Old Dubbo Road on the Southern Outskirts of Dubbo Urban Area. (Point K to Point L).
- From Old Dubbo Road on the Southern Outskirts of Dubbo Urban Area to the Former Junction of the Line with the Main Western Railway Line. (Point L to Point M).

Each of the twelve sections of the railway reserve was regarded as a transect and the species occurring within the boundaries of the reserve were recorded. At selected points along each transect, additional information was obtained from quadrats (50 by 50 metres in area) that were examined to record the occurrence of all ground cover species present.

Additional spot checks of the Rail Line easement were undertaken by OzArk in 2012 at locations where regrowth vegetation could be seen via SPOT 5 aerial imagery. These areas were accessed where the Rail Line easement intercepted close by local roads. 27 additional areas were identified by OzArk via this method for further investigation. Random Meanders in line with methodology identified as the "Random Meander Technique" by Cropper (1993) were undertaken at each location in an attempt to detect the presence or potential of threatened species.

4.6.2.3 Macquarie River Water Pipeline

GCNRC (GCNRC 2002c) used stereoscopic interpretation of colour air photos prior to, and during, the field survey to determine vegetation community features and boundaries. The photographs used were those produced by AAM Surveys Pty Ltd [1: 25000] specifically for the Dubbo Zirconia Project. The prints used in the stereoscopic interpretation were AAM - Run 1 Nos. 003 to 008 and Run 2 Nos. 009 to 014, flown on February 13 1999.

The different landforms and vegetation communities identified through stereoscopic air photo interpretation were then sampled in the field to ascertain the variation in species composition within these communities. Paddock boundaries also formed section boundaries in some areas where land use differed between adjacent paddocks. A total of thirteen individual sections of the proposed pipeline route were described and species composition data was recorded. At selected sites within each section, 50 by 50 metre quadrats were carried out to record the occurrence of all ground cover and other species present.

The Macquarie River Water Pipeline route was driven in its entirety by OzArk in 2012 and revisited for minor realignments in 2013. Random Meanders in line with the methodology identified as the "Random Meander Technique" by Cropper (1993) were undertaken in select areas for the purpose of assessing regrowth or potential threatened species in the easement.

4.6.2.4 Obley Road Realignment

Obley Road was driven in entirety from Dubbo to Toongi in an effort to map vegetation communities. Nine portions of road were identified via design detail as requiring realignment. Vegetation in all nine sections was inspected on foot and aligned to a *Biometric* vegetation community. Individual trees in the zone of realignment were inspected for potential threatened species habitat. Two vegetation quadrats (20 by 20 metres), and two 50 metre transects through native vegetation within the road reserve was undertaken in accordance with the BioBanking Methodology.

4.6.3 Plant Identification

Plant identification was made according to recent nomenclature in Harden 1990 to 2002, Cunningham *et al.* 1992, Royal Botanic Gardens (RBG 2011), and PlantNet NSW Flora Online (RBG 2011a). The national conservation significance of flora was determined by referencing *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh 2006) and the Schedules associated with the TSC Act or the EPBC Act.

Detailed botanical survey for native plants was carried out and the observed species composition within the community was aligned to *Biometric* (Gibbons *et al.* 2005).

Community composition, health, age status, habitat value for fauna and flora species, overall conservation significance and structural or habitat importance of the vegetation present was assessed. The extent/distribution of the vegetation communities was mapped in the field.

4.6.4 Vegetation Mapping

Vegetation communities recorded by Geoff Cunningham in 2001 were transcribed into 'best fit' Biometric Vegetation Communities and incorporated into the vegetation map for the DZP Site. These areas required limited ground truthing.

To ensure that an accurate final map could be produced, OzArk collected Rapid Data Points (RDPs) across areas of intact vegetation in addition to BioBanking plots collected under the BBAM (**Figure 16**). The collection of RDPs is a new method of vegetation mapping being developed by Bell & Driscoll (in progress) for accurate spatial depiction of vegetation biodiversity. Central to this method is the recognition that variability in vegetation distribution cannot yet be predicted using computer GIS programs, and that simply documenting what actually occurs on the ground is the simplest yet most important fact to be reflected in a final map. Many recent mapping programs have relied heavily on GIS capabilities to predict where certain vegetation communities occur, with disappointing results (Note the differences between the BVT map -**Figure 8**, which is a CMA GIS predicted map (no ground truthing) and the maps generated for this Proposal - **Figure 17**). RDPs are essentially summaries of floristic information recorded at specific points in the field. At specific and regular locations waypoints are taken on a GPS, and summaries of the vegetation are recorded. Information recorded includes the following.

- Canopy layer dominant species.
- Shrub layer dominant species.
- Ground layer dominant species.
- Draft vegetation unit.
- Miscellaneous notes.

Initially, all trafficable paths across the Application Area are driven in 4WD vehicle recording RDPs. Those areas lacking extensive trail networks are then walked on foot with hand-held GPS units, recording the same information which is later added to the main database. In this way, a large dataset of summary information can be rapidly collected to use in modelling and vegetation mapping procedures.

Digital mapping of vegetation community boundaries was conducted using the QGIS software package. Vegetation community boundaries were identified in the field using a Mobile Mapper GPS. A combination of field data, existing broad-scale vegetation mapping, aerial photograph interpretation and biophysical data such as elevation and soil type was used to map the boundaries of vegetation communities. Ground-truthing was employed in late 2012 and in 2013 to resolve any questions identified during digitisation.

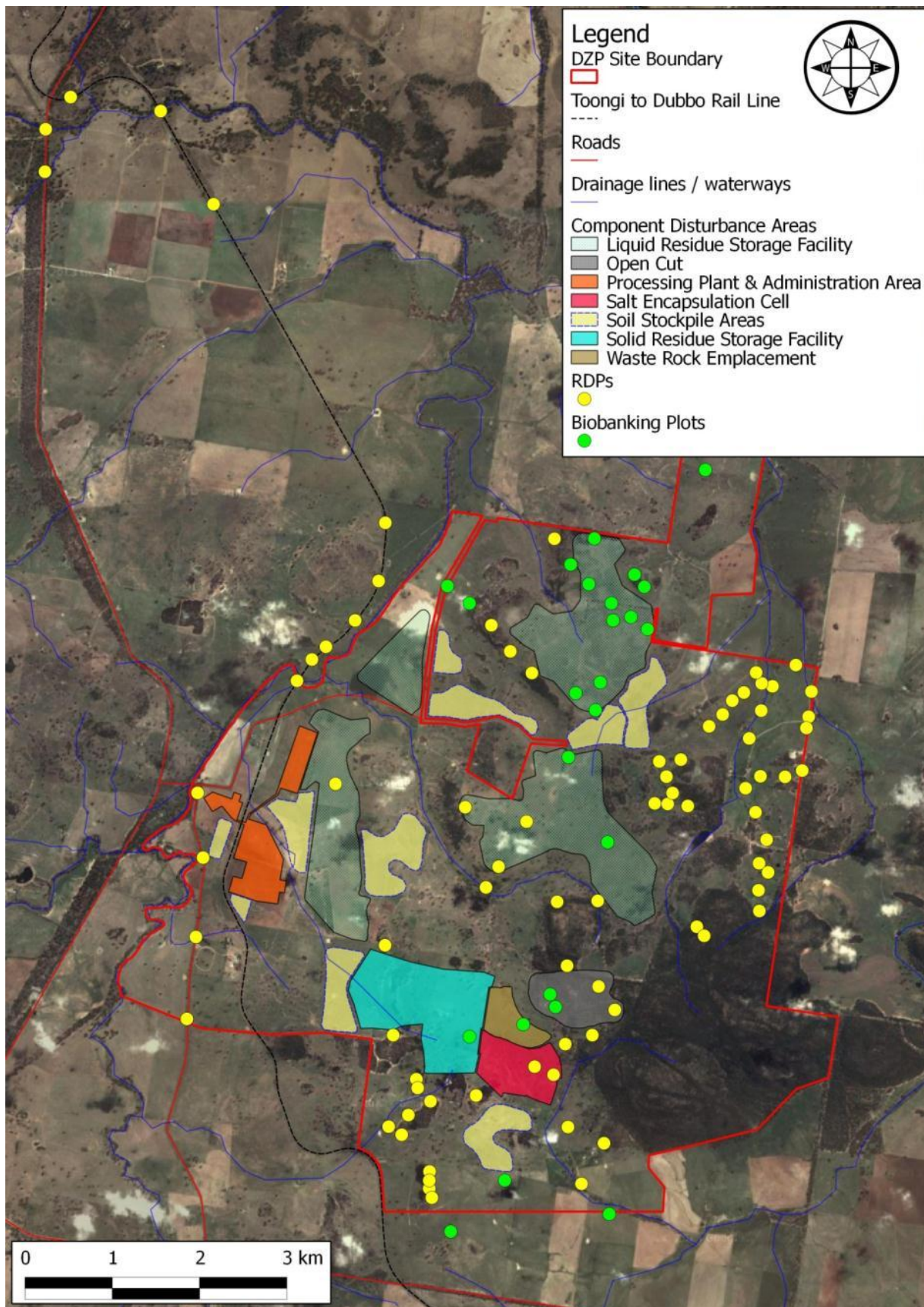
4.6.5 Targeted surveys

4.6.5.1 Terrestrial Orchids

Rationale

Survey for threatened terrestrial orchid species is highly reliant on accessibility to fertile flowering material to enable confident identifications. In some species (e.g. the leafless saprophyte *Cryptostylis hunteriana*), plants are not visible at any other time of the year and indeed one species (the underground Orchid, *Rhizanthella slateri*) undergoes its entire life cycle within the leaf litter and upper layers of soil (Bishop 1996). As a consequence, it is imperative that any survey for terrestrial orchid species is undertaken during the relevant flowering periods. Two threatened orchids have potential to occur in the Application Area, Cobar Greenhood Orchid (*Pterostylis cobarensis*, TSC and EPBC Acts), and Pine Donkey Orchid (*Diuris tricolor*, TSC Act).

Figure 16: BioBanking Plots and RDPs in the Application Area



Note: Image presents the DZP Site assessed area.

Both have a flowering period from September to November, or generally, spring. The probability for orchid detection is also strongly linked to extended durations of seasonal rains as was the case in 2012.

Survey method

Targeted survey occurred within the Application Area in September 2012 concurrent with the extra vegetation survey in accordance with the BBAM and separately again in October 2012. The latter assessment was deliberately undertaken when the OzArk principal ecologist observed another Dubbo local population of Pine Donkey Orchid (*Diuris tricolor*, TSC Act) was in flower.

Where potential habitat was identified, targeted meander transects were walked at a slow pace, emphasis was in Component Disturbance Areas with potential habitat for the species.

4.6.5.2 Threatened Flora Species (Non-orchid) Survey

Survey method

Targeted threatened (non-orchid) plant species (*Philotheca ericifolia*, *Swainsona* sp.) surveying was incorporated within each of the terrestrial orchid survey periods, and the general quadrat / map production surveys. Both of those survey programs included extensive periods of targeted meander searching across the primary impact areas, areas which were considered evidently suitable for detecting threatened species. Intensive surveying for threatened plant species was not undertaken in the proposed conservation offset / ecological offset investigation areas. Any listed plants observed during the mapping phase were recorded. Emphasis was placed on those threatened species considered to potentially occur in the Application Area (due to existing nearby records, suitable habitat or as indicated using the BBAM). Targeted survey occurred within the Application Area concurrent the survey times required under the BBAM.

Mapping

Where recorded, locality co-ordinates were collected for all threatened species, using a MobileMapper© GPS, and transferred to QGIS © GIS for the construction of maps. All co-ordinates were in Geodetic Datum of Australia (GDA94), zone 55 (GDA94, z55).

4.6.5.3 Survey for Endangered Ecological Communities

Rationale

The EPBC Act Protected Matters Report for the Dubbo LGA shows that there are five threatened ecological communities (TECs) that have potential to occur in the search area (Appendix 2).

Survey method

Assessment of the presence of any EEC was based on general reconnaissance of the Application Area, together with examination of detailed floristic plot survey as detailed above. Comparisons of delineated vegetation communities were made against species lists and descriptions provided in the relevant Final Determinations.

Mapping

Where located, vegetation considered equivalent to any listed TEC was mapped as part of the general vegetation mapping.

4.7 CONSTRAINTS

4.7.1 Survey Constraints

Not all animals and plants can be fully accounted for within any given Application Area. The presence of threatened species is not static. It changes over time, often in response to longer term natural forces that can, at any time, be dramatically influenced by man-made disturbance. This report is based upon data acquired from recent and current surveys, however, it should be recognised that the data gathered is indicative of the environmental conditions of the site at the time the report was prepared.

In order to overcome some of these limitations, database searches and extensive field surveys in accordance with the threatened species guidelines were undertaken for threatened species, populations and ecological communities known to occur within the region (see **Appendix 2** and **3**).

Further survey of threatened species 'requiring survey' under the BBAM is required in the south-western portion of the DZP Site at the Soil Stockpile Area and Solid Residue Storage Facility prior to impacts in these areas. Specific species required to survey for include Ausfeld's Wattle (*Acacia ausfeldii* V TSC Act), Narrow Goodenia (*Goodenia macbarronii*, V EPBC Act), Pine Donkey Orchid (*Diuris tricolour*, V TSC Act), *Rulingia procumbens* (V EPBC Act), Silky Swainson-pea (*Swainsona sericea*, V TSC Act, EPBC Act), Sloane's Froglet (*Crinia sloanei*, V TSC Act) and the Small Purple-pea (*Swainsona recta*, E TSC Act, EPBC Act). The Little Eagle (*Hieraaetus morphnoides*, V TSC Act), Square-tailed Kite (*Lophoictinia isura*, V TSC Act) and Grey Falcon (*Falco hypoleucos*, V TSC Act) have already been assumed present in these areas and have been included in the BioBanking calculation.

4.7.2 Appropriateness of the Survey

The survey was conducted over several seasons over several years. This has ensured that seasonal constraints associated with flora flowering periods and fauna activity are avoided. Grazing and ploughing within the DZP Site has resulted in instances where some species were difficult to detect or accurately describe to a species level due to a lack of plant flowering material.

4.7.3 Vegetation Mapping

The vegetation communities recorded reflect what was present on-site during the assessment period in March 2012. Since this time, some fields have been subject to ploughing and cropping. Some vegetation rehabilitation has also commenced in the form of direct seed drilling and soil scarification.

The major constraint concerns mapping of what GCNRC (2002a) referenced as grasslands / grazing land / agricultural land' and the knock on effects to BBAM and offsetting. In Section 4.6.2.1, this report highlights that distinction has been made between areas of CW213 (the relevant Biometric Vegetation Community) where greater than 50% native species occur (CW213 quality remnant) and where fewer than 50% native species occur (Derived Grassland >50% weeds, rotationally cropped).

When assessed in March 2012, the areas historically rotationally cropped had been fallow for approximately ten years due to prolonged drought, then flooding rains in 2011 and 2012. Soon after the March 2012 assessment was undertaken the majority of areas identified as Derived Grassland (>50% weeds, rotationally cropped) were sown for a winter crop. These areas have been managed in this report, and for all BBAM calculation, as they were assessed in 2012.

Neither the BBAM nor OEH (2011) provide suitable guidance as to how to assess the significance of impact to Derived Grassland (>50% weeds, rotationally cropped), which potentially has a major influence on the assessment of biodiversity offsets. Although considered in further detail in **Section 8**, the author brings to the attention of the determining authority a request to consider the following alternative approaches to assessing impacts on this vegetation community type.

- Assessing the area identified as Derived Grassland (>50% weeds, rotationally cropped) (414 hectares) as a native vegetation community requiring an offset in accordance with OEH (2011); Or
- Assessing the area identified as Derived Grassland (>50% weeds, rotationally cropped) as of low conservation significance (given the current cultivation and sowing) and excluding from offsetting requirements.

Guidance provided on the most appropriate approach will not change the proposed Biodiversity Offset Area (BOA) (refer to **Figure 21**), it will simply make application of variation to Tier 3 criterion to vary the SDD interim policy (OEH, 2011) more streamline.

5. RESULTS

5.1 GENERAL DESCRIPTION / VEGETATION COMMUNITIES

The DZP Site assessed area can be generally described as supporting a mosaic of Box-Gum Woodland, Fuzzy Box Woodland, Inland Grey Box Woodland, derived native grasslands and cleared/cropped land. Most areas containing remnant native vegetation communities, (excluding those under crop or severely altered) are considered to be consistent with listed TSC Act EECs.

Tumbledown Gum (*Eucalyptus dealbata*), White Cypress Pine and/or Black Cypress Pine, Kurrajong (*Brachychiton populneus*) and White Box (*E. albens*) generally characterise trachyte hills and rocky outcrop knolls. White Box Woodland or derived grassland (derived from White Box Woodland community) occurs on undulating ground. Fuzzy Box (*E. conica*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) occurs on creeks and waterways with River Red Gum (*E. cameldulensis*) also occurring along Wambangalang Creek and the Macquarie River. Inland Grey Box (*E. microcarpa*) associated woodlands also occur back from waterways on alluvial soils.

Evidence of historic ringbarking and pastoral use within the DZP Site assessed area is evidenced by the lack of Mugga Ironbark (popular harvest species for milling) that once would have formed part of the undulating hilly areas of the landscape.

Plates 1 to 5 show typical views in the Application Area.

Plate 1: General Example CW213 Derived Grasslands (>50% weeds, rotationally cropped) on Lower Slopes



Plate 2: White Box Woodland (TSC Act) occurring within the DZP Site outside the areas of disturbance



Plate 3: View of advanced regrowth Biometric community CW213 mainly dominated by Inland Grey Box and native grasses



Plate 4: View of derived grassland on upper slopes (with or without scattered trees) and wooded areas on trachyte hills in the background. These areas are rotationally cropped (depending on suitability of season)



Plate 5: Tumbledown Red Gum community (CW212) on trachyte hills. Note forb understory – not grassy



5.2 VEGETATION COMMUNITIES

Additional flora and fauna survey and vegetation mapping within the DZP Site assessed area, Macquarie River Water Pipeline, Obley Road Realignment and Toongi-Dubbo Rail Line was undertaken by OzArk during autumn and spring 2012. Vegetation communities recorded by GCNRC in 2001 were transcribed into 'best fit' *Biometric* Vegetation Communities and incorporated into the vegetation map for the DZP Site (**Figure 17**).

5.2.1 DZP Site and Adjacent Land

Six *BioMetric* vegetation types and an additional three mapped communities occur within the DZP Site and on adjacent lands⁷. Previous mapping of the DZP Site undertaken by GCNRC spills onto adjacent land, however, is still considered relevant to the Proposal. These areas have been converted to 'best fit' *Biometric* communities and included in the mapping for the DZP Site assessed area (**Figure 17**). Communities include;

- CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201). Recorded on light depressions on the undulating plains or flats, or on lower slopes and on valley flats. It's a Tall woodland or open forest. This community occurs on brown loam or clay, alluvial or colluvial soils. Upper stratum is dominated by Fuzzy Box (*Eucalyptus conica*), mid stratum is missing, lower stratum are mostly Speargrass (*Austrostipa scabra subsp. scabra*) and / or Windmill Grass (*Chloris truncata*).
- CW112 Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277). Recorded on flats and on gentle slopes. It's tall woodland to about 20 metres high. Occurs on fertile deep, loam or clay soils derived from a range of substrates including fine-grained sedimentary and metamorphic rocks but also volcanics and fine-grained granite. Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora*) is the dominant stratum, the midstratum is often missing and the lower stratum is dominated by Redleg Grass (*Bothriochloa macra*).
- CW121 Bulloak - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54). Recorded on the mid-slopes of rises or footslopes on undulating plains. It's a woodland or open woodland on colluvial sandy loam soils. White Cypress Pine (*Callitris glaucophylla*) and Bulloak (*Allocasuarina luehmanni*) is the dominant stratum, the midstratum is often with mixed acacia and the lower stratum is dominated by *Aristida ramosa*.
- CW 212. White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270). Recorded on steep slopes and ridges, it a mid-high woodland on soils derived from fine-grained sedimentary rocks such as shale and mudstone. Upper stratum is dominated by Tumbledown Red Gum (*Eucalyptus dealbata*⁸) and / or White Cypress Pine (*Callitris glaucophylla*). White Box (*Eucalyptus albens*) may be present but is not co-dominant. Midstratum are most often White Cypress Pine monocultures, occasionally with a mixture of acacias. Ground cover is

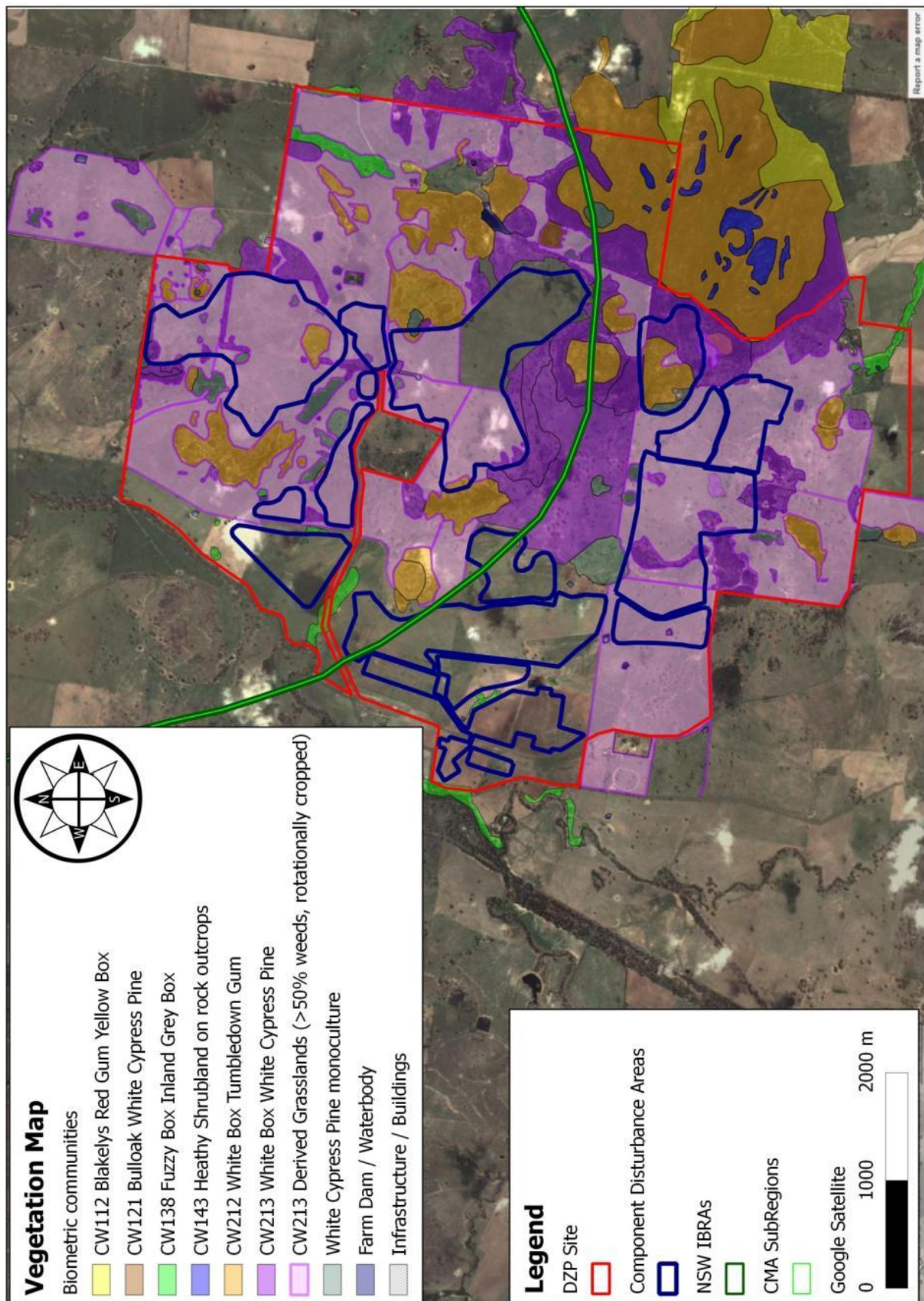
⁷ Consultation with landowners in 2013 revealed that some paddocks which were previously grassed or fallow during the 2012 assessment are now under crop.

⁸ Note: Tumbledown Gum (*E. dealbata*) and Dwyer's Red Gum (*E. dwyeri*) hybridise and it's often very difficult to determine if a 'pure stand' is being recorded.

often missing although *Aristida ramosa*, *Stypandra glauca* and the occasional Red-anther Wallaby Grass (*Joycea pallida*) are recorded. Forbs such as Rock Fern (*Cheilanthes tenuifolia*) usually dominate (**Plate 5**).

- CW213. White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267). Recorded on undulating low hills. It's a tall or mid-high woodland or open woodland with trees to about 15 metres high. Occurs on red-brown loamy soils or loamy sandy soils derived from sedimentary rocks or colluvium. Upper stratum is dominated by White Box (*Eucalyptus albens*), White Cypress Pine (*Callitris glaucophylla*), Inland Grey Box (*Eucalyptus microcarpa*), and Black Cypress Pine (*Callitris endlicheri*) in different densities. Mid-stratum is variable, most often dominated by White Cypress Pine (*Callitris glaucophylla*) but has several species of acacia in places. The lower stratum are mostly Speargrass (*Austrostipa scabra* subsp. *scabra*) and / or Windmill Grass (*Chloris truncata*), in more open areas the grass layer is dominated by Redleg Grass (*Bothriochloa macra*). On the basis of local land use history and condition, this community has been further categorised as follows.
 - CW213 (quality remnants). Areas retaining >50% native groundcover and displaying the general formation identified above.
 - Derived Grasslands (>50% weeds, rotationally cropped). Areas mapped have greater than 50% weeds in the lower stratum. Paddock trees included Tumbledown Red Gum (*Eucalyptus dealbata*), White Box (*Eucalyptus albens*), White Cypress Pine (*Callitris glaucophylla*), Inland Grey Box (*Eucalyptus microcarpa*) on slopes and the occasional Fuzzy Box (*Eucalyptus conica*) and Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora*) on lower alluvial areas. No midstratum was recorded. The native dominating ground later species was Redleg Grass (*Bothriochloa macra*) except on the very shallow soils on hill tops where *Aristida ramosa* was more frequently observed. These areas were generally very weedy as a result of the 'paddock' being fallow between cropping sessions.
- CW143. Heathy shrublands on rocky outcrops of the western slopes. Recorded on or near areas of outcropping rock on Dowds Hill. The upper stratum is dominated by Black Cypress Pine (*Callitris endlicheri*), Dwyer's Red Gum (*Eucalyptus dwyeri*) / Tumbledown Red Gum (*Eucalyptus dealbata*) as individuals or hybrids. Midstratum is dominated by Black Cypress Pine (*Callitris endlicheri*) however several large stands Spur-wing Wattle (*Acacia triptera*) are on 'the hill' in very dense stands. Ground covers are sparse. Many lichens and mosses are on all observed boulders.
- White Cypress Pine Monocultures. Frequently recorded on hill tops, rocky areas. Dominated by White Cypress Pine (*Callitris glaucophylla*), often there was no mid or ground stratum species present.
- Farm Dams / Water bodies, Cleared Land and Buildings and Infrastructure.

Figure 17: Biometric Vegetation Communities within the DZP Site and Adjacent Lands



Note: Image presents the DZP Site assessed area.

5.2.2 Toongi-Dubbo Rail Line

Spot checks of the decommissioned Toongi-Dubbo Rail Line undertaken in 2012 revealed that isolated eucalypts and shrubs (consistent with surrounding vegetation communities) have regrown in some areas in the corridor since this time. These trees are listed in **Section 6.1.4, Table 9**. A Biometric community could not be correlated to the vegetation in the corridor as it has been heavily invaded by introduced plant species. Species recorded are consistent with those recorded by GCNRC (2002b) and a further list was not compiled.

5.2.3 Macquarie River Water Pipeline

The Macquarie River Water Pipeline easement is predominantly through cropped and grazed paddocks. As these paddocks are highly altered from the native vegetation communities that originally covered the route, no attempt was made by GCNRC (2002c) or OzArk to identify and map remnant vegetation communities. Instead of mapping communities, the overall route was divided into thirteen defined sections by GCNRC (2002c). OzArk has summarised GCNRC (2002c) to make the list below:

- The water pipeline easement traverses cultivated land (wheat, barley, lucerne, clover from the Toongi Valley' / 'Grandale' Boundary north to the 'Grandale' / 'Mia Mia' Boundary. No trees would be affected by the activity.
- Within 'Mia Mia' the easement traverses cultivated land (wheat and barley). No trees will be affected by the activity.
- Along fence lines a mix of native and introduced species in which the introduced species predominate. The main native species present are Slender Bamboo Grass (*Austrostipa verticillata*), Rough Speargrass (*Austrostipa scabra* ssp. *scabra*), Purple Wiregrass (*Aristida ramosa*), Wallaby Grass (*Austrodanthonia linkii* var. *linkii*) and Small-flowered Wallaby Grass (*Austrodanthonia setacea*). These species occur generally in areas that appear not to have been ploughed in the past as well as near trees. No trees will be affected by the activity.
- From the Benalong Road to the Macquarie River the ground cover dominated by introduced pastures and weed species. The most prominent native species is Slender Bamboo Grass (*Austrostipa verticillata*) and this occurs generally under Fuzzy Box (*Eucalyptus conica*) paddock trees. Closer to the river individual Yellow Box (*Eucalyptus melliodora*) and Fuzzy Box (*Eucalyptus conica*) occur, the high river bank supports an open stand of River Red Gums (*Eucalyptus camaldulensis*) while the lower terrace of the river supports River Red Gums as well as a number of Willows (*Salix* sp.) No trees will be affected by the activity.
- Re-examination of the pipeline intake point by OzArk in 2013 confirmed that large well-spaced River Red Gums. No trees will be affected by the activity.

5.2.4 Obley Road Realignment

Vegetation within the Obley Road reserve generally contains White Box, Yellow Box, Fuzzy Box Woodland or Inland Grey Box Communities that form part of the State and/or national listed ecological communities. Nine portions of road were identified as requiring realignment. The vegetation communities contained in these road sections are further described in **Section 6.3, Table 10**.

5.2.5 Threatened and Endangered Ecological Communities or Populations Recorded

Any grassland area with more than 50% native ground cover identified within the DZP Site were mapped as 'quality remnants' and a component of the relevant EEC (where the adjoining community was a component of an EEC), as opposed to a standalone derived grassland community (Derived Grassland >50% weeds, rotationally cropped) that were not considered to be part of the EEC.

Two state listed EECs (TSC Act) were recorded within the DZP Site and would be impacted by the Proposal:

- CW213 (quality remnants): White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) - 43.7 hectares of 433 hectares within the DZP Site.
- CW138: Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions (Benson 201) - 0.1 hectares of 23.4 hectares in the DZP Site.

One EEC (TSC Act) was recorded where it is proposed to realign Obley Road:

- CW145: Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76) - 0.18 hectares. The 'patch size in the Obley Road corridor has not been mapped but is considered in order of 70 hectares from Toongi to Dubbo.

On the basis of the flora survey conducted along the proposed Macquarie River Water Pipeline route and Toongi-Dubbo Rail Line and Gas Pipeline Corridor in 2001 and 2012 it is concluded that no threatened flora species, populations or Endangered Ecological Communities exist within either corridor.

Two TECs listed in the schedules of the EPBC Act were recorded in the DZP Site outside areas to be directly impacted:

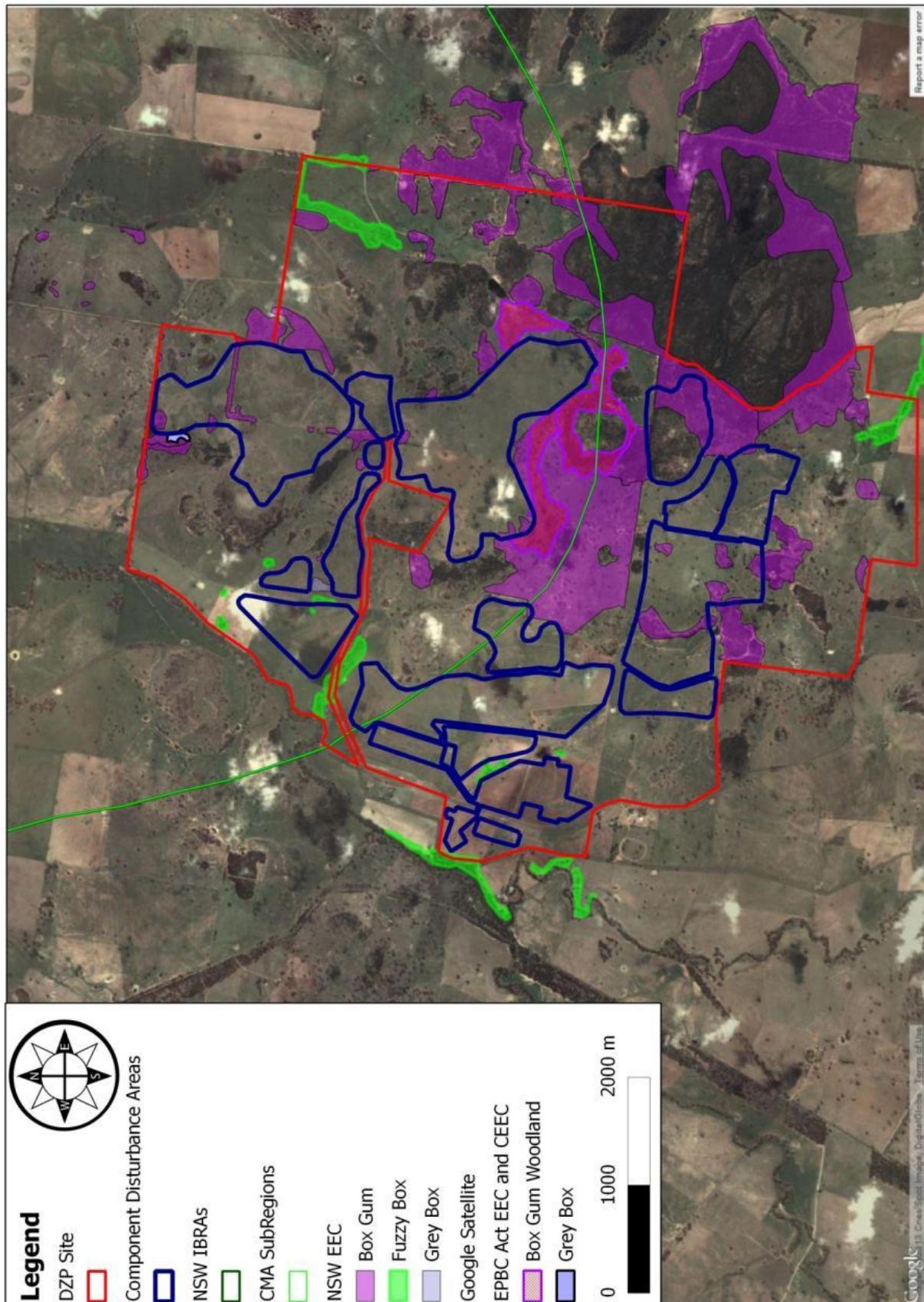
1. 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Community.

Within the DZP Site there is approximately 61.8 hectares of this Critically Endangered Ecological Community (CEEC) that is consistent with the EPBC Act criteria. The current layout of the proposed activities would not result in disturbance to this CEEC.

The described remnant is located north of the proposed open cut (**Figure 18**). This woodland is included within the Biometric Vegetation Community ID CW213: i.e. White Box (*Eucalyptus albens*) - Grey Box (*Eucalyptus microcarpa*) - White Cypress Pine (*Callitris glaucophylla*) Community. It comprises a mixed White Box (*Eucalyptus albens*) - White Cypress Pine (*Callitris glaucophylla*) community in which the White Box is the dominant species. The trees are spaced from less than one metre to 15 metres. It has been partly cleared and supports few shrubs although areas at the margins have a denser shrub understorey. It is likely that this community extends slightly beyond the mapped boundary, or in other areas in the Application Area that were outside the scope of the current investigations.

Other remaining White Box communities within the DZP Site (even those with no tree layer but meeting the benchmark condition) meet the TSC Act criteria for the equivalent White Box Yellow Box Blakely's Red Gum Woodland EEC.

Figure 18: Threatened and Endangered Ecological Communities Listed in the Schedules of the TSC and EPBC Acts within the DZP Site and Adjacent Lands



Note: Image presents the DZP Site assessed area.

2. 'Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia'.

Within the DZP Site there is a small area (1.9 hectares) of this EEC consistent with the EPBC Act criteria. This EEC is located on the 'Grandale' property beyond the limits of the proposed areas of disturbance. The extent and location of this community is shown in **Figure 18**. The community consists of advanced regeneration Inland Grey Box and a healthy grassy understorey, with few shrubs (*Mirabilia* sp. and *Acacia* sp.). It borders other TSC Act listed EECs. This woodland is included within the Biometric Vegetation Community CW213 (quality remnants) as it is likely that White Box would have been a dominant part of the canopy at one stage.

5.2.5.1 Clarification – Why CW212 is not considered an EEC

White Box – Tumbledown Red Gum woodland on fine-grained sediments on the NSW central western slopes (CW212) is not flagged as an EEC in **Table 9**. A total of 27.1 hectares of this vegetation type will be impacted by the development. As this vegetation type can be interpreted as being dominated by White Box it may potentially qualify as an EEC, thus further explanation is required.

As noted in **Section 5.2.1**, the community is described as follows.

- "Upper stratum is dominated by Tumbledown Red Gum (*Eucalyptus dealbata*) and / or White Cypress Pine (*Callitris glaucophylla*). White Box (*Eucalyptus albens*) may be present but is not co-dominant."
- "The midstratum is most often White Cypress Pine or occasionally a mixture of acacias".
- "Ground cover is often missing although *Aristida ramosa*, *Stypandra glauca* and the occasional Red-anther Wallaby Grass (*Joycea pallida*) are recorded. Forbs such as Rock Fern (*Cheilanthes tenuifolia*) usually dominate (**Plate 5**)".

Plot data provided in the BioBanking Assessment indicates that the grass cover is above benchmark while shrub cover is generally below benchmark for the vegetation type. This suggests 'grassy' rather than 'shrubby' woodland meaning a possibility of this vegetation qualifying as a Box-Gum Grassy Woodland EEC.

Upon reflection, plot data for this community was taken within the 'best areas' rather than 'representative areas' of the most common community manifestation. As a result, plot data suggests that it is grassier than what it is. The community description provided in **Section 5.2.1** is correct, as generally White Cypress Pine dominates these areas and grasses are sparse.

Identification of White Box – Tumbledown Red Gum woodland on fine-grained sediments on the NSW central western slopes (CW212) as an EEC is further complicated by the following.

- The OEH threatened species profile website provides a White Box Yellow Box Blakely's Red Gum Woodland – profile:
 - Regional distribution and habitat (Central West) lists four vegetation formations and six classes identifying relationships to the EEC.
 - None of the 19 Types are White Box – Tumbledown Red Gum woodland on fine-grained sediments on the NSW central western slopes (CW212). Thus CW212 is not recognised by OEH as an EEC.

- Whilst Biometric is an invaluable resources it can at times limit choice of community to a 'best fit' in the correct IBRA and CMA regions. In this instance there is no other alternative better suited to describe the community.
- The OEH threatened species profile website provides a White Box Yellow Box Blakely's Red Gum Woodland - endangered ecological community listing NSW Scientific Committee - final determination.
 - Essential the key question is "Is the ground layer mainly grassy?"
 - As noted in preceding text, OzArk acknowledges the discrepancy between the plot data and the broader community type. The community is predominantly 'shrubby' as White Cypress Pine dominates and inhibits ground layer biodiversity.

For the reasons listed above OzArk did not identify the current community as the EEC.

Once the *Biodiversity Offset Strategy* is implemented and Cypress Pine is thinned, the community is likely to be eligible for listing as the EEC according to the NSW Scientific Committee descriptions but not the in accordance with the OEH species profile website.

5.3 FLORA

5.3.1 Flora Species Recorded

244 plant species were recorded during the 2001 and 2002 surveys within the DZP Site undertaken by GCNRC. 67 (27%) were introduced species (GCNRC 2002a). Flora species recorded within the BioBanking plots (in accordance with the BBAM) and incidentals established during the 2012 flora survey can be found in **Appendix 4**.

234 species of vascular flora were recorded during the 2012 survey. 67 (28%) were introduced species. The median number of plants recorded per BioBanking plot was 27. The lowest was nine (Plot 6) and highest 44 (Plot 26). The median percentage of weeds within the BioBanking plots was 61%. The high incidence of weeds reflects the effect of a long history of grazing and ploughing within the DZP Site assessed area (**Appendix 4**).

During the 2001 survey of the decommissioned Toongi-Dubbo Rail Line 260 plant species recorded. 115 (44%) were introduced species (GCNRC 2002b). Introduced species account for the bulk of the ground cover and biomass present.

94 plant species were recorded within the Macquarie River Water Pipeline corridor. 49 (52%) were introduced species (GCNRC 2002c). The abundance of weeds reflects effects of clearing, grazing and cultivation over the past 150 (plus) years.

Additional species were not recorded along the Rail Line or Macquarie River Water Pipeline corridor by the OzArk surveys completed in 2012.

5.3.2 Threatened Flora and Protected Species

No threatened flora species were recorded within areas to be disturbed. *Philothea ericifolia* was recorded on Dowds Hill adjacent to the DZP Site in 2001, outside of the proposed areas of disturbance. This area of Dowds Hill is included in the proposed BOA. Two previous records of *Philothea ericifolia* collected in 1964 occur within the DZP Site. The plant was not relocated at these locations, they are now cropped paddocks.

A targeted orchid search in October 2012 did not reveal the presence of *Diuris tricolour* (TSC Act) or *Pterostylis cobarensis* (TSC and EPBC Acts) within the DZP Site assessed area. Occurrences of protected orchid species or their remains (Schedule 13 – *National Parks and*

Wildlife Act) and other protected plants were searched for during the survey. These species are protected under the general provision in Schedule 13 - i.e. "All native species of epiphytic and lithophytic orchids not included elsewhere in this Schedule". Protected plant species, *Diuris* sp. and *Microtis unifolia*, were recorded along the Toongi-Dubbo Rail Line corridor. Seven species of protected orchid species were also recorded within the DZP Site assessed area.

The potential for further threatened species remains within the less disturbed remnants including areas along fence lines within the larger Application Area. Disturbance precludes threatened species of flora from occurring within the Macquarie River Water Pipeline.

5.4 FAUNA

5.4.1 Fauna Habitat Recorded

5.4.1.1 Woodlands

There are four types of woodland within the DZP Site assessed area.

- Semi-closed woodland associated with trachyte hills (Biometric ID CW212).
- Dense woodland associated with the slopes of Dowds Hill (Biometric ID CW212, CW213, CW143).
- Open grassy woodland on undulating slopes (Biometric ID CW213, CW112).
- Riparian woodland associated with waterways (Biometric ID CW138).

The wooded lower slopes and linear remnants along fence lines in the Application Area provide foraging habitat for a reasonably diverse array of insectivorous bird species (i.e. the Grey-crowned Babbler, Fan-tailed Cuckoo and Black-faced Cuckoo-shrike) and for microchiropteran bats that prey upon insects above, within and below the canopy. Creeks or water-holding areas adjacent to the woodland areas increase the potential to encounter local populations of microchiropteran bats.

The tree canopy in wooded areas where not dominated by White Cypress Pine is comprised of eucalyptus species that provide nectar resources throughout the year. These areas also provide habitat for nectarivorous bird species (i.e. the Red Wattle Bird and honeyeaters) and winter flowering Eucalypts which may increase the suitability of these areas for some winter migratory specialist species (i.e. Superb Parrot, Regent Honeyeater and Swift Parrot). The removal of Mugga Ironbark from the landscape in early pastoral / rail construction days has reduced the weighting of overwintering habitat for the Regent Honeyeater and Swift Parrot in the Application Area.

Small to moderate tree hollows were abundant in Biometric Vegetation type CW213 in moderate to good condition (**Figure 17**). These hollows provided poor to good quality hollows for microchiropteran species and occasionally for small parrots (red-rumped parrots). In areas of old growth (in the EPBC Act listed White Box Woodland north of the Open Cut, **Figure 18**), numerous large hollow-bearing trees exist. These larger and more abundant hollow-bearing trees provide potential nesting habitat for forest owls such as the Masked Owl and Barking Owl. These owls are more likely however to roost in denser vegetation associated with waterways such as the Macquarie River.

Mature trees with small to large hollows are generally scattered in paddocks in the Component Disturbance Areas, with larger tree clumps avoided by impacts. The most notable large hollow-

bearing trees are White Box, transecting the northernmost Solid Residue Storage Facility (**Figure 2**).

Due to previous clearing (as noted by the advanced regeneration of trees) within the Toongi-Dubbo Rail Line and Gas Pipeline Corridor large hollow-bearing trees did not occur as trees started to regenerate in 1987.

Agricultural practices including clearing and cattle grazing occur throughout the wooded areas within the DZP Site. The shrub layer is largely absent from many of the lower woodland stands, or comprises dense monotypic stands of native plants (*Callitris glaucophylla*, *Eremophila* sp. and *Dodonaea* sp.). These areas have limited foraging substrates and resources for native fauna species. Where the mid-storey is present, the understorey provides refuge, foraging and nesting sites for smaller, cryptic bird species (such as Fairy-wrens, Thornbills and Robins). The boom and bust flowering cycle inherent in monocultures of eremophila / acacia communities reduces the availability of year round resources. This in turn reduces habitat diversity (of both flora and fauna) and can lead to the increase of perennial grass cover and soil erosion. These effects can be compounded when combined with uncontrolled grazing pressure from feral, native and domestic animals. Many areas have active sheet erosion under White Cypress Pine monocultures.

Groundcover is variable within the woodland and forest stands and is dependent on the level of clearing and past and present grazing pressure. There are heavily grazed areas where the groundcover is almost absent and these areas provide limited shelter or foraging habitat for many native fauna species. Other areas with a more open grassy understorey provide foraging habitat for larger terrestrial mammals (e.g. the Swamp Wallaby, Wallaroo and Eastern Grey Kangaroo), ground-feeding birds, reptiles and amphibians. Other groundcover elements (e.g. leaf and bark litter, fallen logs and woody debris and rocks) which are critical habitat determinants for many ground-dwelling fauna species (i.e. small terrestrial mammal species, reptiles and ground foraging and nesting birds) were variable within woodland. The occasional tree had crevices or decorating bark (particularly the Dwyer's Mallee / Tumbledown Gum) which provided harbour for insects and geckos.

Scattered canopy trees (one tree to approximately 50 metre to 100 metre radius) within the open grassland area also provide perching, foraging and refuge habitat for bird species.

Dense woodlands on the slopes of Dowds Hill reflect changes in fire and grazing regimes since European settlement which have substantially altered native vegetation on the Western Plains. Dense stands of cypress now exist where open eucalypt and cypress ecosystems formerly occurred. These dense stands suppress groundcover and understorey vegetation, and precipitate the death of older remnant trees. Other flora and fauna that rely on these habitat elements are consequently reduced. The establishment of dense stands of cypress pine and other 'woody weeds' is one amongst many land degradation problems on the western plains. As dense regrowth stands develop and lock up, biodiversity declines (Cameron 1999, **Appendix 15**, Thompson and Eldridge [2005]⁹). Dense stands of pine regeneration lack structural and floral diversity and are likely to have limited faunal habitat value compared to

⁹ White Cypress Pine (*Callitris glaucophylla*): a review of its roles in landscape and ecological processes in eastern Australia. Australian Journal of Botany, 2005, **53**, 555-570.

more open and diverse ecosystems. The ability of dense cypress stands to virtually eliminate understorey and ground vegetation was recognised and used by western landholders for fire protection. Many holdings still have strips of dense cypress retained around their boundaries to serve as fire breaks. Grass fires usually stop when they reach dense cypress stands because there is no ground fuel to carry the fire (Lacey 1973). These dense 'monocultures' represent minimal biodiversity.

Thinning trials undertaken by Cameron (1999) in similar habitat within the Dubbo LGA immediately increased structural diversity. In the short term, populations of groundcover plants and shrubs increased, creating additional structural diversity. Evidence for increased plant species diversity by year five (post thinning) was not clear and was possibly confounded by high grazing pressure within the study area. In the long term, reduced attrition and increased recruitment of mature trees as a result of thinning was noted to contribute to the structural diversity and potential populations of hollow dependent fauna. Increased structural diversity had immediate and short term impacts on biodiversity. Thinning increased the amount of habitat available to Sugar Gliders (also recorded on Dowds Hill) and marsupials. Thinning led to increases in avian diversity and it appeared that reptile populations and diversity may also have been enhanced in the short to medium term. There was evidence suggesting that thinning improved the habitat value for native small mammals and allowed them to compete more effectively with the house mouse.

5.4.1.2 Heath Scrub

The open heath scrub communities generally occur on Dowds Hill (Biometric ID CW143). Although heath scrub communities generally do not contain hollow-bearing trees, the multi-stem trees and shrubby habitat provide suitable areas for small cryptic birds include the Speckled Warbler and robins. The abundance of ground woody debris in less disturbed mallee areas provides refuge for lizards, snakes and invertebrates. Several large boulders or rock landforms were cracked and possessed microchiropteran habitat.

5.4.1.3 Woodland/Grassland Ecotone

Ecotones between wooded slopes / wooded tree corridors and open pasture areas provides habitat for edge-specialists, including the Brown Treecreeper, Diamond Firetail, Microchiropteran bats and raptors. Large forest owls (e.g. the Masked and Barking Owls) utilise such areas for hunting and prefer these areas in proximity to large hollow-bearing trees and water for breeding sites. Larger terrestrial mammal species, such as the Common Wallaroo, Eastern Grey Kangaroo and Red-necked Wallaby also shelter in this ecotone area emerging to forage on the open pasture particularly at night.

Small mammals such as Yellow Footed Antechinus and Dunnarts have hunting and foraging ground near ecotones however little refuge habitat. There is suggestion that animal species living in these ecosystems should be specifically adapted to a patchy mosaic, but one that shifts and changes across the landscape over time (Doerr *et al.* 2009). The value of ecotones between derived grasslands and disturbed woodlands should not be underestimated in providing resources to fauna in a patchy mosaic landscape.

The ecotone environs together with the variable landforms (i.e. rocky hill outcrops and floodplains) together with stock and domestic water, drainage lines and alluvial floodplains make the Application Area suitable for a range of species able to make use of the abrupt vegetation mosaics.

5.4.1.4 Wetland and Dam Habitat

There are various and numerous water sources in the Application Area including named creeks, unnamed drainage lines, farm dams and ephemeral wetland areas. The most notable water sources occur outside the DZP Site and include the Macquarie River, Wambangalang Creek, Paddys Creek, Cockabroo Creek, Hyandra Creek and Twelve Mile Creek.

No permanent creeks, fish habitat or in-stream aquatic vegetation was noted within the DZP Site. However identified drainage lines have the potential to pool water and form semi-permanent wetlands. A narrow gully collects water around the base of Dowds Hill, although many of the drainage lines they contain are small, highly ephemeral and modified by agricultural practises.

The proposed Macquarie River Water Pipeline is in part situated mainly within a flat riverine floodplain associated with the Macquarie River. After prolonged heavy rain, floodplain depressions in ploughed paddocks form ephemeral shallow wetlands that provide habitat suitable for several wetland and migratory wetland birds including the Royal Spoon-bill, White-faced Heron, Egrets, Bitterns, Bustard, Snipes, Curlews and Sandpipers. This was most evident on 'Mia Mia' property. Thus, despite being cleared and cropped, portions of the Macquarie River Water Pipeline easement provide potential wetland habitat and water-filled depressions suitable for specialist wetland birds. It is likely that during summer further threatened migratory wetland birds would utilise habitat within the Application Area than actually recorded. Potential habitats for frogs in the Application Area include several man-made dams and Gilgai/wetland areas.

After rain water collects and forms small rock pools on hard surfaces in trachyte areas and on larger exposed boulders on Dowds Hill. These were noted as providing watering points for a variety of small birds and spawning areas for several frog species (Striped Marsh Frog and Broad-palmed Frog).

5.4.1.5 Derived Grassland / Cleared Areas and Improved Pastures

The majority of the Application Area has been cleared of native vegetation. Vast areas of the DZP Site under crop, left fallow, covered in derived grassland or on rotation and thus semi grassed with isolated and scattered trees (refer to **Figure 9**). The cleared grassland areas lack the structural and floristic diversity to provide specific shelter, foraging and breeding resources for many native mammal species and for many bird, reptile and amphibian species. The sparse and open nature of the grassland portions of the Application Area favours common generalist species which are capable of utilising open ground for foraging and common disturbance-tolerant species which are ubiquitous in modified habitats. Many of the bird species recorded in such habitats on site utilise the open grassland areas for foraging but are reliant on nearby native woodland and forest communities for roosting and nesting (e.g. raptors and parrots). The grassland areas of the site provide foraging habitat for a variety of open ground foraging bird species and supports a moderate density of quail species. Other grassland specialists recorded in these areas included Richard's Pipit and the Jacky Winter. Aerial forages (such as Welcome Swallows) also hawk for insects over the open areas. Wetland birds including the Royal Spoon-bill, White-faced Heron and Egrets were observed foraging in tall grass in moist depressions and around Gilgai and dams. The derived grasslands provide limited habitat and protection for animals under the critical weight range.

Isolated trees within the cleared / derived paddocks are known to contribute to the viability of wildlife populations in agricultural mosaic landscapes by maintaining connectivity between larger patches of remnant vegetation (Gibbons 2000).

5.4.1.6 Koala Habitat

SEPP 44 is not applicable to projects being assessed under Part 4.1 of the EP&A Act. Previous record of Koalas in the Dubbo LGA and evidence of a Koala in the Application Area warrant application of the framework of SEPP 44. SEPP 44 been utilised to identify whether the Application Area is considered "potential koala habitat" or "core koala habitat." The Application Area is considered "potential koala habitat." This is based on the presence of 'feed tree' species identified balanced against the lack of recent Koala records or presence of a breeding population.

The Approved Draft Recovery Plan for the Koala (DECC 2008) provides lists of koala food trees categorised as primary, secondary and supplementary within Koala Management Areas (KMAs). Primary food trees exhibit a level of use that is significantly higher than that of other Eucalyptus species and is independent of tree density. The Dubbo LGA is within KMA 6: Western Slopes. Large populations of koalas occur on the western slopes and plains, in particular the Pilliga region (Kavanagh and Barrott 2001) and in Gunnedah (Smith 1992) and Walgett LGAs (J. Callaghan, Australian Koala Foundation, *pers. comm.*). In the south of this KMA, a population of koalas occurs along the Murrumbidgee River at Narrandera. River Red Gum is listed as a primary food source, Yellow Box and White Box are listed as a secondary food source and Red Stringybark is listed as a supplementary food source. All of these feed tree species occur in the Application Area. River Red Gum communities along both Wambangalang Creek and the Macquarie River would not, however, be impacted by the Proposal.

Where potential habitat is identified, the area must be investigated for core koala habitat, defined as 'an area of land with a resident breeding population of koalas, evidenced by attributes such as breeding females, recent sightings and historical records of a population' (Department of Planning 1995a). The locality is known to have sporadic Koala records. No recent sightings of Koalas have been noted (Bionet Wildlife Atlas) and no Koala populations or breeding females were identified in, or in the immediate vicinity of the Application Area. Due to clearing on the alluvial flats, it is unlikely that Koala movement would be facilitated from the riparian regions to the east across the Application Area. Thus it is only considered possible that sporadic transient Koalas may occur in the Application Area.

5.4.2 Fauna Species Recorded

180 vertebrate fauna species were identified during the 2002 survey in the DZP Site assessed area (Goldney 2002). 185 species of vertebrate fauna representing 4 Classes and 69 Families were recorded in the Application Area in 2012 (**Appendix 4**).

- 117 species of bird, including 12 threatened species (ten listed under the TSC Act, one listed under the EPBC Act and one listed under both the TSC and EPBC Acts) and two introduced species.
- 36 species of mammal including six threatened microchiropterans (three listed under the TSC Act, three under both the TSC and EPBC Acts) and five introduced species.
- 23 species of reptile including one species Pink-tailed Worm-lizard (*Aprasia parapulchella*) listed under both the TSC and EPBC Acts.
- Nine species of amphibian.

No targeted fauna species were trapped during the survey and no hair samples noted in the hair funnels. Traps were, however, frequently set off by a number of reptiles.

5.4.3 Threatened and/or Migratory Vertebrate Fauna Species detected of the TSC Act and EPBC Act

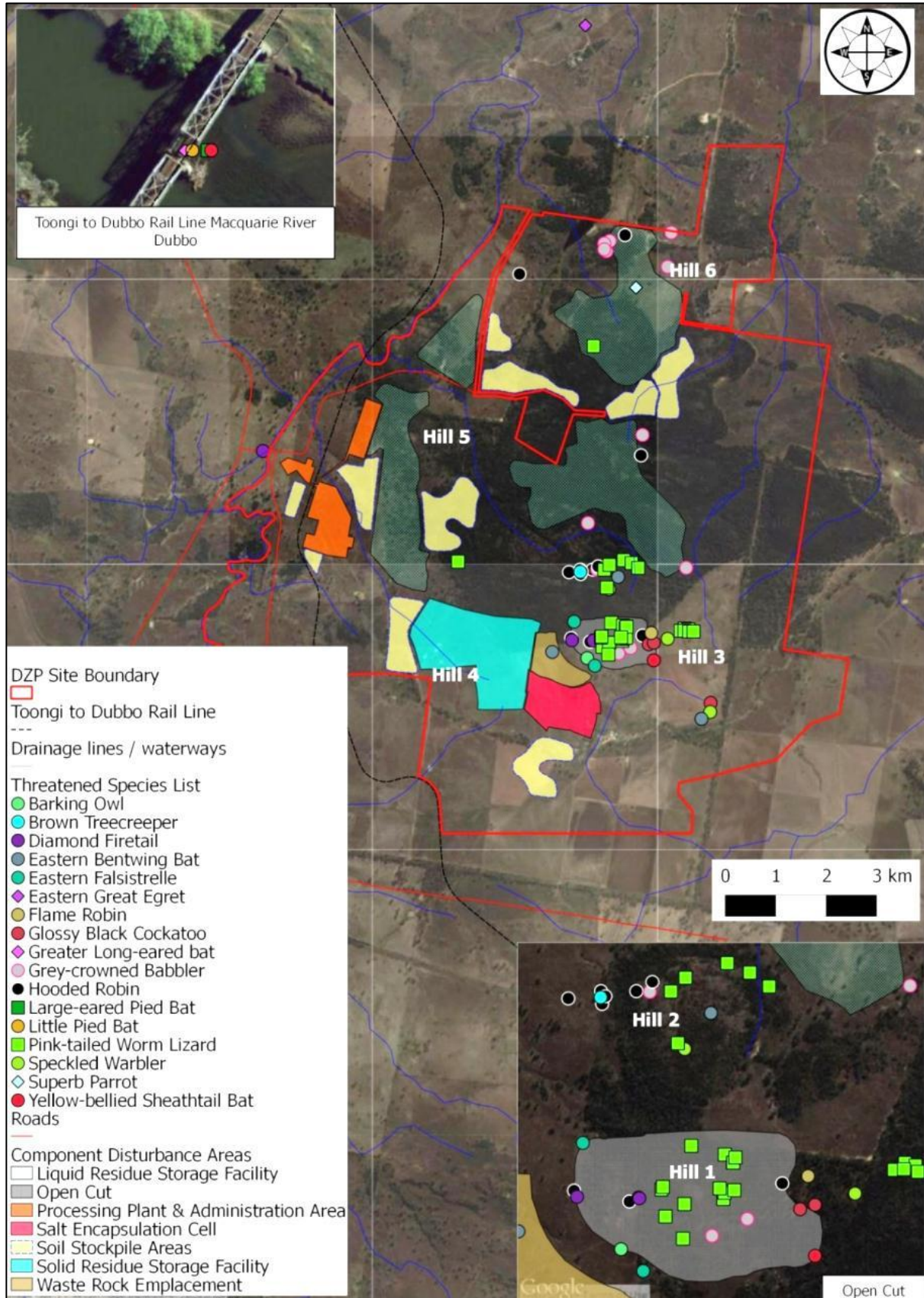
22 threatened species were recorded in the DZP Site (**Table 8, Figure 19¹⁰**). This includes 18 threatened species recorded by OzArk during the 2012 and additional species recorded by Goldney (2002).

Table 8: Threatened Fauna Recorded listed under the TSC Act and EPBC Act

No.	Species	Relevant Legislation	OzArk (2012)	Goldney (2002)
1	Barking Owl (<i>Ninox connivens</i>)	TSC Act	X	X
2	Brown Tree-creeper (<i>Climacteris picumnus</i>)	TSC Act	X	X
3	Diamond Firetail (<i>Stagonopleura guttata</i>)	TSC Act	X	X
4	Eastern Bentwing Bat (<i>Miniopterus schreibersii orianae oceanensis</i>)	TSC Act	X	
5	Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	TSC Act	X	
6	Flame Robin (<i>Petroica phoenicea</i>)	TSC Act	X	X
7	Glossy Black Cockatoo (<i>Calyptorhynchus lathamii</i>)	TSC Act	X	
8	Great Egret (<i>Ardea alba</i>), EPBC Act.	TSC Act	X	
9	Greater Long-eared Bat (<i>Nyctophilus timoriensis / corbeni</i>)	TSC Act	X	
10	Grey-crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	TSC Act & EPBC Act	X	X
11	Hooded Robin (<i>Melanodryas cucullata</i>)	TSC Act	X	X
12	Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	TSC Act	X	
13	Little Eagle (<i>Hieraaetus morphnoides</i>)	TSC Act	X	X
14	Little Pied Bat	TSC Act	X	
15	Pink-tailed Worm-lizard (<i>Aprasia parapulchella</i>) (see also Figure 20)	TSC Act & EPBC Act	X	X
16	Speckled Warbler (<i>Pyrrholaemus saggitatus</i>)	TSC Act	X	X
17	Superb Parrot (<i>Polytelis swainsonii</i>)	TSC Act & EPBC Act	X	
18	Yellow-bellied Sheath-tail bat (<i>Saccolaimus flaviventris</i>)	TSC Act	X	
19	Swift Parrot (<i>Lathamus discolor</i>)	TSC Act & EPBC Act		X
20	Spotted Harrier (<i>Circus assimilis</i>)	TSC Act		X
21	Koala (<i>Phascolarctos cinereus</i>)	TSC Act & EPBC Act		X
22	Square-tailed Kite (<i>Lophoictinia isura</i>)	TSC Act		X

¹⁰ Dr Arthur White recorded additional; Pink-tailed Worm Lizards the week after this figure was made. **Figure 20** provides the most updated known distribution of the species and demonstrates practical application of "Avoid" where a Soil Stockpile Site was abandoned to protect habitat for the species.

Figure 19: Threatened species (TSC and EPBC Acts) Recorded in the DZP Site Assessed Area Including Rail Line and Water Pipeline. Basemap, Google Earth.



Note: Image presents the DZP Site assessed area.

An additional nine threatened fauna species have been recorded nearby and are considered likely to occur at some stage of their lifecycle in the Application Area.

- Regent Honeyeater (*Anthochaera Phrygia*, E TSC Act, EPBC Act). This species has potential to occur during winter (non-breeding). It is known to utilise White Box Woodlands for over winter feeding resources.
- Australasian Bittern (*Botaurus poiciloptilus* V TSC Act, EPBC Act). This species has potential to occur along the Macquarie River riparian gallery and shallow wetland areas along the proposed Macquarie River Water Pipeline route on the floodplain.
- Australian Painted Snipe (*Rostratula australis*, V TSC Act, EPBC Act). This species has potential to occur along the Macquarie River riparian gallery and shallow wetland areas along the proposed Macquarie River Water Pipeline route on the floodplain.
- Rainbow Bee-eater (*Merops ornatus*, EPBC Act). This species is known to utilise sandy banks in the Macquarie River in Dubbo for breeding sites. Thus it is also highly likely to have foraging habitat in the Application Area.
- Black-chinned Honeyeater (*Melithreptus gularis gularis*, TSC Act). It is known to utilise White Box Woodlands as a winter feeding resource.
- Masked Owl (*Tyto novaehollandiae*, TSC Act).
- Grey Falcon (*Falco hypoleucos*, TSC Act).
- Painted Honeyeater (*Grantiella picta*, TSC Act). It is known to utilise White Box Woodlands as a winter feeding resource.
- Varied Sittella (*Daphoenositta chrysoptera*, TSC Act).

Further notes on species not re-recorded by Ozark in 2012 include:

- Koala, (*Phascolarctos cinereus*). Identified by isolated old scats recorded during the 2002 fauna survey (Goldney 2002). The species has not been re-detected during the 2012 assessment or from interview with landholders (some of which are three generations in the area). The scats are considered a one off record of a transient Koala.
- *Philotheca ericifolia*. Recorded during the 2001 flora survey (GCNRC 2001a). A small population was recorded from the top of Dowds Hill. Two previous records of *Philotheca ericifolia* (collected in 1964) also exist one kilometre south of Toongi Siding, which is within the DZP Site. These individuals were not relocated in this location which is now a cropped paddock. Further records occur near Wambangalang, three kilometres southwest of Toongi.

5.4.4 Pink-tailed Worm Lizard Survey Results

The Pink-tailed Worm-lizard (*Aprasia parapulchella*) was originally recorded within the DZP Site in 2001. A sample specimen was sent to the Australian Museum and initially incorrectly identified as Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*). After request for the specimen to be cross checked in January 2012, the sample specimen was subsequently reclassified as *Aprasia parapulchella* by the Australian Museum.

By March 2013, 35 Pink-tailed Worm-Lizards were found in 30 sites in or within five kilometres of the DZP Site. This is the largest known population in NSW. All locations are not in an area currently managed for conservation.

Pink-tailed Worm-Lizards have been found on or near Hills 1, 2, 3, 4 and 6 (**Figure 20**). Each of these areas comprises a weathered trachyte outcrop. Most lizards are found in areas around the base of the outcrops where exfoliated slabs of trachytes lie loosely scattered across open woodland or grassland.

The Pink-tailed Worm-lizard is listed as Vulnerable under the EPBC Act (and TSC Act). The potential impact of the Proposal on this species was referred to DSEWPaC and determined as a Controlled Action (EPBC Ref: 2012/6625). The location of these known populations, overlain by the proposed areas of disturbance associated with the Proposal and habitat quality for the species, has been provided as **Figure 20**.

Pink-tailed Worm Lizards are relatively widespread in the local area, having been found on sites at Hills 1, 2, 3, 4 and 6. Hills 1, 2, 3 and 6 are discrete trachyte knolls. Hill 4 is the exception as it is dominated by poorly metamorphosed sandstones. Not all trachyte areas are suitable for the Pink-tailed Worm-lizard, e.g. Hill 3 is one of the largest trachyte outcrops in the local area but only parts of the outcrop provide suitable habitat for the Pink-tailed Worm-lizard as there is no grassy understory. The major impediment to habitat availability at Hill 3 appears to be the extensive Cypress Pine monocultures that dominate the hill and 'shade out' the mid and ground stratum.

Given the distribution of the Pink-tailed Worm-lizards on the DZP Site it is highly likely that they are also present on other trachyte outcrops away from the DZP Site. These sites remain unassessed (August 2013).

The *Pink-tailed Worm-lizard Plan of Management* (**Appendix 13**) provides detailed discussion for management of this species.

Figure 20(A): Pink-tailed Worm-lizard Populations (underlying geology)

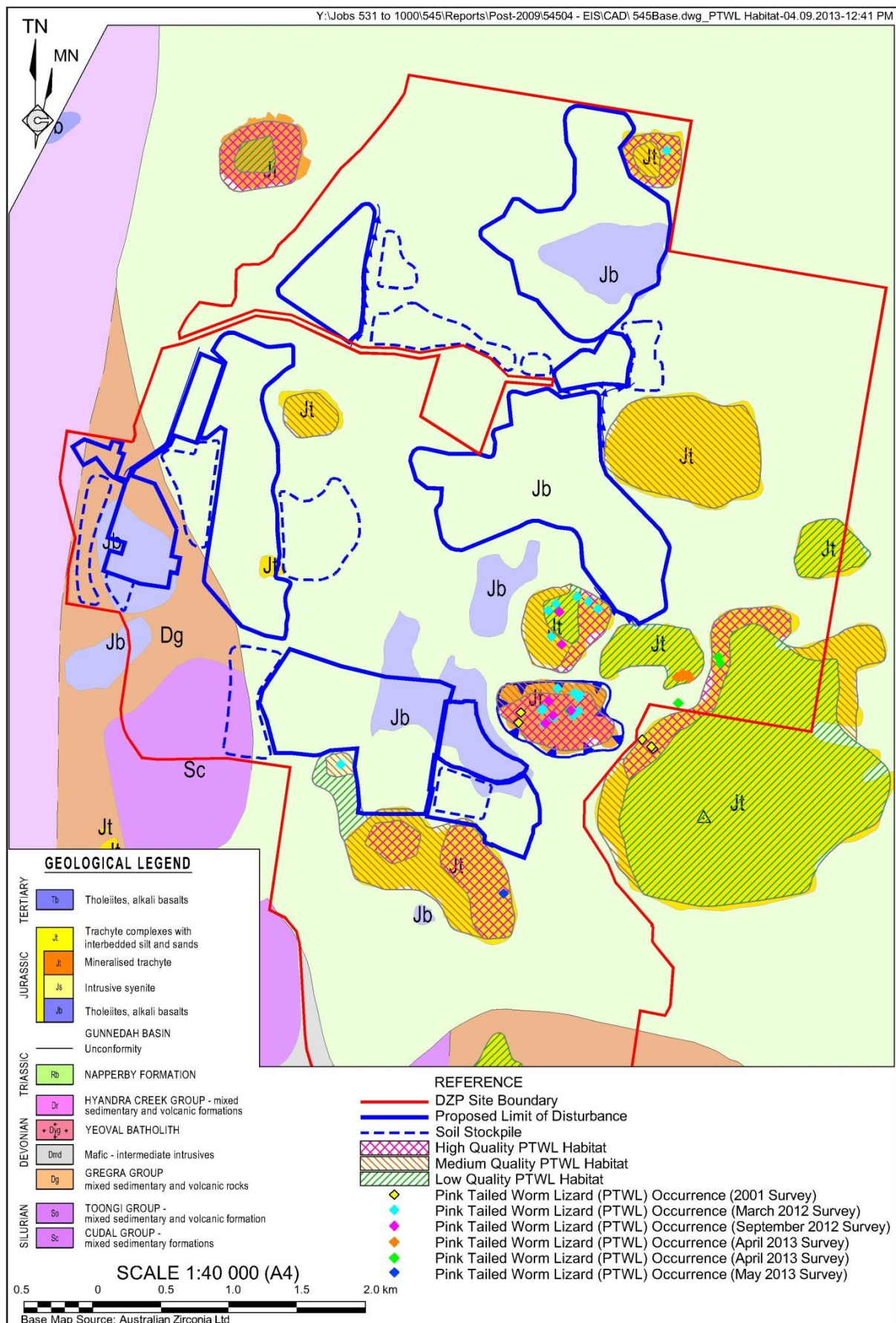
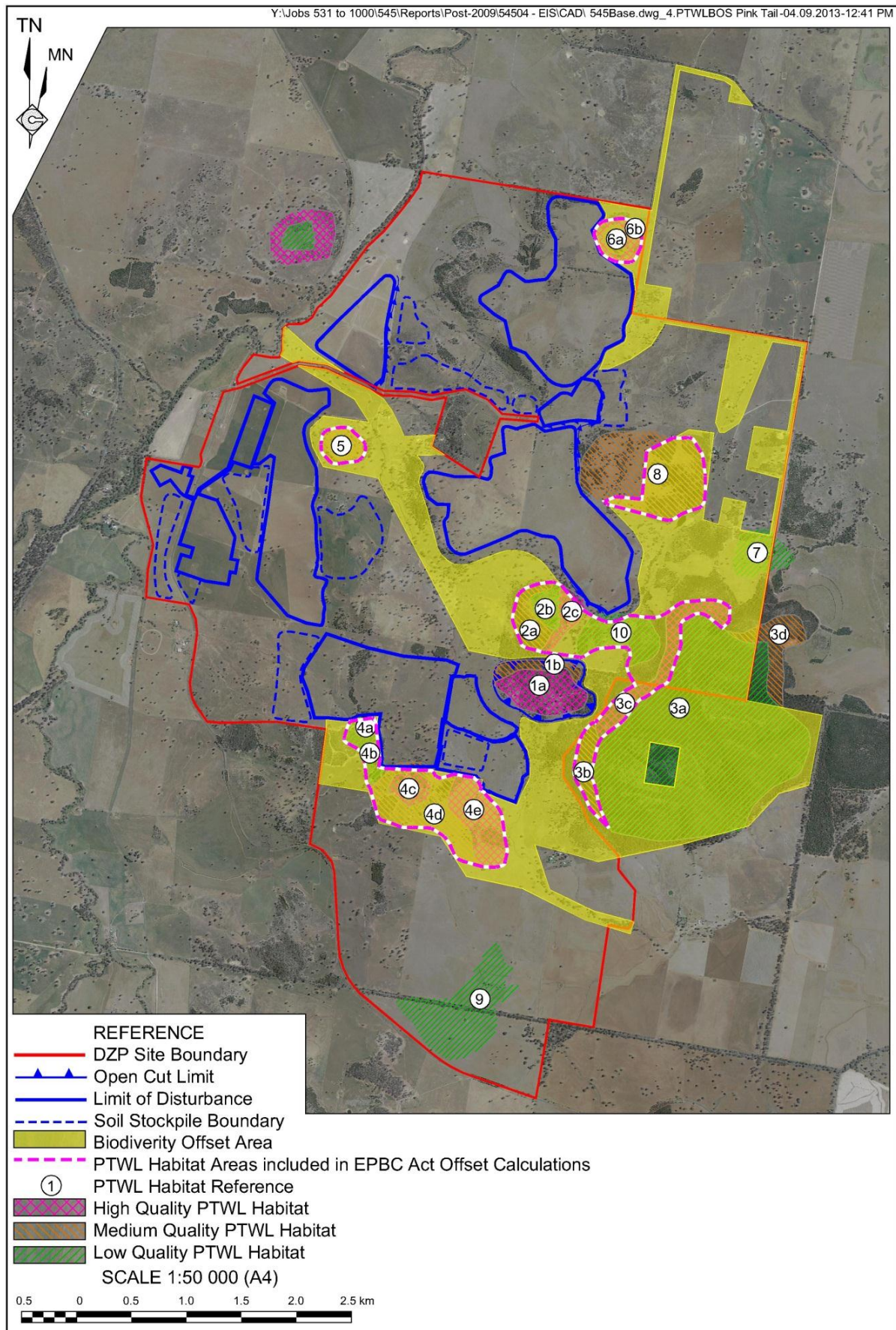


Figure 20(B): Pink-tailed Worm-lizard Populations (DZP Site Assessed Area / BOA relationship)



6. IMPACT ASSESSMENT

6.1 VEGETATION

6.1.1 DZP Site

Up to 808 hectares would be directly disturbed by the various activities and operations within the DZP Site assessed area (**Table 9**).

Table 9: Vegetation Communities Impacted as a Result of Component Disturbance Areas within the DZP Site.

Veg Type ID	Veg Type Name	% cleared in CMA	Total Area Mapped	Total within DZP Site assessed area	Total Disturbed
CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)	95% (Red flag, an over cleared veg type, EEC TSC Act, EPBC Act)	127.1	3.2	0.00
CW213	White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267) - Quality remnants	90% (red flag, EEC TSC Act)	520.5	433.0	43.70
CW213	White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267) - Derived Grassland (>50% weedy, rotationally cropped).	Not an EEC	674.8	532.4	414.00
CW138	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	95% (Red flag and an over cleared veg type, EEC TSC Act)	43.3	23.4	0.10
CW143	Heathy shrublands on rocky outcrops of the western slopes	0.10	25.5	2.6	0.00
CW121	Bullock - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54)	95% (Red flag and an over cleared veg type)	3.9	3.9	0.00
CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270)	0.40	539.0	289.0	27.10
N/A	Cleared / Grazed Crop (remainder)	N/A	1208.2	1208.2	313.0
N/A	White Cypress Pine monoculture	N/A	67.9	8.9	9.6
			3211.3	2215.6	807.5

A significant proportion of this disturbance is located on agricultural land mapped as either *Cleared Land* (313 hectares) or *Derived Grassland* (>50% weeds, rotationally cropped, 414 hectares). The remaining 81.5 hectares will impact on mainly CW213 (quality remnants, 43.7 hectares) and CW212 (27.1 hectares).

The actual area required for the soil stockpiles may be less than 129 hectares. This larger assessed area allows the selection of the most appropriate soil stockpile location within the larger area. Progressive clearing and progressive rehabilitation within the DZP Site would mean that only a proportion of the total vegetation would be removed at any one time. Other areas of woodland vegetation within the DZP Site would be maintained and increased in the long term as a result of the rehabilitation program and the implementation of the *Biodiversity Offset Strategy* (**Section 8**). The aim of the BOS is to reinstate 'grassy woodlands'. Tree planting in the Biodiversity Offset Areas is not required; White Cypress Pine thinning would be undertaken.

6.1.2 Macquarie River Water Pipeline

No trees would be impacted by the installation of the water pipeline as it passes through agricultural paddocks. The alignment is also away from the drip line of older mature trees. Trees are well spaced and the water pipeline weaves around the drip line of tree canopies to minimise root damage. Mitigation measures would ensure that during construction of the final route that the pipe trench is located outside the drip line of any individual trees.

6.1.3 Obley Road Realignment

The works at the nine areas requiring treatment would collectively result in disturbance to 1.08 hectares to *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions* (CW145). **Table 10** provides a more detailed analysis of the disturbance.

6.1.4 Rail Line

A few White Box (*Eucalyptus albens*) trees occur within the Toongi-Dubbo Rail Line Corridor since they started to regenerate after the line was closed in 1987. Due to the degree of invasion by introduced species there are no sections of the corridor that could be classed as meeting the description of a Biometric community (see **Table 11**).

6.2 SIGNIFICANCE ASSESSMENT

6.2.1 Introduction

The appropriate management of ecological items is usually determined on the basis of their assessed significance, as well as the likely impacts of any Proposal. Significance of a species, population or community is determined by appointed NSW and National Scientific Committees, cultural and public significance are considerations within the significance determination process. Within the framework of an impact assessment impacts to listed significant item must be assessed at a State (under the TSC Act) or National (under the EPBC Act) level, even if it is the same species / or community. The following sections identify state or nationally listed threatened (significant) species, then determines if impacts are 'significant'. Although not required for Major Projects assessed under Part 4.1, Seven-Part Tests of Significance have been provided for transparency.

6.2.2 Affected Species, Populations and Communities

The *Threatened species assessment guidelines: The assessment of significance* (DECC 2007) notes that a species does not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species:

- does not occur in the study site, or
- will not use on-site habitats on occasion, or
- will not be influenced by off-site impacts of the Proposal.

Table 10: Obley Road Realignment Impacts to Vegetation

Realignment Portion ID	Chainage	Portion length	Location	BVT Mapped community	Biometric Vegetation Type	Dominant Overstorey Species	No of trees to be impacted (in accordance with plans)
Portion 1	3500 to 4000	500	Proposed realignment corridor adjacent to camp road intersection	Blakely's Red Gum - Yellow Box open-woodland of the tablelands	CW145	Inland Grey Box	10
Portion 2a	4400 to 4700	300	Belowrie Road Intersection	Blakely's Red Gum - Yellow Box open-woodland of the tablelands	CW145	Inland Grey Box	-
Portion 2b	4700 to 6032	1332	Belowrie Road Intersection	Mugga Ironbark Woodland on hills	CW213	White Box	-
Portion 2c	6032 to 6150	118		Mugga Ironbark Woodland on hills	CW145	Inland Grey Box	-
Portion 3	7050 to 7400	350	Cumboogle and Belowrie Rd Intersection	Fuzzy Box woodland on flats and alluvial terraces	CW145	Inland Grey Box, Blakely's Red Gum, Yellow Box, White Cypress Pine	-
Portion 4	9830 to 9855	25	Past Benolong Rd	Fuzzy Box woodland on flats and alluvial terraces	CW145	Inland Grey Box, Blakely's Red Gum, Yellow Box, White Cypress Pine	-
Portion 5	10740 to 10900	160		Blakely's Red Gum - Yellow Box open-woodland of the tablelands	CW213	White Box	-
Portion 6	11371 to 11534	163		Fuzzy Box woodland on flats and alluvial terraces	CW213	White Box	-
Portion 7a	14650 to 14900	350	Near Oakdene Road and Hyandra Road	Blakely's Red Gum - Yellow Box open-woodland of the tablelands	CW213	White Box	-
Portion 7b	14900 to 15240	340	Near Hyandra Road. Crosses Hyandra Creek	White Box - White Cypress Pine woodland	CW145	Inland Grey Box, Blakely's Red Gum, Yellow Box, White Cypress Pine	2 Tree 1 (BRG) Tree 2 (YB) Large Hollow-bearing
Portion 8	17880 to 18170	290		Blakely's Red Gum - Yellow Box open-woodland of the tablelands	CW145	Inland Grey Box	>9
Portion 9a	20230 to 20300	70		White Box - White Cypress Pine woodland	CW213	White Box	-
Portion 9b	20300 to 20380	80		White Box woodland with a shrubby understorey	CW213	White Box	13
Portion 9c	20380 to 20626	246	North of Toongi	Fuzzy Box woodland on flats and alluvial terraces	CW213	White Box	-
Total Impacts (supplied by CAD) 1.08 hectares							

Table 11: Impacts to Vegetation within the Decommissioned Toongi-Dubbo Rail Line

ID	Item	GDA East	GDA North	Species	Large	Medium	Small	location	Comment
					Tree size & No.				
1	Dubbo end of Rail Line	652441.07	6430981.84						
2	Group of five trees	652539.96	6430633.21	Planted Ironbark		5		North of Wingewarra St ARTC car park	
3	Up to seven separated trees	652620.6	6430325.35	White Cedar			7	Adjacent to Apex Park between Mitchell Hwy and Wingewarra St	
4	Group of three trees	652866.36	6429416.8	White Cedar			3	Adjacent to RAAF depot between Mitchell Hwy and High Street	
5	one tree on line	652798.75	6428786.29	White Cedar			1	Between Lovett Ave and Lerbeski St	
6	Three to four trees on line	651721.73	6427612.55			1	3	Treverrow Court and Macquarie St	
7	Two large trees	651216.77	6427224.52	River Red Gum	2			On Miriam North of Macquarie River	Lopping, unlikely removal
8	one tree on line	651144.32	6427130.11	River Red Gum		1		On Miriam North of Macquarie River	
9	One tree near line	650963.95	6426887.64	River Red Gum			1	On Dundullimal South of Macquarie River accessed by Obley Rd	
10	One tree near line	650821.41	6426435.27	River Red Gum			1	Adjacent to Obley Rd South of Dundullimal	Additional smaller trees to south
11	One tree on line	650705.21	6425265.52	White Box		1		Adjacent to Obley Rd , 503 m South of Camp Rd	
12	Possible six trees on line	651141.18	6424387.93	White Box		5	1	376m from Rail bridge number 2	
13	Two small trees on line	650503.82	6422239.77	Fuzzy Box			2	Adjacent to Obley Rd and 800m south of Cumboogle Rd	Second tree 50m from co-ordinates with some shrubbery a further 152m away
14	seven possible trees on line	650211.27	6421298.2	Fuzzy Box		3	4	from co-ordinates between 312m south along Obley Rd and track crossover near Cumboogle	
15	one small tree on the line	649729.44	6420031.22	White Box			1	616m South of Belgravia Heights Rd	second tree 125m west of co-ordinates
16	one tree on the line with three	648830.55	6419726.82	White Box			4	adjacent to Obley Rd near Wilbertree	580m around bend from ID 15

ID	Item	GDA East	GDA North	Species	Large	Medium	Small	location	Comment
	trees near the line								
17	around a group of trees on the line with a further two down the line	648985.88	6418314.29	White Box		1	1	adjacent to Obley Rd 747m from Bellevue Rd crossover	
18	One small tree on line with small shrubbery to the north	648250.63	6417319.15	White Box			1	between Oakdene Rd and Obley Rd	543m from Bellevue Rd and track crossover
19	Up eleven small trees on line	648069.83	6415630.64	White Box			1 1	on the bend where Obley Rd and track crossover and track runs along Oakdene Rd	
20	Up to 10 trees on line	648939.67	6415482.19	White Box		2	8	from point where Glengeera Rd and track crosses continues up along bend	
21	six trees and some shrubbery on line	649438.32	6414577.4	White Box			6	on straight between Glengeera Rd and Glengeera	co-ordinates from middle stretch of trees
22	Group of many trees	651055.15	6411483.45	White Box				in-between Glengerra and Toongi just above Toongi Rd and track crossover	co-ordinates from middle stretch of trees
23	Group of many trees	650981.59	6410924.17	White Box				just below Toongi Rd and track crossover approx. 218m below last group of trees	co-ordinates from middle stretch of trees
24	four trees on line	650748.29	6410547.45	White Box			4	where unnamed waterway flows into Wambangalang Creek approx. 1.16km along rail track from Toongi Rd and track crossover	co-ordinates from middle stretch of trees
25	four trees on line	650462.21	6410298.87	White Box			4	adjacent to Wambangalang Creek approx. 833 m along rail track from Toongi Rd and track crossover	co-ordinates from middle stretch of trees
26	two trees on line	650324.77	6410177.63	White Box			2	approx. 641m along rail track from Toongi Rd and track crossover	co-ordinates from middle stretch of trees
27	two trees on line	650177.17	6409974.92	White Box			2	Where Wambangalang creek flows across rail track approx. 395m along rail track from Toongi Rd and track crossover	co-ordinates from middle stretch of trees

Otherwise all species likely to occur in the Application Area (based on general species distribution information) and known to use that type of habitat, should be considered in the rationale that determines the list of threatened species, populations and ecological communities for the assessment of significance. Of those species predicted to have potential to occur (**Appendix 3**) only those considered likely to be impacted by the Proposal are listed in **Table 12**.

Table 12: Threatened Species and Communities Known To Occur or Likely to Occur Within the Application Area

No.	Common Name	Scientific name	TSC Act Status	EPBC Act Status	Assessment of Significance Test Required
1	Pink-tailed Worm-lizard	<i>Aprasia parapulchella</i>	Vulnerable	Vulnerable	7-Part Test & Significance Assessment. Assessment for Controlled Action Approval (EPBC Ref: 2012/6625).
2	Superb Parrot	<i>Polytelis swainsonii</i>	Vulnerable	Vulnerable	7-Part Test & Significance Assessment
3	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Vulnerable	Vulnerable	7-Part Test & Significance Assessment
4	Greater Long-eared Bat	<i>Nyctophilus timoriensis / corbeni</i>	Greater Long-eared Bat	Endangered	7-Part Test & Significance Assessment
5	Koala	<i>Phascolarctos cinereus</i>	Greater Long-eared Bat	Endangered	7-Part Test & Significance Assessment
6	Swift Parrot	<i>Lathamus discolor</i>	Endangered	Endangered	7-Part Test & Significance Assessment
7	Regent Honeyeater	<i>Anthochaera phrygia</i>	Critically Endangered	Endangered	7-Part Test & Significance Assessment
8	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable	N/A	7-Part Test
9	Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	Vulnerable	N/A	7-Part Test
10	Little Pied Bat	<i>Chalinolobus picatus</i>	Vulnerable	N/A	7-Part Test
11	Glossy Black Cockatoo	<i>Calyptorhynchus lathami</i>	Vulnerable	N/A	7-Part Test
12	Diamond Firetail	<i>Stagonopleura guttata</i>	Vulnerable	N/A	7-Part Test
13	Masked Owl	<i>Tyto novaehollandiae</i>	Vulnerable	N/A	7-Part Test
14	Black-chinned Honeyeater	<i>Meliphaga gularis gularis</i>	Vulnerable	N/A	7-Part Test
15	Grey Falcon	<i>Falco hypoleucos</i>	Endangered	N/A	7-Part Test
16	Painted Honeyeater	<i>Grantiella picta</i>	Vulnerable	N/A	7-Part Test
17	Varied Sittella	<i>Daphoenositta chrysoptera</i>	Vulnerable	N/A	7-Part Test
18	Spotted Harrier	<i>Circus assimilis</i>	Vulnerable	N/A	7-Part Test
19	Square-tailed Kite	<i>Lophoictinia isura</i>	Vulnerable	N/A	7-Part Test
20	Little Eagle	<i>Hieraaetus morphnoides</i>	Vulnerable	N/A	7-Part Test
21	Barking Owl	<i>Ninox connivens</i>	Vulnerable	N/A	7-Part Test

No.	Common Name	Scientific name	TSC Act Status	EPBC Act Status	Assessment of Significance Test Required
22	Brown Tree-creeper	<i>Climacteris picumnus</i>	Vulnerable	N/A	7-Part Test
23	Speckled Warbler	<i>Pyrrholaemus sagittatus</i>	Vulnerable	N/A	7-Part Test
24	Flame Robin	<i>Petroica phoenicea</i>	Vulnerable	N/A	7-Part Test
25	Hooded Robin	<i>Melanodryas cucullata</i>	Vulnerable	N/A	7-Part Test
26	Eastern Bentwing Bat	<i>Miniopterus schreibersii orianae oceanensis</i>	Vulnerable	N/A	7-Part Test
27	Grey-crowned Babbler	<i>Pomatostomus temporalis temporalis</i>	Vulnerable	N/A	7-Part Test
28	Fuzzy Box Woodland	<i>Fuzzy Box Woodland</i>	EEC	N/A	7-Part Test
29	Box-Gum Woodland	<i>Box-Gum Woodland</i>	EEC	CEEC	7-Part Test only
30	Inland Grey Box Woodland	<i>Inland Grey Box Woodland</i>	EEC	CEEC	7-Part Test only
31	Pine Donkey Orchid	<i>Diuris tricolor</i>	Vulnerable	N/A	7-Part Test
32	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	N/A	Migratory	Significance Assessment
33	Australian Painted Snipe	<i>Rostratula australis</i>	N/A	Migratory	Significance Assessment
34	Latham's Snipe	<i>Gallinago hardwickii</i>	N/A	Migratory	Significance Assessment
35	White-throated Needletail	<i>Hirundapus caudacutus</i>	N/A	Migratory	Significance Assessment
36	Fork-tailed Swift	<i>Apus pacificus</i>	N/A	Migratory	Significance Assessment
37	Rainbow Bee-eater	<i>Merops ornatus</i>	N/A	Migratory	Significance Assessment
38	Australasian Bittern	<i>Botaurus poiciloptilus</i>	N/A	Migratory	Significance Assessment
39	Trout Cod	<i>Maccullochella macquariensis</i>	N/A	Endangered	Significance Assessment
40	Murray Cod	<i>Maccullochella peelii</i>	N/A	Vulnerable	Significance Assessment

The relevant criteria given in the administrative guidelines for the TSC Act and EPBC Act to determine whether the action would or is likely to have a significant impact on the identified threatened species, population or community are presented in **Appendix 10**.

6.2.3 Matters of National Environmental Significance (EPBC ACT Considerations)

6.2.3.1 Threatened Fauna

Matters of NES relevant to the Proposal are nationally listed threatened species and migratory species. Those species that occur or could potentially occur within the Application Area and are subject to assessment pursuant to the EPBC Act are listed in **Table 12**.

The relevant criteria given in the administrative guidelines for the EPBC Act to determine whether the action will or is likely to have a significant impact on the identified threatened species are presented in **Appendix 10**.

Other assessments of significance (**Appendix 10**) showed that the Proposal would not have a significant impact on local populations of the Swift Parrot, Superb Parrot and Regent Honeyeater. Swift Parrot and Superb Parrot are both migratory birds that do not have breeding habitat within the Application Area or Dubbo locality more generally. The Regent Honeyeater has once been known to breed at the Wellington Arboretum 'Fern Gully' (approximately 25 kilometres southeast of the DZP Site). Whilst it is possible that breeding habitat is available within the Application Area it is very unlikely to be used given the 'disturbed' nature of suitable vegetation types (the remnant vegetation of Dowds Hill and surrounds within the DZP Site does not provide a suitable vegetation type).

Despite Koala scats being identified by Goldney in 2001, this is considered a one-off transient individual. Koala populations have not been recorded in the DZP Site (or identified through interviews with landholders, some of which have lived on the property for 60 years). An assessment of significance showed that the Proposal is it is unlikely to impact any local occurring population.

With respect to the Application Area, the majority of those species known to occur in the Dubbo LGA would remain unaffected by Proposal. A few EPBC listed species that have the potential to occur require further comment.

1. The Australian Painted Snipe, *Rostratula benghalensis*. This species has potential to occur along the Macquarie River riparian gallery and shallow wetland areas along the proposed Macquarie Water Pipeline route on the floodplain. The Proposal would not affect the likelihood of this species to occur. Further assessment is currently not warranted, however, if transient individuals were to be recorded, regular population monitoring should occur.
2. Australasian Bittern, *Botaurus poiciloptilus*. This species has potential to occur along the Macquarie River riparian gallery and shallow wetland areas along the proposed Macquarie Water Pipeline route on the floodplain. The proposed impacts would not affect the potential for this species to occur in the area. Further assessment is not required unless it is subsequently recorded as habitually occupying the Application Area. In this instance, regular population monitoring should occur and given the overall life of the mine suitable amelioration can occur well in advance of the impact to specific habitats occurring.
3. Large-eared Pied Bat, *Chalinolobus dwyeri*. This species would not be affected by a net decrease in habitat. Further assessment is not required.
4. Spotted-tailed Quoll, *Dasyurus maculatus maculatus*. This species has not been detected in the Application Area. Further assessment is not required.

Pink-tailed Worm Lizard is considered likely to be significantly impacted by the Proposal. The Proposal was referred to DSEWPaC on the basis of this impact and subsequently determined to represent a Controlled Action (EPBC Ref: 2012/6625). **Section 6.3** considers the potential impact on the Pink-tailed Worm-lizard.

6.2.3.2 Threatened Flora

No EPBC listed flora species would be affected by the Proposal.

Philothea ericifolia was recorded on Dowds Hill at the eastern extremity of the DZP Site¹¹. This is well away from the areas of proposed disturbance. This area is within the proposed Biodiversity Offset Area would form part of a *Biodiversity Offset Strategy* to be developed and implemented should approval for the Proposal be granted.

6.2.3.3 Threatened Ecological Communities

An assessment of significance showed that the Proposal (**Appendix 10**), with certainty, would not impact directly on 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Community' or endangered 'Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia' as both mapped communities are outside the areas of proposed disturbance (**Figure 18**).

6.2.3.4 Listed Migratory Species

Predicted impacts would not detrimentally alter habitat such that any listed migratory species would have the potential to occur at less densities / frequency than currently experienced.

Impacts to creek and river banks would occur to reinstate the Rail Line between Toongi and Dubbo and construct the proposed Macquarie River Water Pipeline. Mitigation measures would ensure that no potential Rainbow Bee-eater breeding sites would be impacted at waterway areas.

The only wetland area (a cleared area in a ploughed paddock on the Macquarie River floodplain on 'Mia Mia') would be avoided by specific alignment of the pipeline. This area is a cropped paddock supporting limited native vegetation when inundated.

It is unlikely that any migratory species would have their potential to occur reduced in the DZP Site assessed area due to the Proposal. The proposed action would not reduce the probability of commonly occurring listed migratory species nor will it impede transient individuals of the more selective species from temporarily visiting the area in times of suitable environmental conditions.

6.2.4 Threatened Species Conservation Act Considerations

6.2.4.1 Listed Fauna

Twenty-seven species of threatened fauna are considered likely to utilise habitat in the Application Area (**Table 12**). Consideration of the type and scale of habitat to be removed for Pink-tailed Worm-lizard has been determined within BBAM, the proposed offsets are allowable. The Proposal would not have a significant impact on any other item listed in **Table 12**. This is based on habitat parameters and previous records.

¹¹ Cunningham (2001). No coordinates provided. Map in the report plots the location.

Forest owls, woodland birds and microchiropterans are the general 'groups' of fauna require further discussion. These species are associated with woodland areas and utilise habitat resources such as hollow-bearing trees and cliff lines along Dowds Hill. Progressive rehabilitation during mining would include rehabilitating woodland habitat to reinstate 'grassy woodlands'. Habitat features, such as suitable fallen timber would be undertaken as follows:

- Whole trees for habitat improvement (re-snagging watercourses) habitat complexity.
- Tree hollows kept for habitat enhancement activities
- Suitable species (White Cypress Pine, White Box, Ironbark) for milling fencepost, structural timber, floor boards.
- Woodchipping crowns and limbs once seed has been harvested.
- Pyrolysis to charcoal if it proves to be a viable use for soil amelioration.
- Firewood for community benefit/use.

AZL has an audit done of the timber resource to ensure that a flexible and variable best use can be found for the timber. Not all trees will be cleared as part of construction earthworks rather clearing will be staged as LSRFs and SRSFs are required. Stockpiling all timber for later use in rehabilitation will not suit this project which has a potential 80 year life. Even stockpiling trees for 20 years is problematic (feral animal refuge). Many areas dominated by White Cypress Pine will be 'thinned'.

Rocks will be salvaged during clearing.

These measures would help bird and bat species to maintain territories in the locality, by providing habitat features in the medium to long term. Tree planting would not be located in the BOA as "Grassy Woodlands" are the desired outcomes, there are many paddock trees to be included in the BOA facilitate this outcome.

Abundant similar habitats are available in the proposed BOA (**Section 8**). Offsets will aim to improve the connectivity of conservation areas and the quality of remnant vegetation within the locality and region. This will potentially increase movement corridors for genetic exchange, foraging habitat and increase breeding resources for threatened fauna species.

The design and layout of DZP Site have been altered to minimise impacts on riparian areas. The current Proposal design avoids creek diversions, which were originally proposed, substantially reducing potential impacts to this species.

6.2.4.2 Listed Flora

No threatened flora species were identified within areas to be impacted by the Proposal and as such, no impact on threatened flora species is expected. One flora species Pine Donkey Orchid (*Diuris tricolor*) was identified as requiring a 7-Part Test of Significance (**Table 12**). There is potential that the Pine Donkey Orchid could occur in less disturbed grass remnants outside of the Component Disturbance Area.

On the basis of the flora survey conducted along the proposed Macquarie River Water Pipeline route and Toongi-Dubbo Rail Line and Gas Pipeline Corridor in 2001 and 2012 it is concluded that no threatened flora species, populations or Endangered Ecological Communities would be impacted by the Proposal within these easements.

6.2.4.3 Listed Ecological Communities

Three EECs Fuzzy Box Woodland, Box-Gum Woodland and Inland Grey Box Woodland are identified as requiring a 7-Part Test of Significance (**Table 12**).

A 7-Part test of Significance showed that the Proposal within the DZP Site, with certainty, will directly impact on the following EECs (**Figure 18**).

- Approximately 43.7 hectares of White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland) (mapped as CW213, quality remnants).
- Approximately 0.1 hectares of Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South bioregions (CW138).

The following TSC Act listed EECs would be directly impacted by the proposed realignment of Obley Road.

- Approximately 1.1 hectares of Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (CW145).

No significant Impact will occur to any listed EEC (**Appendix 10**).

6.3 IMPACTS ON THE PINK-TAILED WORM-LIZARD

Aprasia parapulchella is the only listed EPBC Act and TSC Act species that has potential to be significantly impacted by the direct impacts associated with the Proposal.

The action will disturb a local sub-population residing on Hill 1. A much larger population has been found to exist in the surrounding area including land owned by the Applicant. This is the largest known population in NSW, none of it is currently in an area managed for conservation.

Targeted field assessment (March 2012, September 2012, and March 2013) has mapped the current known extent of the local population (**Figure 20**). Other 'likely' environments that may support this species have also been investigated. Surrogate habitat trials were also undertaken. Surrogate habitat was created in September 2012 by laying 150 roof tiles in grassy areas to see if this would increase the area of occupancy by the species. By May 2013, one individual Pink-Tailed Worm Lizard was recorded under the surrogate habitat created by a roof tile.

Preliminary work to date suggests the population is more common than thought. A range of factors have potential to play key roles in the species ability to naturally recover unassisted. The overall research strategy presented as **Appendix 13** has begun to investigate a link between the species and various factors including the underlying geology / particular species of ant / changed fire regimes / dominance of White Cypress Pines and subsequent shading of grassy habitat / removal of bush rock. Dr Arthur White (reptile expert) is developing the Plan of Management for this species with the assistance from Dr Gilbert Whyte (entomologist and soils) and OzArk, Phillip Cameron and Heidi Kolkert (vegetation and habitat).

The mapped area of extent for the population (as of autumn 2013) showed the impacts would not be likely to trigger the loss of a local population of the species. As the species has been recorded in small localised populations in remnant woodland it is highly likely that protection and enhancement of these woodland remnants would ensure that a viable local population would continue on land owned by the Applicant under an approved Plan of Management. The BOA and the *Pink-tailed Worm-lizard Plan of Management* would result in Dowds Hill and other known populations of the species protected and managed for conservation.

Appendix 13 and **Section 8.2** provides detailed information regarding the management of the Pink-tailed Worm-Lizard population while **Appendix 15** provides an example of expected results delivering an increase of biodiversity values in thinned areas of cypress pine that would assist in recovery of this species.

6.4 IMPACTS TO BIODIVERSITY LINKS

Existing cleared areas of the DZP Site are a significant barrier to connectivity and movement in the landscape. The cleared areas have been targeted for the construction of the LRSF, SRSF, SECs and WRE and as such have reduced impacts to better quality remnants. Connectivity between local remnants is likely to improve as a result of the creation of a proposed rehabilitation corridor detailed in the BOA. Specifically, connectivity between Wambangalang Creek (a regional biodiversity link, **Figure 22**) and Dowds Hill would be improved through the creation of a rehabilitation corridor. All creeks and drainage lines within the DZP Site (outside of the Component Disturbance Areas) would also be rehabilitated to create a 20 metre wide vegetation buffer – new Local Biodiversity Links.

Connectivity of potential and known Pink-tailed Worm-lizard habitat would also be established in the BOA. This is part of the *Pink-tailed Worm-lizard Plan of Management* (**Appendix 13**).

Nine sections of Obley Road Reserve would be impacted as a result of road widening activities. The road reserve would not, however, be reduced in size nor connectivity severed. Clearing of this habitat is unlikely affect local fauna movement.

Connectivity is unlikely to be affected as a result of impact for the Water Pipeline and Rail Line, which occur in highly disturbed and cleared environments.

6.5 LIKELY INDIRECT OR OPERATIONAL IMPACTS

General impacts likely to affect threatened fauna species include the following.

- Loss of habitat as a direct result of clearing and trampling.
- Predation by feral pigs.
- Creation of disturbed edge areas which can encourage introduction of competitive native and introduced species that out-compete other native species and dominate native vegetation.
- Changes in hydrology which could lead to changes in vegetation assemblages.
- Erosion and sedimentation which could promote introduced species and alter conditions for native species.
- Changes in habitat resources can disrupt extant food-chain processes such as an increase in cleared areas encouraging an increase in aerial predation from raptors.
- Disruption to essential behavioural patterns because of noise generation, artificial lighting, dust and air quality, road traffic, human interference and invasion of introduced species and predation by other feral animals.
- Mortality due to drinking polluted waters, collision with artificial structures such as power lines and road traffic.

Some species of threatened terrestrial fauna are suspected or known to have part of their home range within the Application Area. As suitable extensive habitat would remain within the

surrounding environs, most fauna (aside from breeding / nesting birds) would have a chance to disperse to adjacent habitat. Impacts to threatened species has been characterised in the respective 7-Part Tests and Assessments of Significance for the Proposal (**Appendix 10**).

6.6 KEY THREATENING PROCESSES

The Project is likely to exacerbate key threatening processes listed under the TSC Act and EPBC Acts, including:

- Alteration to the natural flow regime of streams and their floodplains.
- Bush rock removal.
- Clearing of native vegetation.
- Loss of hollow-bearing trees.

Potential impacts on threatened species as a result of key threatening processes would be minimised through implementing the environmental mitigation and management measures listed in **Sections 7** and **8**. Reinstatement of “Grassy Woodlands” would benefit the majority of species recorded in the Application Area.

6.7 CRITICAL HABITAT

Critical habitat has not been declared under the TSC Act or EPBC Act for any species, population or community that occurs in the Application Area.

Critical habitat has been broadly defined in the draft NSW recovery plan for Box Gum Woodland (DECCW 2010b) as occurring on the moderate to highly fertile soils of the western slopes of NSW. The Application Area occurs within this region and consequently all remnant areas identified as Box Gum Woodland EEC are considered critical habitat under the draft recovery plan.

The Proposal would rehabilitate disturbed areas with species indicative of this community. Areas of critical habitat for Box Gum Woodland would also be included within BOA, where remnants of the community would be rehabilitated, improved and protected.

7. RECOMMENDATIONS AND MITIGATION MEASURES

Recognising the relatively large impact footprint of the Proposal, the Applicant has followed the principles of 'avoid, minimise, mitigate' to reduce the impact of the Proposal on local biodiversity values. The following provides a summary of the approach taken.

7.1 AVOID IMPACT

7.1.1 General

The following impact avoidance measures have been adopted by the Applicant.

- The site of the proposed processing operations and related infrastructure has been located over land which has been regularly cultivated over many years, i.e. There is no remnant native vegetation.
- The areas targeted for the positioning of disturbance associated with the management of waste materials and residues generated by the mining and processing operations considered local landforms and vegetation with efforts made to exclude the following areas:
 - Species populations and communities listed in the EPBC and TSC Acts.
 - The remnant vegetation of Dowds Hill.
 - Larger and intact remnants of native woodland vegetation.
 - Major drainage lines.

It is noted that in identifying preferred areas for disturbance, areas of higher quality agricultural land was also attempted to be avoided.

- All areas suitable for listing as critically endangered Box Gum Woodland under the EPBC Act were avoided through re-design of the Proposal. Furthermore, 61.8 hectares of this community will be protected in perpetuity within the BOA.
- Redesign of the Proposal was undertaken to reduce effects to the NSW Fuzzy Box endangered ecological community to 0.1 hectares (essentially paddock trees in a cropping area). The remaining 21.9 hectares of this EEC would be protected in perpetuity within the BOA.
- Management of CW213 'White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267)' has been problematic as there are two distinct quality categories under the one "CW213" heading. Those areas mapped as CW213 are consistent with the Biometric description and are the EEC (CW213 quality remnants), those areas mapped as 'Derived Grassland' have >50% weed species and are used for rotational cropping (not the EEC). 520.5 hectares of the quality remnant has mapped, 433 hectares is within the DZP Site and 43.7 hectares would be effected (residual effects reduced to 10% of the quality community in the DZP Site).

7.1.2 Pink-tailed Worm-lizard Habitat

Surveys carried out in 2012 and 2013 (White 2012, 2013), and subsequent assessment and evaluation of various factors influencing the occurrence of the species have identified Pink-tailed Worm-lizard habitat areas on the DZP Site (**Figure 20**). Having identified these areas, the original planning footprint for the open cut and associated infrastructure was overlain and areas of conflict were identified. The two major impact areas identified were the open cut and residue storage facilities (both solid and liquid).

There is limited scope to relocate the open cut (based on the boundary of the ore body. AZL has committed to developing the open cut in two stages such that only half of the open cut is impacted during the initial ten years of the Proposal. Using this approach it should be possible to collect Pink-tailed Worm-lizards from the impact area and relocate these animals to nearby know habitat areas. Physical relocation is a last resort. Emphasis is placed upon created habitat areas to be developed between the open cut area and existing habitat areas to facilitate the passive transfer of lizards away from the open cut impact area (see also **Appendix 13**).

Conflict between Pink-tailed Worm-lizard habitat confirmed on Habitat Areas 2, 3, 4 and 6 and initially proposed residue storage facilities was reviewed and these facilities modified to avoid impact on the high quality habitat areas (**Figure 20**).

- Cell C of the SRSF was modified to avoid a known occurrence of the species on moderate quality habitat.
- Several of the proposed cells of the Salt Encapsulation Cells have been modified to avoid impact on high quality habitat associated with a known occurrence of the species.
- Several proposed soil stockpile locations have been discounted due to encroachment of areas of high or moderate quality habitat.

Impact on a small area (1.6 hectares) of medium quality habitat (of Habitat Area 4) could not be completely avoided due to the large areas required for these structures and objective to locate these away from remnant native vegetation wherever possible. The disturbance footprint of the Proposal has avoided all but one known population of the species and coincident high quality habitat. A 1,021 hectare BOA is proposed where the majority of high and moderate quality habitat within the DZP Site would be protected. Specific impact avoidance to design the BOA undertaken has been as follows:

- The processing plant and associated infrastructure are located adjacent to the Toongi-Dubbo Rail Line and Village of Toongi on the western boundary of the DZP Site. This location is away from habitat for the species and would therefore not impact on any known Pink-tailed Worm-lizard habitat areas.
- Roads between the open and processing plant could impact on Pink-tailed Worm-Lizard habitat. Impact will be minimised by avoiding Pink-tailed Worm-lizard habitat areas as much as possible and only crossing the habitat areas at sites where it would have the least impact.

7.2 MINIMISE IMPACT

In addition to the impact avoidance measures noted in **Section 7.2**, the following impact minimisation would be implemented by the Applicant.

- The largest area of impact would be associated with the Liquid Residue Storage Facility. The Applicant has, at significant cost, continued to modify the processing operations to improve water efficiency. Through this process optimisation, the water required has been reduced by approximately 20%, in turn reducing the area required for the LRSF.
- Further reducing the areas required for the LRSF. The Applicant has committed to the construction of a reverse osmosis water recycling plant which would further reduce the volume of liquid residue discharged to the LRSF. The process and water recycling optimisation has reduced the overall liquid residue generation by 50%.
- Through reference to vegetation mapping prepared for the DZP Site, the Applicant targeted exclusion of those LRSF Areas located on more ecologically sensitive areas. In particular, LRSF Area 7 to be located on the "Ugothery" property to the north of Dowds Hill would have impacted on areas of two EECs, White Box - Yellow Box - Blakely's Red Gum Grassy Woodland EEC and Fuzzy Box Woodland EEC.
- Cell C of the SRSF was also further modified to minimise the area of disturbance to the Grassy White Box Woodland EEC.
- Ancillary areas of disturbance such as soil stockpiles have also been modified to minimise impacts on EECs. No soil stockpile area is now located over areas mapped as EECs.

7.3 MITIGATE IMPACT

7.3.1 General Recommendations and Application to the Proposal

An Environmental Management Plan and Integrated Land Management Plan (ILMP) should be prepared to detail measures to minimise the potential impacts on terrestrial biodiversity. These plans should include adaptive management measures, including monitoring to manage, protect and enhance vegetation and fauna habitat within the DZP Site and its surrounds. A rehabilitation management plan should detail the progressive rehabilitation methods according to the rehabilitation strategy. General recommendations for impact mitigation and application to the Proposal are provided in **Table 13**.

Table 13: Impact Mitigation Recommendations and Application to the DZP

Category	Examples	Relation to the Application Area
Protection and avoidance	<ul style="list-style-type: none"> • Relocating or changing the design of the Proposal • Restricting access of construction crew and machinery • Implementing stringent sediment and erosion control measures • Creating buffer areas between a significant area and the footprint 	<ul style="list-style-type: none"> • The majority of the Component Disturbance Areas has avoided large stands of vegetation. • Avoidance of dense dead tree stags and hollows in the Application Area. This will reduce potential impacts to many hollow dependant species that would utilise tree hollows. Big hollow-bearing trees within the component disturbance areas should be moved to the BOA, or areas immediately outside the extraction area. • Restricting access to only areas to be impacted is feasible in a mining project. • Soil and sediment control devices are an integral

Category	Examples	Relation to the Application Area
	of the Proposal.	<p>component of the project.</p> <ul style="list-style-type: none"> • Buffer areas would be the same as point one above. Buffer zones will be created along all waterways (20 metres either side), drainage lines (10 metres either side) and major gullies. The buffer zones will then be revegetated as part of on-site rehabilitation. • Care should be taken to ensure that the chosen pipeline route, wherever possible, is located outside the drip line of the individual tree canopies to minimise root damage.
Enhancement	<ul style="list-style-type: none"> • Bush regeneration activities • Replacing animal habitats such as tree hollows, mallee areas, woodland and wetlands • The use of plantings outside the Application Area to allow the passage of native animals between natural areas prior, during and post the Proposal. 	<ul style="list-style-type: none"> • BOAs will adequately compensate for impacts. Remnant native vegetation associated with Dowds Hill adjacent to the extraction site will also be protected and conserved additionally to the BOA. • Rehabilitation of the DZP Site will also occur within buffer zones, which is also addition to the proposed BOA. • The rehabilitation plan of the spoil should include the use of native species known to occur on the site for rehabilitation.
Compensation	<ul style="list-style-type: none"> • Biodiversity habitat compensation • Construction of artificial replicas of important habitat features (e.g. artificial nesting sites for birds, frog-friendly ponds). 	<ul style="list-style-type: none"> • 1,021 hectares of adjacent land including Dowds Hill has been identified as the 'BOA'. Additional land connecting the BOA to Wambangalang Creek to the west will also be set aside for conservation and rehabilitated. The BOA adequately compensates for the area of vegetation to be impacted and based on vegetation types impacted within the Application Area (Figure 11). Consultation with OEH has acknowledged that feral animal control in the Application Area will significantly improve habitat available for threatened species in the Application Area. • Regenerating, revegetating and rehabilitating the Application Area through a 'Biodiversity Compensatory Strategy' are proposed. Basically, habitat removed within the Component Disturbance Areas will be moved into surrounding habitat (outside the impact areas) to create habitat diversity. • Construction of artificial habitats for the Pink-tailed Worm-lizard has occurred for this project. This includes tiles placed on the ground and thinning of White Cypress Pine to promote a grassy understorey. No tree planting will occur in the BOA to maintain a Grassy Woodland Formation.
Management	<ul style="list-style-type: none"> • Weed and feral animal control programs • Bushfire management • Ongoing monitoring programs • Restricting livestock, domestic pets and humans to certain areas 	<ul style="list-style-type: none"> • Currently biodiversity is limited due to the degree of pastoral land use in the DZP Site. Numbers of pigs, kangaroos, foxes and cats also occur in the Application Area, with a recent addition of feral pigs. Active animals control would ensure fewer native animals are impacted by land clearing. It would be advisable that once land clearing has occurred to then appropriately address feral animals. Predation by the European red fox pigs and feral cat are listed as key threatening processes under the EPBC Act and the TSC Act, with threat abatement plans prepared under guidelines set by each Act (Environment Australia 1999.NPWS 2001a). The Applicant would address the management of feral animals (The Applicant has already addressed pigs) within the Application Area as they have already have had a detrimental impact upon the native wildlife of the area, particularly reptile, bird and ground dwelling mammal species. • The area exotic weeds, a weed management strategy

Category	Examples	Relation to the Application Area
		<p>would be developed as part of the project. The abundance of 'woody weeds' also demonstrates a dramatic shift in landscape ecology since European settlement. The weed management plan would combat the spread of weeds prior during and after construction work. The Applicant should regularly inspect the site having particular regard to the requirements for weed species listed as 'noxious' under the NW Act. Weed inspection should occur at three months and twelve months after the ground disturbing works.</p> <ul style="list-style-type: none"> • All species present are believed to respond to fire. Controlled burning may be beneficial but not recommended within the context of this study. • Ongoing monitoring will be part of the Biodiversity Management Plan and <i>Pink-tailed Worm-lizard Plan of Management</i>. • Restricting livestock to areas identified for conservation has already been undertaken. Restriction of human movement (vehicles etc.) would benefit soil conservation. • Trees removed will be used in the following ways: <ul style="list-style-type: none"> • Whole trees for habitat improvement (re-snagging watercourses) habitat complexity • Tree hollows kept for habitat enhancement activities. • Suitable species (White Cypress Pine, White Box, Ironbark) for milling fencepost, structural timber, floor boards. • Woodchipping crowns and limbs once seed has been harvested. • Pyrolysis to charcoal if it proves to be a viable use for soil amelioration. • Firewood for community benefit/use.

7.3.2 Mitigation Measures – General Principles

The following recommendations are made to minimise impacts of the Proposal on the ecological values of the Application Area.

- Grassy Woodland Formation is the rehabilitation target. Tree planting should not occur within the BOA. Existing paddock trees within this area reflect tree densities for this formation. Cypress Pine thinning at a 8m spacing is required to increase biodiversity levels.
- Fire regimes would need to enhance native biodiversity and to minimise harm to the Pink-tailed Worn-Lizard population.
- Protect in-perpetuity the 1,021 hectare BOA as planned. The BOA will create a Local Biodiversity Link between Dowds Hill and Wambangalang Creek. This will fulfill a goal consistent with the National Wildlife Corridor Plan.
- Habitat values (large hollow-bearing trees) should be relocated to areas outside of the targeted Component Disturbance Areas to increase structural integrity and thus further aid in woodland restoration. The result would increase the area of occupancy of intact vegetation impacted, as well as assisting in natural recovery of the ecosystem and the animals and plants that depend on them. Not all trees require salvaging for rehabilitation, additional uses have been provided on **Table 13** (see 'Management').

- Schedule staged tree clearing i.e. both at separate locations and when clearing one location i.e. push a tree over, leave it overnight (for unobserved fauna to escape) then manage the removed trees the day after pushing. Avoid leaving trees that are to be relocated to other areas on ground unmanaged for more than two weeks as these would quickly become habitat for hollow dependent species. Where trees are not required for environmental or salvage purposes they should be chipped when removed.

Considering the nature and extent of the Proposal, amelioration measures should include the following.

- General land management amelioration measures (e.g. pest animal control, grazing management and weed management strategy).
- Review all tracks / access roads and minimise the number traversing the DZP Site.
- Opportunities to avoid, minimise or mitigate impacts should continue to be investigated.
- Schedule vegetation clearing for early to mid-winter (avoids breeding periods for species) as the top priority and leave spring as the last choice.
- Familiarise staff undertaking pre-clearing assessments prior to the clearing campaign in order to:
 - ensure they understand the nature and extent of each stage clearing;
 - determine what habitats and what species have potential to be effected.
 - prepare themselves to understand what they need to do and what equipment to prepare to humanely and ethically manage species that may be affected by the activity; and
 - orientate themselves with the location, nature and extent of unaffected habitat on site so that they will know the best locations to release relocated fauna.
 - The best seasonal timing for staff familiarisation and to prepare a clearing monitoring plan would be in spring where breeding hollows / nests are easier to detect.
 - Develop administrative controls i.e. procedures or inductions to inform workers of their environmental requirements.
 - Apply a buffer zone of no less than ten metres to all ephemeral drainage lines and creek in the DZP Site for rehabilitation and revegetation.
 - In areas outside the BOA increase the area of extent native vegetation by using indigenous species, rehabilitation of existing remnant and improving structural complexity.
 - Species lists for planting have been presented on **Table 14**.
 - The aim would be to have 10% mature tree cover, 10% mature mid-stratum and 80% grassy ground cover to retain grassy woodland vegetation formation.
 - Tree spacing should be 30 metres between each tree.
 - Natural recovery of the ground stratum would occur.
 - Assisted recovery by weed control, seeding or introducing missing species may be beneficial at a case by case basis.

Table 14: Suggested Species Lists for Rehabilitation Areas (Landform Based)

Where	Dominant canopy spp Aim 10% tree cover. The following tree species to plant should be 50% of all trees planted (5% of tree cover).	Main associated spp Remaining 50 percent of tree species to plant (the remaining 5% of tree cover)	Landscape position	Mid-storey spp Aim 10% cover.	Groundcover spp Aim 80% cover.	Landscape features
On hill tops	White Box (<i>Eucalyptus albens</i>)	Inland Grey Box (<i>Eucalyptus microcarpa</i>) Kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>), Tumbledown Red Gum (<i>Eucalyptus dealbata</i>)	On undulating low hills.	<i>Acacia hakeoides</i> , <i>Acacia pycnantha</i> , <i>Acacia decora</i> , <i>Dodonaea viscosa</i> subsp. <i>cuneata</i> , <i>Western Boobialla</i> (<i>Myoporum montanum</i>), <i>Pittosporum angustifolium</i> , <i>Silver Cassia</i> (<i>Senna</i> form taxon 'artemisioides')	<i>Austrostipa bigeniculata</i> , <i>Austrodanthonia caespitosa</i> , <i>Kangaroo Grass</i> (<i>Themeda australis</i>), <i>Redleg Grass</i> (<i>Bothriochloa macra</i>), <i>Dichopogon strictus</i> , <i>Hydrocotyle laxiflora</i> , <i>Podolepis jaceoides</i> , <i>Vittadinia cuneata</i> , <i>Atriplex semibaccata</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Tall or mid-high woodland or open woodland with trees to about 15 m high. Plant on red-brown loamy soils or loamy sandy soils derived from sedimentary rocks or colluvium.
On slopes	White Box (<i>Eucalyptus albens</i>)	Kurrajong (<i>Brachychiton populneus</i> subsp. <i>populneus</i>), Tumbledown Red Gum (<i>Eucalyptus dealbata</i>)	On lower slopes and alluvial plains mainly on sedimentary substrates	<i>Cassinia laevis</i> , <i>Sticky Daisybush</i> (<i>Olearia elliptica</i>), <i>Acacia buxifolia</i> , <i>Western Rosewood</i> (<i>Alectryon oleifolius</i> subsp. <i>canescens</i>), <i>Acacia implexa</i> , <i>Native Olive</i> (<i>Notelaea microcarpa</i> var. <i>microcarpa</i>), <i>Sticky Wallaby Bush</i> (<i>Beyeria viscosa</i>), <i>Quinine Bush</i> (<i>Alstonia constricta</i>), <i>Wilga</i> (<i>Geijera parviflora</i>)	<i>Queensland Bluegrass</i> (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>), <i>Kangaroo Grass</i> (<i>Themeda australis</i>), <i>Barbed Wire Grass</i> (<i>Cymbopogon refractus</i>), <i>Aristida ramosa</i> , <i>Desmodium brachypodum</i> , <i>Speargrass</i> (<i>Austrostipa scabra</i> subsp. <i>scabra</i>), <i>Cyperus gracilis</i> , <i>Glycine tabacina</i>	Tall or mid-high woodland or open woodland with trees to about 15 m high. Plant on red-brown loamy soils or loamy sandy soils derived from sedimentary rocks or colluvium.

Where	Dominant canopy spp Aim 10% tree cover. The following tree species to plant should be 50% of all trees planted (5% of tree cover).	Main associated spp Remaining 50 percent of tree species to plant (the remaining 5% of tree cover)	Landscape position	Mid-storey spp Aim 10% cover.	Groundcover spp Aim 80% cover.	Landscape features
On flats near creeks	Fuzzy Box (<i>Eucalyptus conica</i>)	Yellow Box (<i>Eucalyptus melliodora</i>), Poplar Box (<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>), White Box (<i>Eucalyptus albens</i>), Blakely's Red Gum (<i>Eucalyptus blakelyi</i>), Rough-barked Apple (<i>Angophora floribunda</i>)	On undulating plains, footslopes or hillslopes	Bulloak (<i>Allocasuarina luehmannii</i>), <i>Acacia deanei</i> subsp. <i>paucijuga</i> , Wilga (<i>Geijera parviflora</i>), <i>Acacia implexa</i> , <i>Cassinia laevis</i>	Speargrass (<i>Austrostipa scabra</i> subsp. <i>scabra</i>), <i>Aristida ramosa</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , <i>Microleana stipoides</i> var. <i>stipoides</i> , <i>Einadia nutans</i> subsp. <i>nutans</i> , Windmill Grass (<i>Chloris truncata</i>), <i>Ajuga australis</i> , <i>Crinum flaccidum</i> , <i>Glycine clandestina</i> , <i>Glycine tabacina</i> , <i>Desmodium varians</i> , Slender Bamboo Grass (<i>Austrostipa verticillata</i>),	Tall woodland up to 20 m high. Plant on colluvial and alluvial sandy loam soils.

7.3.3 Mitigation Measures – Vegetation Clearing and Fauna Relocation Protocol

Vegetation clearing and fauna relocation protocol is recommended to minimise mortality to species over the life of the Proposal. The features of such a protocol should include.

- AZL has completed an audit done of the timber resource to ensure that a flexible and variable best use can be found for the timber. Not all trees will be cleared as part of construction earthworks. Clearing will be staged as LSRFs and SRSFs are required.
- Stockpiling all timber for later use in rehabilitation will not suit this project which has a potential 80 year life. Stockpiling trees for 20 years is problematic.
- Native vegetation to be retained should be clearly shown on maps, identified in the field, included in inductions and demarcated on site as a 'no-go' zone for clearing and operations.
- An experienced ecologist should complete pre-clearing surveys of habitat trees / or habitat areas (i.e. for Pink-tailed Worm-lizards) identified within any given impact footprint. Ecologists with different skill sets may be required depending on the type of habitat to be affected.
- Salvage trees will be identified by the ecologist in agreement with the Applicant's representative. Tree management will include:
 - suitable whole trees will be retained for habitat improvement (re-snagging watercourses) habitat complexity.
 - suitable tree hollows kept for habitat enhancement activities.
 - suitable species (White Cypress Pine, White Box, Ironbark) for milling fencepost, structural timber, floor boards.
 - woodchipping of whole trees or crowns and limbs once seed has been harvested.
 - pyrolysis to charcoal if it proves to be a viable use for soil amelioration
 - firewood for community benefit/use.
- Tree removal contractors should examine all trees for the presence of birds or nestlings and arboreal mammals before felling or pushing and then only commence with tree removal immediately after visual inspection.
- Controlled clearing of large hollow-bearing trees is preferred i.e. removed in pieces rather than just pushed.
 - When a large hollow-bearing tree requires clearing, it is advisable to gradually 'nudge' it intermittently. Any animal occupying it has the chance of vacating the area after the initial disturbance period. Push with the dozer / excavator, wait five minutes, repeat, then fell the tree.
- Fallen trees should not be stacked in one location in the BOA but evenly scattered.
- Signs should be erected stating the purpose of the scattered trees on the BOA and their value to the wildlife and that no fire wood collection is permitted.
- Habitat removal work will occur outside of the Spring season. This will avoid the breeding period for the majority of threatened species.
 - Plan all bridge upgrades outside the Rainbow bee-eater (Migratory EPBC Act) breeding period (between August to January). Sandy creek and river banks in the locality are known breeding sites. If this timing is not possible then inspect

- any creek bank to be effected for mouse size / snake sized horizontal holes in the expose incised creek bank. If these are detected call in an experienced ecologist to determine if Rainbow bee-eaters could be affected by the activity and manage them accordingly.
- To further reduce risk of impact to tree dependant microchiropterans, clearing of substantive trees should be scheduled between April to September.
 - Administrative controls should ensure the induction incorporates proper management procedures for the handling of any species of bats during tree clearing to prevent infection with zoonoses (a disease that animals carry which can affect humans).
 - Only suitably qualified and vaccinated personnel should be allowed to handle the removal of bats of any species.
- An increased risk of vehicle collision exists within the DZP Site within both the construction phase and operation of the Proposal:
 - All machinery should be speed limited as directed by AZL (nominally maximum of 20km/h) at night to reduce the risk of collision with arboreal fauna and nocturnal birds (dunnarts, gliders and owls).
 - A reporting system should be adopted resulting in disciplinary action for employees breaking the legal speed limit to and from work. Many Kangaroos are observed along Obley Road and as such a higher level of risk to fauna, people and assets are noted. This OH&S requirement not only protects the employer, who is responsible for the employee on their journeys to and from work, it would reduce the risk of harm to wildlife. Implementation of this system is achieved through administrative controls such as inductions, policies and procedures.

7.3.4 Mitigation Measures - Operations

During operations within the Application Area the following mitigation measures should be undertaken.

- Areas to be cleared should be clearly marked to ensure no accidental clearing occurs.
- Administrative controls should include inducting employees regarding the nature and extent of clearing required as well as having no impact to surrounding vegetation (only using designated roads, tracks and trails or predefined areas in disturbed sites).
- Pre- and post-clearing audits should be conducted and any non-compliance of conditions of consent would be immediately reported.
- Topsoil in cleared areas should be managed to preserve soil seed banks in areas containing native vegetation for progressive rehabilitation.
- Any infrastructure and machinery required for the Proposal should be positioned to avoid retained native vegetation, e.g. adjacent vegetation outside designated Component Disturbance Areas.
- Any noxious weed and other weed material encountered during activities, should be destroyed and / or removed using appropriate methods to ensure weeds do not spread to other locations within the Application Area, especially in regards to invasion of drainage lines and storage dams.

- Thick stands of White Cypress Pine dominate some areas since fire regimens have been altered. These areas should be managed for conservation. Fire management aimed to reinstall biological diversity through controlled mosaic burning and / or manual thinning is required to address this issue. **Appendix 15** provides an overview of managing cypress pine for conservation in the Dubbo LGA.
- Drainage and surface water runoff should be controlled in such a way that no polluted waters leave the DZP Site.
- Sediment and erosion control structures, which conform to relevant guidelines, should be installed.
- Exposed surface soil should be stabilised as soon as possible, with mulching, covering or replanting with native species, to avoid potential erosion.
- All water supplies should be fenced to prevent pigs, goats, foxes, cats and kangaroos having free access to water.
- All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent providing forage habitats for foxes, rats, dogs and cats.

7.3.5 Mitigation Measures – Post Proposal

The following provides recommendations as to the measures to be implemented to mitigate against impacts on native flora and fauna following the completion of the DZP.

- Arrangements for the long-term management of the BOA should be in place.
- Rehabilitation of the Application Area should be monitored to ensure native vegetation regeneration is successful (e.g. permanent plots can be established to gauge germination success) and to control weed invasion.
- Planting guides are to be prepared for all rehabilitation areas, including species lists and recommended planting densities. Rehabilitation of the creek may require the use of saline tolerant plant including:
 - *Paspalum* (*Paspalum dilatatum*), Spike Rush (*Juncus acutus*) Black Roly Poly (*Sclerolaena muricata*), Common Couch (*Cynodon dactylon*), Native Panic (*Panicum buncei*), Cumbungi (*Typha* sp.).
- Plans for the continuation or cessation of the *Pink-tailed Worm-lizard Plan of Management* should be in place.

7.4 SPECIES SPECIFIC MITIGATION: PINK-TAILED WORM-LIZARD

7.4.1 Introduction

Residual impacts to Pink-tailed Worm-lizard will occur. The Applicant aims to mitigate this impact by:

- Managing effects to Pink-tailed Worm-lizard under a Plan of Management. This Plan of Management is under preparation by a renowned herpetological expert, Dr Arthur White of Biosphere Environmental Consultants (**Appendix 13**). It is a 'living document'

that is regularly reviewed and updated to deliver outcomes that are in the best interest of the Pink-tailed Worm-lizard population.

- Developing the open cut in two separate stages. Stage 1 is over the western half of the ore body, allowing for the enhancement of existing and creation of additional habitat for the species adjoining the impact area and elsewhere on the DZP Site. This technique provides sufficient time for passive relocation of individuals from the impact footprint through artificial habitat (roof tiles placed on the ground to link the impact footprint to suitable same quality or better habitat).
- Incorporating, enhancing and conserving all other areas of moderate or high quality habitat within the DZP BOA.
- It is noted that the mitigation measures noted for vegetation clearing and Pink-tailed Worm-lizard impacts would also provide mitigation for most other native fauna species (including those listed as threatened under the TSC Act or EPBC Act).

The following specific mitigation measures have been taken from the *Pink-tailed Worm-lizard Plan of Management* (**Appendix 13**)

7.4.2 Potential Impacts

7.4.2.1 Establishment and Construction

The greatest impact on the Pink-tailed Worm-lizard is loss of habitat over the area associated with the development of the open cut on Habitat Area 1. In order to develop and mine the open cut, and construct and operate haul roads and utility service easements, the clearance of vegetation and surface rocks would be required.

The development of various other structures on the DZP Site including a waste rock emplacement, Liquid Residue Storage Facility, Solid Residue Storage Facility and Salt Encapsulation Cells will also impact on areas of Pink-tailed Worm-lizard habitat.

On the basis of the mapped Pink-tailed Worm-lizard habitat (see **Figure 10**), and the proposed impact footprint of the DZP, the impact would be as follows.

- 25.5 hectares of high quality habitat.
- 9.8 hectares of medium quality habitat.

It is noted that the majority of this disturbance occurs over the proposed open cut site and that approximately 50% of this would not be impacted for at least 10 years (based on a staged open cut development plan – see also **Figure 2** and Section 5.2).

7.4.2.2 Operations

Once the mine is fully operational, it is not envisioned that there would be further impacts or loss of potential habitat of the Pink-tailed Worm-lizard.

7.4.3 Conservation Measures For The Pink-Tailed Worm-Lizard On Site

7.4.3.1 General Principles

The aims of the Plan of Management are as follows.

- Ensure Pink-tailed Worm-lizard populations on the DZP Site remain and continue to be viable populations regardless of the presence or operation of the DZP.
- Increase the area of occupancy for this species.
- Detail measures to be implemented to avoid disruption to existing areas of Pink-tailed Worm-lizard habitat as much as possible.
- Create and/or enhance equivalent or greater areas of habitat to areas likely to be disrupted or lost.

Areas for habitat creation and/or enhancement have been chosen primarily on two factors; location and availability of habitat factors (see **Appendix 13, Section 3.5**). Areas with suitable underlying geology, vegetation and are in close proximity to existing Pink-tailed Worm-lizard habitat should be selected. In implementing these criterion, created habitat areas should be developed to fill in gaps between existing habitat areas and thus create biodiversity links between otherwise disconnected areas.

7.4.3.2 Conservation, Enhancement and Management of Known High-Quality Potential Habitat Areas

Creation and Enhancement of Habitat for the Pink-tailed Worm-Lizard

A variety of measures could be implemented to create or enhance the habitat of the Pink-tailed Worm-lizard on the DZP Site. The attributes of habitat that are desirable for created or enhanced areas are presented in **Appendix 13 Section 3.5**. In general, the habitat areas to be created or enhanced should be on sites close to trachytes outcrops where the soils are derived from trachytes weathering and alluvial influx, where grass cover is extensive, where tree canopies are limited, where surface shelter rocks (or artificial shelter materials) are abundant, and where ant prey species are abundant.

Selection of Habitat Areas

With ideal habitat attributes pre-determined, the choice of sites for habitat creation and enhancement needs to be based on four further features.

1. Proximity to known Pink-tailed Worm-lizard habitat.
2. Utility in linking isolated Pink-tailed Worm-lizard habitat areas.
3. Free of impacts associated with the establishment or operation of the mine.
4. Habitat creation should not determinately affect threatened plants or animals.

Using these criteria, the main focus for habitat creation and enhancement should be between Habitat Areas 1, 2 and 3 (**Appendix 13, Figure 11**). This area has suitable lithology, meets most of the ideal habitat components (except that it lacks surface shelter rocks) and links two apparently isolated groups of Pink-tailed Worm-lizards (on Habitat Areas 1 and 3). Once established as linking habitat, it may serve as a corridor for any displaced Pink-tailed Worm-lizards seeking to increase its existing area of occupancy from the open cut and Habitat Area 1 (whilst the western half of the open cut is developed) and investigate new habitat areas.

Other areas which form part of the wider BOA should be subject to habitat enhancement / creation, e.g. on or around Habitat Areas 4 to 6. Habitat modification / enhancement conditions on the high and moderate condition habitat of Habitat Area 3 (Dowds Hill) should focus on thinning Cypress Pine as described in Cameron (1999), **Appendix 15**.

Land Surface Preparation

The new habitat area (linking Habitat Areas 1, 2 and 3) would be approximately 600 metres long and vary between 100 and 150 metres wide (**Appendix 13, Figure 11**). To prepare this area so that it retains a high grass cover, reduced tree cover and minimal shrub cover, the area should be slashed and then scarified. This would remove all of the shrub cover and sever small tree roots. By preparing soil in this way, shrubs and small trees can be eliminated from the area and subsoil rocks may be exposed. Once the soil has been prepared, the area would need to be "seeded" with shallow surface rocks or roofing tiles.

Collection and Re-use of Surface Rocks

To prepare the open cut for mining, the area should be stripped of vegetation with minor re-contouring of the hill to take place to accommodate the haul road, and utility easements. Prior to any earthwork in the open cut area, loose surface rocks should be manually collected and relocated to the habitat creation area linking Habitat Areas 1, 2 and 3. The rocks should be spaced out between one and four metres apart to create a corridor that is about 600 metres long and 100 metres wide. For such a large area, the surface rocks in the open cut area would not be sufficient and alternate surface cover materials will be used to complete the corridor (**Appendix 13, Section 5.3.5**).

Use of Artificial Shelter Materials

To supplement the natural surface rock placed out in the new habitat area, roofing tiles should be placed as either single tiles or groups of four overlapping tiles. Like the surface rocks, the tiles would be laid out at spacings of between one and four metres until the area is completely covered. Once the new habitat area has been seeded with surface rocks and tiles, the rocks and tiles would be numbered and their positions recorded on a central data base, in order to facilitate subsequent monitoring of Pink-tailed Worm-lizards. GIS mapping would be a suitable way to manage and present the data.

Artificial shelter materials, such as roofing tiles, have been used successfully in the ACT to provide habitat for Pink-tailed Worm-lizards (**Appendix 13** - Osborne pers. comm.). During these trials it was found that Pink-tailed Worm-lizards occupied the ant tunnels beneath the tiles within six months of the tiles being laid down. Clearly, the use of these tiles as habitat is dependent on the occupation of the soil beneath the tiles by prey ant species.

A trial is currently underway to assess how quickly Pink-tailed Worm-lizards will colonise new sites where the only cover available are roof tiles. Tiles have been laid in as single tiles or as groups of four tiles (**Appendix 13, Figure 12**). The number and type of animals sheltering under the tiles is recorded regularly, as are ground temperatures and soil moisture content. While this trial is still in its early stages, it is already evident that the presence of the tiles changes the soil temperature and humidity beneath them, and that a variety of small vertebrate and invertebrate animals utilise these sites when they are available (A. White unpubl. Data). Notably, one Pink-tailed Worm-lizard has been identified beneath a roof tile laid down within an established area of habitat (Tile laid in September 2012, animal recorded by March 2013).

7.4.3.3 Passive Relocation of Pink-tailed Worm-Lizards from the Eastern Half of the Open Cut

To enable the passive (unassisted) relocation of Pink-tailed Worm-lizards from the impact area to safe conservation areas, the open cut would be developed in two stages. The western half of the open cut would be excavated and developed first. This allows time for habitat corridors to become established leading from the eastern side of the open cut towards Dowds Hill (Habitat Area 3) to the east and Habitat Area 2 to the northwest. It is anticipated that work in the eastern side of the open cut would not start until 10 years after the commencement of excavation of the western side of the open cut. This time frame allows for passive translocation.

Passive relocations of this type have been used successfully in the ACT with Pink-tailed Worm-lizards occupying new habitat areas within 12 months of their creation (**Appendix 13** - Osborne pers. comm.).

7.4.3.4 Assisted Relocation of Pink-tailed Worm-Lizards from the Western Half of the Open Cut

Passive relocation by habitat manipulation is the primary method of species management. In the twelve month period preceding to commencement of mining works repeated searches of the area to be disturbed should be carried out according to relevant survey guidelines. Any Pink-tailed Worm-lizards found would be collected, measured and relocated to established and conserved or new habitat areas created nearby. When Pink-tailed Worm-lizards are found, the rock that they were found under should also be relocated to the new habitat area (to discourage other Pink-tailed Worm-lizards to recolonise this site within the open cut impact area). It is intended that this process would relocate many Pink-tailed Worm-lizards before this area is subject to major earthworks. It is acknowledged that it will not be possible to collect all Pink-tailed Worm-lizards from this area. Through the creation of the new habitat areas and through the passive and active relocation programs, a large proportion of the Pink-tailed Worm-lizards in the open cut area should be rescued.

Collection of Pink-tailed Worm-lizards is only likely to be successful at times when the lizards are close to surface (i.e. in spring and autumn). Therefore, no collections of lizards should be attempted during summer or winter when the lizards are deeper underground and generally inaccessible.

7.4.3.5 Monitoring and Reporting

Progress reports should be prepared for AZL after each major survey and collection period (i.e. at the end of spring and the end of autumn). These reports would detail the areas surveyed, the animals collected and their relocation positions. It would also report on any modifications to the habitat areas that may be required.

An annual report should be prepared in June of each year to be submitted to both DSEWPoC and OEH. This would contain the results of the two survey and collection periods for the year and recommend any changes to habitat modifications that may be required.

8. BIODIVERSITY OFFSET STRATEGY

8.1 REQUIREMENT FOR IMPACT OFFSETTING

Noting that some impact on native vegetation would be unavoidable, these residual impacts would require offsetting. A *Biodiversity Offset Strategy* provides for the implementation of appropriate biodiversity conservation to achieve offset these impacts and is a requirement of the DGRs and condition of approval under section 134 of the EPBC Act.

The *Biodiversity Offset Strategy* should:

- Describe existing biodiversity.
- Provide evidence of approvals and consultation.
- Provide details and evidence of legal and other requirements.
- Clearly provide *Biodiversity Offset Strategy* objectives and targets.
- Provide details of management of the Biodiversity Offset Area.
- Provide an overview of the *Biodiversity Offset Strategy* management actions.
- Provide details and evidence of securing the *Biodiversity Offset Strategy*.
- Provide details of management strategies.
 - Short-term Management Strategies (from project approval to 12 months).
 - Mid-term Management Strategies (from project approval to three years).
 - Long term Management Strategies.
- Be prepared in consultation with OEH, and submitted to the Director-General for approval prior to construction.
- Describe how the implementation of the *Biodiversity Offset Strategy* would be integrated with the overall rehabilitation of the site.
- Include detailed performance and completion criteria for evaluating the performance of the *Biodiversity Offset Strategy*, and triggering remedial action (if necessary).
- Include a seasonally-based program to monitor and report on the effectiveness of these measures, and progress against the detailed performance and completion criteria.
- Identify the potential risks to the successful implementation of the *Biodiversity Offset Strategy*, and include a description of the contingency measures that would be implemented to mitigate against these risks.
- Include details of who would be responsible for monitoring, reviewing, and implementing the plan.

Appendix 17 provides the Integrated Land Management Plan (ILMP) template for management actions.

8.2 PROPOSED BIODIVERSITY OFFSET STRATEGY

The Applicant proposes to conserve an area of 1,021 hectares of land on and surrounding the DZP Site focused on the remnant vegetation of Dowds Hill. Linkage between this regionally significant remnant and other linear remnants of the local setting, Wambangalang Creek and Benolong Road through conservation and habitat enhancement is also a feature of the proposed offset. **Figure 21** provides an illustration of the areas and vegetation communities to be included within the proposed offset. These areas form the basis of assessment against the NSW and Commonwealth offset policy guidelines.

The boundaries on **Figure 21** are representative as roads, fire-breaks, fire fighting tanks, hard stand areas etc. may be required within the BOA. The boundaries shown may change slightly to ensure that 1,021 hectares of land is set aside for conservation that is used for operational activities.

In broad terms, the implementation of the *Biodiversity Offset Strategy* as proposed would:

- reinstate “Grassy Woodlands” vegetation formations and classes;
- conserve the largest contiguous remnant of native vegetation on the DZP Site (and the locality), Dowds Hill;
- enhance other connected remnants of native vegetation and conserve these;
- increase the biodiversity value of these conserved and enhanced remnants by creating and conserving biodiversity links between Dowds Hill (local biodiversity link) and Wambangalang Creek (regional biodiversity link) to the west and Benolong Road to the north (local biodiversity link); and
- improve the overall condition of the conserved remnants, and areas of rehabilitated final landform, by planting / seeding of native woodland and grassland species and linking these to the conserved remnants. No tree planting would occur in the BOA to facilitate “Grassy Woodlands”.

The proposed BOA would be managed for conservation. Crash grazing would be undertaken to reduce fuel loads and to stimulate new growth for many ground layer species. Grazing would be undertaken following a sustainable grazing management plan within the *Biodiversity Offset Strategy* template for management actions.

8.3 OEH OFFSET PRINCIPLES

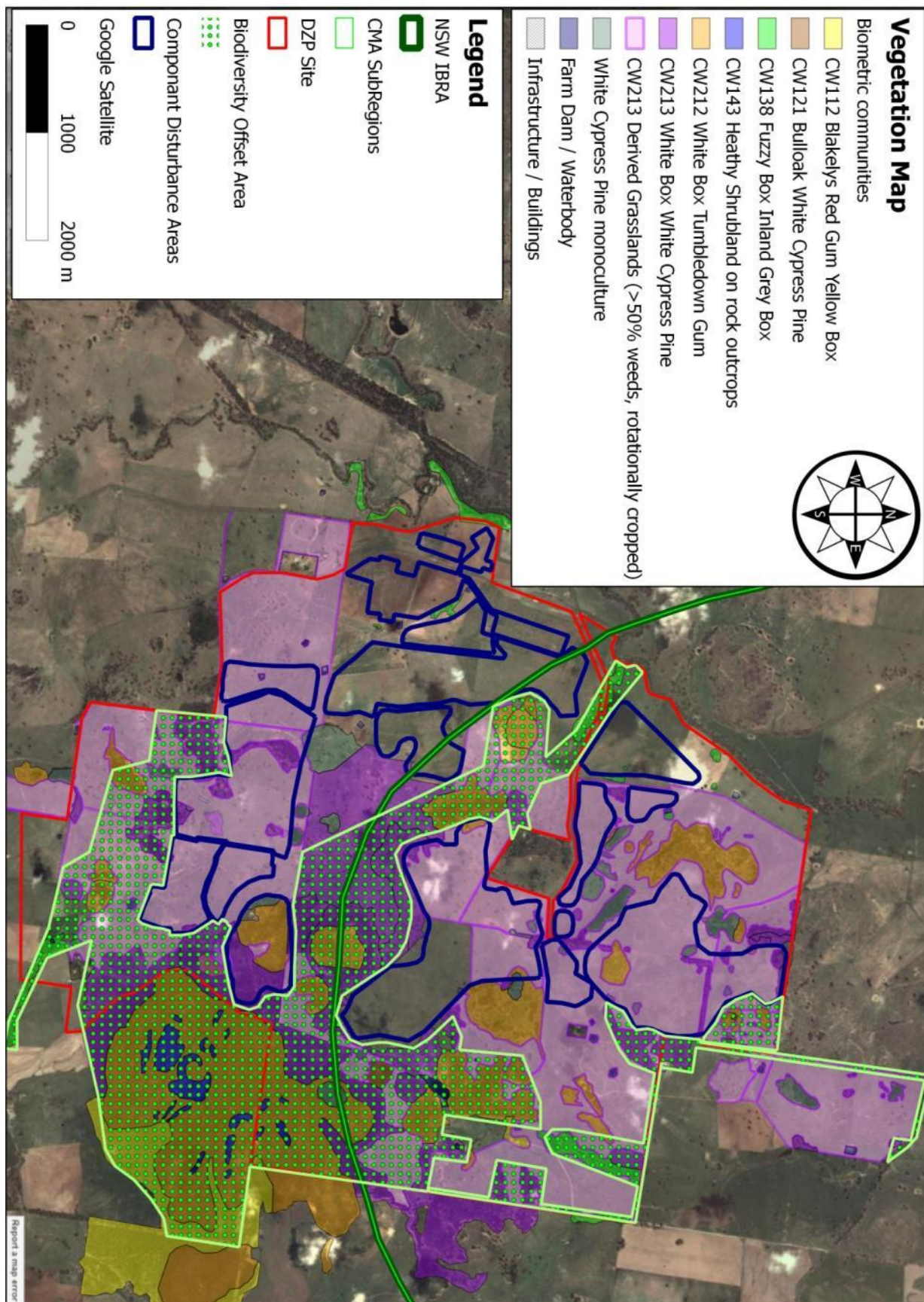
8.3.1 Introduction to OEH Offset Principles (BioBanking)

OEH developed the Biobanking Scheme to provide a structured approach for offsetting. The Biobanking Scheme is based on robust / transparent set rules underpinned by peer reviewed science to determine if a Proposal meets the ‘improve or maintain’ standard.

The Biobanking Scheme is voluntary, however, the *OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of State Significant Development (SSD) and State Significant Infrastructure (SSI) projects* (OEH, 2011) (hereafter ‘the interim policy’) provides for the BioBanking Assessment Methodology (BBAM) such that:

- biodiversity values and impacts of SSD projects can be quantified and categorised;
- the offset that would be required to meet the improve or maintain standard can be established for benchmarking purposes.

Figure 21: Proposed Biodiversity Offset Area.



Note: Image presents the DZP Site assessed area.

By implementing the BBAM, the interim policy provides a mechanism to enable a consistent and transparent approach to impact assessment and offsetting for SSD project under the EP&A Act. It provides a structured approach to determining how proposals may, in lieu of meeting the 'improve or maintain' standard, meet one of two alternative standards established under this policy.

A proportion of SSD projects also affect nationally listed threatened species and threatened ecological communities. These Proposals are considered by the DSEWPaC under the EPBC Act.

8.3.2 Application of OEH Offset Principles

The Proposal is being assessed by DP&I under the SSD provisions of the EP&A Act (Division 4.1), and is not being considered as part of the BioBanking Scheme.

The *Biodiversity Offset Strategy* follows the interim policy and applies BBAM for the following purposes:

- to describe, quantify and categorise the biodiversity values and impacts of a Proposal;
- to identify, for benchmarking purposes, the offsetting that would be required to meet the improve or maintain standard.
- to provide the information for calculating offsets under this policy.

8.3.3 Introduction to BBAM

The methodology assesses biodiversity values as defined by the TSC Act. These values include the composition, structure and function of ecosystems. They also include (but are not limited to): threatened species, threatened populations and threatened ecological communities, and their habitats. This definition does not include fish or marine vegetation within the meaning of Part 7A of the *Fisheries Management Act 1994*, unless that fish or marine vegetation has been the subject of an order under s. 5A of the TSC Act.

BBAM tells users how to assess the biodiversity values at development sites (DZP Site) and BioBank sites (BOA, **Figure 21**). It also describes the process used to measure the loss of biodiversity values that results from removing native vegetation, threatened species habitat and threatened species on a development site. It also highlights the gain in biodiversity values from taking management actions on a BioBank site or a BOA in the case of the current Proposal.

The methodology establishes two classes of biodiversity credits that may be created through undertaking management actions at a BioBank site (the BOA). The two classes of biodiversity credits are:

- **Ecosystem credits** – these are created or required for all impacts on biodiversity values (including threatened species that can be reliably predicted by habitat surrogates), except the threatened species or populations that require species credits.
- **Species credits** – these are created or required for impacts on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Species Profile Database. Species credits are applied where a threatened species has been recorded but not predicted to occur by the BBAM credit calculator (Pink-tailed Worm-lizard, Grey Falcon, Little Pied Bat, Square-tailed Kite and Little Eagle).

BBAM outlines the assessment process and the information required to assess the loss and gain of biodiversity values. This includes data that are collected in the field (see **Appendix 4, 7 and 8**) and data that are held by OEH in its biodiversity databases and contained in the credit calculator. The evidence is presented by generating BioBanking Credit Reports.

The strategy used in this Proposal uses the BBAM to quantify vegetation and habitat impacts. The *Biodiversity Offset Strategy* has also been developed in accordance with the principals within the EPBC Act *Environmental Offsets Policy October 2012*. In line with the guiding offset principles, the proposed offsets would:

- Provide a net improvement in the quantity, quality and conservation of biodiversity values within the region in the medium to long term through:
 - rehabilitation and protection of woodland, particularly the Box Gum Woodland, Inland Grey Box Woodland and Fuzzy Box Woodland TECs;
 - protection of threatened flora and fauna habitat and habitat features (e.g. hollow-bearing trees);
 - providing long-term protection for threatened flora and fauna and TECs;
 - improving vegetation and habitat connectivity between existing conservation areas within the locality with creation of a local biodiversity link to other local, regional and State biodiversity links; and
 - protecting areas identified as key corridors within the Central West Catchment Action Plan (CW CMA 2011) and as NPWS conservation priorities.
- Provide consistency with priority actions for biodiversity identified in the Central West Catchment Action Plan to:
 - Reinstate natural fire regimes for dry sclerophyll forest and semi-arid grassy/shrubby woodland.
 - Shrub thinning and increase surface roughness for semi-arid shrubby woodland.
 - Manage hydrologic regime for semi-arid grassy woodland.
 - Investigate opportunities to reuse Invasive Native Scrub refuse.
 - Revegetation and regeneration to improve structural and floristic diversity.
 - Contribute to NRS goal of greater than 15 percent area managed for conservation per bioregion (CAR reserve system).
 - Implement recovery actions of high priority threatened species in PAS2.
 - Habitat rehabilitation and improvement.
 - Manage total grazing pressure.
 - Improve shape, size and connectivity of remnant vegetation patches.
 - Manage threatening processes (e.g. invasive species).

8.3.4 Biobanking Assessment Report Checklist

A checklist of BBAM report adequacy has been provided as **Table 15** to assist the determining authority.

Table 15: BBAM Checklist for the Assessor.

Section of report	Obligatory / Optional	Present/absent
Introduction including description of Proposal including location (CMA, CMA Sub – region and Mitchell Landscape).	Obligatory	<p>The DZP Site is:</p> <ul style="list-style-type: none"> • 50% within IBRA Brigalow Belt South Bioregion. • 50% within the IBRA South-western Slopes Bioregion. • 100% within the Central West CMA. • 50% in the CW – Upper Slopes CMA subregion • 50% in CW – Talbragar CMA sub region • The following Mitchell Landscapes are within the DZP Site <ul style="list-style-type: none"> ○ Dubbo Basalts (tertiary) ○ Goonoo Slopes (dominant) ○ Macquarie Alluvial Plains (minor) ○ Nangar Slopes and Ranges (subdominant). <p>Figures within Appendix 8 provides map of these attributes</p>
Detail proposed methods to be used in surveys.	Obligatory	<p>Methods applied followed BBAM. Section 4.5 of this report discusses fauna, Section 4.6 discusses flora. The most important aspect of flora concerns classification of derived grasslands. Grasslands in the DZP Site are used for rotational cropping, when fallow they return to 'grassland'. BBAM was strictly applied, when assessed if it was less than 50% weedy it was considered to be part of a Biometric community and if the community is an EEC it was treated / mapped accordingly. Areas with more than 50% weedy they were mapped as 'Derived Grassland'. In BBAM both areas are managed as CW213 – 'moderate to good quality' where more than 50% native and as 'low quality' when more than 50% weedy. Figures in the report are label 'Derived Grasslands' but do not have CW213 as the prefix to reduce confusion.</p>
Map illustrating location of circles	Obligatory	Figures within Appendix 8 provide maps showing these attributes.
Table detailing vegetation types found on site and biometric equivalents. This should include underlying assumptions for the selection of vegetation types.	Obligatory	See Section 5.2.1 to 5.2.4. Appendix 5 provides flora species recorded at plots assessed (see Figure 13 for BBAM and Rapid Plot Data locations). As the DZP is divided by two IBRA boundaries OzArk used 'biometric best fit' according to IBRA South-western Slopes for the entire DZP Site because this area is where the largest changes to vegetation would occur.
Adequate descriptions of vegetation communities including photos and lists of species observed in each stratum.	Obligatory	See Section 5.1 (general description and photos) and 5.2 specific descriptions of mapped communities.
Map illustrating vegetation zones	Obligatory	Figures within Appendix 8 provide a map showing these attributes.
Map illustrating threatened species zones	Obligatory	Figures within Appendix 8 provide a map showing these attributes.
Map illustrating management zones	Obligatory	Figures within Appendix 8 provide a map showing these attributes.
Results of targeted surveys for threatened species	Obligatory	Section 5.4 (Flora) Section 5.5 (fauna) also Appendices 4 and 5 respectively.
Map showing location of threatened flora species or map of habitat for threatened fauna found to occur within the study area.	Obligatory	Records of threatened flora is shown on Figure 7 (Wildlife Atlas), no threatened flora was recorded during the OzArk assessment. Geoff Cunningham recorded <i>Philotheca ericifolia</i> in rocky heathland on Dowds Hill in 2001.

Section of report	Obligatory / Optional	Present/absent
		Coordinates are not provided in the report but he notes 'The collection site will not be impacted in any significant way by the development of the DZP project as it is well outside the area of disturbance'. Figure 15 provides a map showing threatened fauna recorded during the assessment. Habitat mapping has been undertaken for the Pink-tailed Worm-lizard (see Section 9.3). Appendix 13 maps low, medium and high quality habitat (and details methodology used to determine this).
Screen shot of Step 1 in tool showing data entered for 'Landscape values' for each circle.	Optional - if xml file is provided this can be viewed in tool.	Figures within Appendix 8 show these attributes. xml file has been issued with this report but can also be obtained by emailing phil@ozarkeh.com.au
Screen shot of Step 1 data entry for each threatened species subzone for each landscape circle -including patch size, adjacent remnant area, vegetation type, vegetation condition, area.		Figures within Appendix 8 show these attributes.
Screen shot of Step 2 geographic features selections		Figures within Appendix 8 show these attributes.
Screen shot of Step 4 showing site survey times and species requiring an expert report		Figures within Appendix 8 show these attributes.
Screen shot showing Step 5a – Red Flag Status of each vegetation type		Figures within Appendix 8 show these attributes.
Screen shot showing Step 5b - or Table detailing survey results of survey transects/plots.	Obligatory	Figures within Appendix 8 show these attributes.
Screen shot showing Step 5c	Optional - if xml file is provided this can be viewed in tool.	Figures within Appendix 8 show these attributes xml file has been issued with this report but can also be obtained by emailing phil@ozarkeh.com.au
Screen shot showing Step 5d – data entry for management zone score including decrease for additionally or increase in site value for additional management.		Figures within Appendix 8 show these attributes.
Screen shot or Table showing Step 5f – results of targeted species searches		Figures within Appendix 8 show these attributes.
Copy of credit requirements generated by BioBank or/and development site	Obligatory	Provided as Appendix 8 and Appendix 9 .
Plant species list for each plot preferably with an cover abundance estimate	Obligatory	See Appendix 4 . A summary is provided at the end of each plot assessed to demonstrate weediness.
Species list for site	Obligatory	See Appendix 4 (Flora) and Appendix 5 (fauna).

8.3.5 Development Area Ecosystem Credit Requirements

Four BioMetric communities will be affected by the activity (**Section 6, Tables 9 and 16**).

CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267) is the most effected by the activity. Collectively 1,195 hectares have been mapped, 965.4 hectares has been recorded in the DZP Site (**Table 19**). 457.7 hectares are to be effected by the Proposal and 613.3 hectares are located within the proposed BOA (**Table 16**). 10% of the proposed impacts to this community are within CW213 (quality remnants - see **Section 6** Avoid, Mitigate, Offset) and 90% are within areas mapped as 'Derived Grassland' (>50% weedy, rotationally cropped).

Separate terms are being used to break CW213 into two groups. These will become a feature of "rules of variations" used in subsequent Sections to discuss appropriateness of offsetting.

- 'CW213' = Higher quality remnants. The remnant is consistent with the BioMetric description and has been identified as an EEC where irrespective of prior disturbance native ground stratum is greater than 50% native species and / or it possesses native mid and upper stratus. This mapped area has:
 - 433 hectares in the DZP Site (the BBAM Development Site).
 - 43.70 hectares to be disturbed.
 - 306 hectares located within the BOA (the BBAM BioBank Site).
 - 'Derived Grassland, Scattered trees and tree clumps' are low quality remnants.
 - The ground stratum is greater than 50% weed species.
 - Data captured in the field demonstrate they are at or greater than 50% above the lower value of the Biometric communities BBAM benchmark.
 - These areas are used for rotational cropping are assumed to be derived from Benson 267.
 - Most areas were fallow in March 2013 but were cropped in the following winter as a response high seasonal rainfall.
 - Rotational cropping in these areas is an ongoing seasonally and climate dependant agricultural activity.
 - The 2012 field assessments occurred in the 'best time' for native species to be recorded in the past two decades. These areas were fallow between five to ten years and were assessed just prior to being returned for cropping agriculture.
 - An argument can be used to map these areas as 'cropping' and to eliminated them from BBAM by May 2013 they were back under crop.
 - To provide transparency all areas have been mapped as they were assessed in March 2012. This reflects the ability of the rotationally cropped area to return to the same community recorded on site if left fallow again.
 - These areas have not been identified as an EEC but could be within five years if weed control was implemented.
 - This mapped area of Derived Grassland has:
 - 532.4 hectares in the DZP Site.
 - 414 hectares to be disturbed.
 - 306.5 hectares located within the BOA.

Impacts to CW213 require 8,900 credits to offset the impact (890 for the areas mapped as CW213 [quality remnants] and 8,010 for Derived Grasslands).

Tier 1 (applying 9.3 credits per hectare) would need 956.99 hectares in total (861 hectares for Derived Grassland and 95.99 hectares for CW213).

Tier 2 (applying 6 credits per hectare¹²) would require 1,483.33 hectares (1,335.03 for Derived Grassland and 148.3 hectares for CW213) to meet offsetting requirements.

- CW212 White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270) has:
 - 539 hectares mapped.
 - 289 hectares mapped within the DZP Site.
 - 27.1 hectares would be impacted by the activity.
 - Impacts to CW212 require 1,448 credits to offset the impact.
 - Tier 1 (applying 9.3 credits per hectare) would need 155.7 hectares.
 - Tier 2 (applying 6 credits per hectare) would require 241.33 hectares to meet offsetting requirements (**Table 16**).
- CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201) has:
 - 43.3 hectares mapped.
 - 23.40 hectares mapped within the DZP Site.
 - 0.1 hectares mapped as being affected by the activity.
 - Impacts to CW138 require 17 credits to offset the impact.
 - Tier 1 (applying 9.3 credits per hectare) would need 1.83 hectares.
 - Tier 2 (applying six credits per hectare) would require 2.83 hectares (**Table 16**) to meet offsetting requirements.
- CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76) has been mapped along Obley Road:
 - 1.08 hectares will be affected by the activity.
 - Impacts to CW145 require 62 credits to offset the impact.
 - Tier 1 (applying 9.3 credits per hectare) would need 6.7 hectares.
 - Tier 2 (applying six credits per hectare) would require 10.33 hectares (**Table 16**).

¹² The difference in the value of the dividing factor between Tier 1 (9.3) and Tier 2 (6) reflects the conservation value of the vegetation to be effected i.e. dividing 1000 credits by 9.3 (Tier 1) = 107.52 hectares, dividing 1000 credits by 6 (Tier 2) = 166.6 hectares. More hectares are required to offset EECs and vegetation types >70% cleared in the CMA.

8.3.6 Offset Area Ecosystem Credits

Six BioMetric communities have been mapped within the 1,021 hectare BOA (**Figure 21, Tables 16 and 19**).

The largest amount of ecosystem credits in the BOA is generated by CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267). Approximately half the ecosystem credits in the BOA are from CW213 (higher quality) the remaining half are from 'Derived Grassland (>50% weedy, rotationally cropped)'. A summary of the credit / hectare relationship in the BOA is presented below:

- 6,185 credits were generated within 613.3 hectares (10.08 credits per hectare).
 - 306.5 hectares of CW213 (quality remnants).
 - 306.8 hectares of Derived Grasslands (>50% weedy, rotationally cropped).

CW212 White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270) has:

- 4,076 credits generated within 256.1 hectares (15.88 credits per hectare).

CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201) has:

- 238 credits generated within 21.9 hectares (10.87 credits per hectare).

CW143 'Heathy shrublands on rocky outcrops of the western slopes Bioregion (Benson 54)' has:

- 237 credits generated within 25.5 hectares (9.29 credits per hectare).

CW112 'Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)' has:

- 374 credits generated within 39.2 hectares (9.54 credits per hectare).

CW121 'Bullock - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54)' has:

- 404 credits generated within 3.9 hectares (103.59 credits per hectare).

CW121 generates the highest number of ecosystem credits per hectare. CW121 is an over cleared vegetation type in the CMA that provides feeding habitat for Glossy Black Cockatoos (V TSC Act). This species has been recorded within the BOA.

8.3.7 Development and Offset Area Credit Matching

Table 16 provides a direct comparison between ecosystem credit requirements for effected vegetation and ecosystem credit availability for allowable vegetation types within the BOA. The table has been developed by summarising BBAM Development Site (Application Area) and Biobank Site (BOA) credit reports (**Appendix 8**).

Table 16: Development and Offset Area Ecosystem Credit Matching

Veg ID	Biometric name	IMPACT SITE: Area Impacted (ha)	IMPACT SITE: Credits Required to offset impact	IMPACT SITE: Ha required Tier 1 (9.3 credits / ha)	IMPACT SITE: Ha required Tier 2 (6 credits / ha)	IMPACT SITE: Allowable Vegetation Types (BBAM) Bold = used in calculation	OFFSET SITE: Available Offset Area (ha)	OFFSET SITE: Number of Credits Generated	OFFSET SITE: No. Credits Generated/ ha	Credit Surplus / Deficit Including allowable veg types minus credits already used	Tier 1 Surplus / Deficit (ha)	Tier 2 Surplus / Deficit (ha)	Area (ha) required to meet Tier 3 Offset (2:1 ha ratio including allowable vegetation types)	Hectare Surplus / Deficit
CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270)	27.10	1448.00	155.70	241.33	CW212	256.10	4067.00	15.88	2619.00	100.40	14.77	54.20	201.90
CW213	White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267)	457.70	8900.00	956.99	1483.33	CW102 CW109 CW112 CW138 CW139 CW145 CW211 CW213 CW215 CW216 CW266 LA218 MR643 MU606	613.30	6185.00	10.08	-2240.70	-343.69	-870.03	915.40	-241.00

Veg ID	Biometric name	IMPACT SITE: Area Impacted (ha)	IMPACT SITE: Credits Required to offset impact	IMPACT SITE: Ha required Tier 1 (9.3 credits / ha)	IMPACT SITE: Ha required Tier 2 (6 credits / ha)	IMPACT SITE: Allowable Vegetation Types (BBAM) Bold = used in calculation	OFFSET SITE: Available Offset Area (ha)	OFFSET SITE: Number of Credits Generated	OFFSET SITE: No. Credits Generated/ ha	Credit Surplus / Deficit Including allowable veg types minus credits already used	Tier 1 Surplus / Deficit (ha)	Tier 2 Surplus / Deficit (ha)	Area (ha) required to meet Tier 3 Offset (2:1 ha ratio including allowable vegetation types)	Hectare Surplus / Deficit
CW138	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	0.10	17.00	1.83	2.83	CW138	21.90	238.00	10.87	221.00	20.07	19.07	0.20	21.70
CW145	Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76)	1.08	62.00	6.67	10.33	CW145	0.00	0.00	0.00	-62.00	-6.67	-10.33	2.16	-2.16
CW143	Heathy shrublands on rocky outcrops of the western slopes	0.00				N/A	25.50	237.00	9.29	237.00	25.50	25.50	0.00	25.50

Veg ID	Biometric name	IMPACT SITE: Area Impacted (ha)	IMPACT SITE: Credits Required to offset impact	IMPACT SITE: Ha required Tier 1 (9.3 credits / ha)	IMPACT SITE: Ha required Tier 2 (6 credits / ha)	IMPACT SITE: Allowable Vegetation Types (BBAM) Bold = used in calculation	OFFSET SITE: Available Offset Area (ha)	OFFSET SITE: Number of Credits Generated	OFFSET SITE: No. Credits Generated/ ha	Credit Surplus / Deficit Including allowable veg types minus credits already used	Tier 1 Surplus / Deficit (ha)	Tier 2 Surplus / Deficit (ha)	Area (ha) required to meet Tier 3 Offset (2:1 ha ratio including allowable vegetation types)	Hectare Surplus / Deficit
CW121	Bulloak - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54)	0.00				N/A	3.90	404.00	103.59	404.00	3.90	3.90	0.00	3.90
CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)	0.00				N/A	39.20	374.00	9.54	374.00	39.20	39.20	0.00	39.20
	Cleared / Grazed Crop (remainder)	313.00				N/A	53.70	0.00	0.00				626.00	-572.30
	White Cypress Pine monoculture	9.60				N/A	7.40	0.00	0.00				19.20	-11.80
	Total	808.58	10427.00				1021.00	10490.00		63.00				

Table 17: Development Area (Orange) and Offset Area (Green) Species Credit Matching

Scientific name	Common name	Red flag	Species Tg value	Final credits	Scientific name	Common name	Species Tg value	Final credits	Credit Surplus / Deficit
<i>Falco hypoleucos</i>	Grey Falcon	No	0.74	6473	<i>Falco hypoleucos</i>	Grey Falcon	0.74	6126	-347
<i>Hieraaetus morphnoides</i>	Little Eagle	No	0.74	6473	<i>Hieraaetus morphnoides</i>	Little Eagle	0.74	6126	-347
<i>Chalinolobus picatus</i>	Little Pied Bat	No	0.48	1844	<i>Chalinolobus picatus</i>	Little Pied Bat	0.48	6126	4282
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	No	0.35	1286	<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard	0.35	1434	148
<i>Lophoictinia isura</i>	Square-tailed Kite	No	0.74	6473	<i>Lophoictinia isura</i>	Square-tailed Kite	0.74	6126	-347
					<i>Philotheca ericifolia</i>	Philotheca ericifolia	0.63	6	6

Note: All species presented in this table are those on the Specie Credit Profile that were not predicted to occur or could not be deleted as they were not manually added.

Minor adjustments were made of the Biobank Site credit report to rectify an inconsistency. The CAD file supplied by the Client showing the limit of the BOA would not accurately convert to GIS software. OzArk created a new GIS file based upon the CAD image, given the scale of the Proposal a degree of mapping error was expected. The degree of mapping variation is:

- The CAD image calculates 1,021 hectares in the BOA (the correct values used in all EIS documents).
- the OzArk consultants GIS shape file calculates the area as 1062.04 hectares.
- There is a 3.8% difference in the size of the BOA (41.04 hectares). The community most affected by mapping differences was Derived Grasslands (>50% weedy, rotationally cropped).

When **Table 16** was developed:

- All impact values to vegetation (in hectares) used in this report were generated from the CAD file (the correct values). There will be minor variance in the Biobank credit report (**Appendix 8**).
- The number of credits per hectare ratio was derived from the GIS files from BBAM using the OzArk shape file. There would be a negligible difference in this ratio and that if the CAD file was used.
- All vegetation values (in hectares) in the BOA used in the **Table 16** were generated from the CAD file (the correct values).

The critical issue for discussion subsequent Sections in this report is management of CW213 and Derived Grasslands (>50% weedy, rotationally cropped).

BBAM separates native vegetation by condition, 'Moderate to Good' or 'low'. The output of CW213 manages these two very different areas as the one standalone community "CW213" (**Table 16**). The principal author accepts BBAM output but has managed CW213 (quality remnants) and Derived Grassland (>50% weedy, rotationally cropped) as separate entities. This has been addressed in 'rules of variations' used in subsequent Sections to discuss appropriateness of offsetting in **Section 8.1.8**.

8.3.8 Species Offset Matching

Species credits for the Development Site (Application Area) and outstanding credits for species identified in the Biobank Site species credit report (Biodiversity Offset Area) have been provided on **Table 17**. Species offset matching shows Little Pied Bat and Pink-tailed Worm-lizard meet credit requirements. Three raptors have deficit credit requirements. The raptors in deficit are discussed in **Section 8.3.8.2**.

8.3.8.1 Significant Items Recorded at the DZP Site

All species predicted to occur (OEI and EPBC databases) and those species known to occur, or not recorded but considered likely to be recorded, meet or exceed species offsetting requirements.

The most 'notable' species¹³ to consider is *Aprasia parapulchella* Pink-tailed Worm-lizard (V TSC Act, EPBC Act) identified by Dr David Goldney in 2000 and Dr Arthur White and OzArk in 2012 to 2013. This species has a very low Tg¹⁴ value (0.35) reflecting its poor ability to respond quickly to habitat improvements, hence many credits were generated by this species for offsetting. 1,286 credits were generated in the DZP Site; the BOA has 1,434 species credits (surplus of 148 credits). **Section 8.4** provides a detailed discussion for this species as it has been subject to a Referral to DSEWPaC and has been determined as a Controlled Action.

Philothea ericifolia (V EPBC Act) identified by GCNR in 2001 was recorded 'on the top of Dowds Hill. No coordinates were provided in the report. The population was stated as 'will not be affected by the activity'. This population is within the BOA. This species has a relatively high Tg value. There is no requirement to meet species credits for *Philothea ericifolia*.

8.3.8.2 Significant items not recorded and predicted to occur by BBAM calculator at the DZP Site

Raptors were the only species that have species credit deficits. This is a consistently common outcome using BBAM because these species all have very large home ranges (circa 50 to 100 km²) and can use a wide range of vegetation communities for feeding, breeding and roosting. The issue for BioBank calculations is that species with these attributes use large multipliers in their logarithms to calculate habitat loss and a low Tg. In this instance the overriding factor is effects to Derived Grassland (>50% weeds, rotationally cropped) CW213 (feeding habitat), including these areas effectively doubles the credits required compared to other species located on site. Raptors with a species credit deficit are:

- *Falco hypoleucos* (Grey Falcon) has 374 species credit deficit.
- *Hieraaetus morphnoides* (Little Eagle) has 374 species credit deficit.
- *Lophoictinia isura* (Square-tailed Kite) 374 species credit deficit.

Further explanation has been provided below:

- Little Eagle (*Hieraaetus morphnoides*). Little Eagles travel further from rivers and have potential to be recorded at the DZP Site. The areas to be affected by the activity do not possess breeding habitat for the species (too exposed). The DZP Site is potential feeding and roosting habitat. The Proposal, as opposed to the ecosystem matching profile, would increase the natural area of occupancy for these species.

¹³ 'Notable species' is a subjective value used by the principal author to identify listed species that are truly 'rare' or a memorable record in the Dubbo LGA i.e. commonly recorded listed species are not in this subjective value.

¹⁴ The ability of a species to respond to improvement in the site value or other habitat improvement through management actions. The value is based upon the lowest value of effectiveness of management actions scales to the species life history, conservation value etc. Low Tg = very sensitive species (high credits are generated).

- *Falco hypoleucos* (Grey Falcon) has not been recorded during the assessment. It is predicted to occur in the CMA subregion. As the Proposal will introduce protect and enhance 1,021 hectares of Grassy Woodland it will be more likely to attract the species to an existing vacant habitat than affect an extant population.
- *Lophoictinia isura* (Square-tailed Kite) was during the 2001 assessment. It was not recorded during the 2012 to 2013 assessment. This species is predicted to occur in the CMA subregion. The breeding habitat will not be affected by the activity (no watercourse areas to be altered), due to their large range for hunting feeding and or roosting habitat may be affected. As the Proposal will introduce protect and enhance 1,021 hectares of Grassy Woodland it will be more likely to attract the species to an existing vacant habitat than affect an extant population.

8.3.9 Determining an Appropriate Outcome

Tier 1, 2 or 3 are used to determine an appropriate outcome. The Tier system is not 'whole project' it can be applied for each biometric vegetation community effected affected by the activity.

8.3.9.1 Tier 1: 'Improve or Maintain'

While not required of State significant projects or former Part 3A Proposals, the "Improve or Maintain" represents the high standard of biodiversity protection following BBAM.

The Proposal has fallen short of the "Improve or Maintain" standard in two main ways:

- Red flag assets are to be cleared outside the rules allowed by the BBAM.
- The amount and type of offsetting secured is inconsistent with the requirements of the BBAM credit calculator.

Ecosystem credits

CW212 "White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270)" achieved Tier 1. CW212 is not a flag area.

1,448 ecosystem credits are required for offsetting, the BOA has 4,067 (2,619 surplus). Tier 1 requires 155.7 hectares for offsetting, the BOA has 256 hectares (100.3 hectares surplus), **Table 16**. The surplus credits for this, however, are not an 'allowable type' to transfer to deficits in other communities in the proposal.

Species Credits

Species credits for the Development Site (Application Area) and outstanding credits for species identified in the Biobank Site species credit report (BOA) have been provided on **Table 17**. Species offset matching shows all species except those listed in **8.3.8.2**. meet or exceed the credit requirements.

Aprasia parapulchella (Pink-tailed Worm-lizard) V TSC Act, EPBC Act and Little Pied Bat (*Chalinolobus picatus*), V TSC Act meet or exceed species offsetting requirements. **Section 8.3.8.1** provides further discussion for Pink-tailed Worm-lizard and *Philothea ericifolia* (V EPBC Act).

Falco hypoleucos (Grey Falcon), *Hieraaetus morphnoides* (Little Eagle) and *Lophoictinia isura* (Square-tailed Kite) all V TSC Act are 347 credits in deficit.

8.3.9.2 Tier 2: Negotiating a 'No Net Loss' outcome

'No Net Loss' is attained when it is proposed to clear red flags outside the variation rules permitted by the BBAM, but all impacts are to be fully offset in accordance with the BBAM requirements.

CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201) meets the Tier 2 criterion.

CW138 is both an EEC and a red flag. 17 ecosystem credits are required for offsetting, the BOA has 238 (221 surplus credits). Tier 2 requires 2.8 hectares for offsetting, the BOA has 21.9 hectares (19.1 hectares surplus), **Table 16**. The ecosystem credit surplus has been allocated to CW213 as it's an allowable vegetation type.

The Proposal has fallen short of the "No Net Loss" standard for the remaining vegetation communities (see Tier 3 discussion below).

8.3.9.3 Tier 3: Negotiating a 'Mitigated Net Loss' outcome

"Mitigated Net Loss" occurs when red flag assets are to be cleared and this clearing is considered acceptable under the requirements set out for no net loss, the amount and type of offsetting proposed is inconsistent with the requirements of the BBAM credit calculator.

The following vegetation types of the Proposal has fallen short the amount and type of offsetting proposed and are inconsistent with the requirements of the BBAM credit calculator (**Table 17**):

- CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267).
 - 8,900 credits are required, there are 6,185 within the BOA (deficit of 2240 ecosystem credits).
 - At a 2:1 ratio 915.40 hectares are required for offsetting but only 613.3 hectares are available in the BOA (241 hectare deficit).
 - Splitting the requirements into CW213 (quality remnants) and Derived Grassland (>50% weeds in rotationally cropped areas) has been provided below to demonstrate the effectiveness of the offsets:
 - CW213 (quality remnants) require 890 ecosystem credits (91.5 hectares at 2:1). This can be achieved directly as a Tier 3 outcome.
 - CW213 Derived Grasslands (>50% weeds in rotationally cropped areas) require 8,010 ecosystem credits (823.9 hectares at 2:1). As offsetting cannot be directly achieved under Tier 3 and 'Variation of the offset rules for using ecosystem credits' have been considered in **8.3.9.4**.
- CW145 Inland Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (Benson 76).
 - 17 ecosystem credits (2.16 hectares at 2:1) are required however this community does not occur within the BOA.

Tier 3: Negotiating a 'Mitigated Net Loss' outcome is requisite.

8.3.9.4 Variation of the Offset Rules (main considerations NSW Interim Policy)

The variation criteria:

- 1. Make provision for the conversion of ecosystem credits to another type of ecosystem credit**
 - CW138 (101.3 surplus ecosystem credits), CW112 (374 surplus ecosystem credits) have been allocated to CW213. The remaining deficit for CW213 is therefore 1 765.4.
- 2. Make provision for conversion of one type of ecosystem credit to another type of ecosystem credit and for the waiving of species credits in some circumstances**
 - No additional allowable ecosystems credits are available (**Table 16**).
 - Species ecosystem credit report shows a surplus of credits (**Table 17**). 148 credit surplus for *Aprasia parapulchella* (Pink-tailed Worm-lizard) V TSC Act and 6 credit surplus for *Philotheca ericifolia* V EPBC Act. These surplus credits can be used to eliminate the 1 765.4 ecosystem credits debt for CW213 and will meet the Tier 3 variation rules (if the surplus species credits can be used to offset the ecosystem credit deficit).
- 3. Remove the need for offsets where clearing is minimal and confined to non-threatened vegetation**
 - Areas mapped as Derived Grassland (>50% weeds, rotationally cropped) have been managed as CW213 in BBAM.
 - An argument presented for consideration is that the determining authority manages offsetting requirements as follows.
 - Any area mapped as CW213 require 890 ecosystem credits to offset the impact in accordance with BBAM calculations. At a 2:1 Tier 3 outcome 87.4 hectares would be required. This can be achieved within the BOA.
 - Areas mapped Derived Grasslands (requiring 8,010 ecosystem credits / 828 hectares required at 2:1 ratio) is 50% weedy and rotationally cropped. This community does not have the ability to improve under existing management regimes.
 - There are 306.5 hectares of CW213 (quality remnants) of which 84.7 hectares would be required to meet existing obligations.
 - The remaining 221.8 hectares of CW213 (quality remnant) plus the 306.80 hectares of Derived Grassland (>50% weeds, rotationally cropped) may be considered as an adequate offset.
- 4. Make provision for the conversion of ecosystem and species credits to hectares which, in turn, allows the land value of the offset to be estimated. In this way, approvals can be issued that specify either the hectares or the financial contribution that would need to be made to secure the land required for offsetting.**
 - This option is not appropriate.
- 5. Waive the requirements for species credits.**
 - Raptors were the only species that have species credit deficits. This is a consistently common outcome using BBAM. These species all have very large home ranges (circa 50 to 100 km²) and can use a wide range of vegetation communities for feeding,

breeding and roosting. The issue for BioBank calculations is species with these attributes use large multipliers in their logarithms to calculate habitat loss and a low Tg resulting in large credit requirements being generated for offsetting.

- In this instance the overriding factor is effects to CW213 Derived Grassland (>50% weeds, rotationally cropped). It is feeding considered as habitat in BBAM. These areas effectively doubles the credits required compared to other species located on site. Raptors with a species credit deficit are:
 - *Falco hypoleucos* (Grey Falcon) has 374 species credit deficit.
 - *Hieraaetus morphnoides* (Little Eagle) has 374 species credit deficit.
 - *Lophoictinia isura* (Square-tailed Kite) 374 species credit deficit.
 - A request for variation criterion for mitigated loss in the OEH interim Polity Attachment B 'point e' is made to waive the requirements for species credits because:
 - Ecosystem credits in the most productive habitats have been achieved as Tier 1 and Tier 2.
 - Removal of a >50% weedy, rotationally cropped areas will not substantially affect the availability of prey species. Operational and derelict mines in the western region are more likely to attract prey species due to an increase habitat complexity.
 - Reinstatement of 'Grassy Woodlands' in the BOA would directly benefit these species.
- 6. Convert ecosystem credits to a regional conservation priority as identified in a regional conservation plan or similar**
- In the event where the abovementioned variation criterion are not acceptable by the determining authority the deficit can be met by managing the local population of *Aprasia parapulchella* Pink-tailed Worm-lizard (V TSC Act, EPBC Act) in the BOA. To reduce repetition, refer to a detailed program in **Sections 8.4.3 to 8.4.7** of this report and **Appendix 13** (*Pink-tailed Worm-lizard Plan of Management*).

8.3.9.5 Variation of the Offset Rules (other considerations BCAM¹⁵ 2011)

In considering whether the mitigated net loss standard is appropriate for each biometric vegetation type to be affected by the activity, consideration has been given to:

a) whether the credits required by the calculator are available on the market

- The OEH BioBanking website "search for Biodiversity credits" using Central West Upper Slopes and Central West Talbragar Valley CMA credit status "All" search criterion was searched on 24.5.2013.
 - No records for these searches were found.
 - Credits required for this Proposal are not available on the market.

¹⁵ OEH *Biodiversity Certification Assessment Methodology* February 2011.

b) whether alternative offset sites (other than credits) are available on the market

- The BioLands website was searched on the 24.5.2013. This privately owned company specialises in BioBanking assessed lands available for purchase.
 - The closest sites are between the Warrumbungle's and Liverpool Plains. Approximately three properties are within (or likely within the Central West CMA).
 - Whilst similar vegetation communities may be available on the listed properties within the Central West CMA, the Applicant and the consultant (both Dubbo based) do not believe that offsetting outside the Dubbo LGA or the locality (50 kilometre radius) is appropriate as significant species, populations or communities recorded in the DZP Site cannot be found on the same underlying geology in one location in similar or better condition elsewhere.
- The Nature Conservation Trust website was searched on the 24.5.2013 (using the 'Central West' criterion).
 - The closest site is at Warren (Carwell Station), the remaining three properties are two hours' drive from Sydney (not really the Central West).
 - Carwell Station does not have similar vegetation communities as those in deficit for the DZP Site. Further offsetting outside the Dubbo LGA or the locality (50 kilometre radius) is not considered appropriate.
- The Dubbo City Council has similar vegetation types within the existing reserve system to those in the DZP Site with ecosystem credit deficit (CW213 and CW215). This is a secondary outcome for offsetting as:
 - Ecologically, The BOA provides a large patch size (1,021 hectares) as opposed to Council reserves (10s of hectares). The deficit of credit requirements for CW215 (62 ecosystem credits) would be met but not for CW213 (2,240.7 ecosystem credits).
 - The BOA provides a superior local biodiversity link¹⁶ than any other Council derived option. It connects a large area (1,021 hectares) to be managed for conservation to a regional biodiversity link (Wambangalang Creek) and a local biodiversity link (Obley Road TSR). Wambangalang Creek joins a State biodiversity link (the Macquarie River).
 - The Council reserve system already provides a conservation mechanism for the regions EECs within them. This option would not increase the existing area of occupancy for the EECs managed for conservation. The tangible outcome for Council is being more financially empowered to better manage the reserves not at the cost of the rate payer.
 - Council reserves do not provide habitat for the Pink-tailed Worm-lizard or the full suite of listed species recorded in the DZP Site.

¹⁶ As per definition in OEH Biodiversity Certification Assessment Methodology (2011:23).

c) the overall cost of the offsets and whether these costs are reasonable given the circumstances.

- The Applicant has purchased a significant volume of land in addition to that required for the development. The 1,021 hectare portion of this is dedicated as the BOA and the remaining non-operational areas are to maintain existing agricultural activities.
- The costs for achieving a local biodiversity outcome are reasonable given the circumstances as approximately 50% of the BOA is "Dowds Hill". Purchasing Dowds Hill was not 'essential' but desirable and reasonable as:
 - Outside of the National Parks system Dowds Hill is one of the largest continuous native vegetation remnants in the Dubbo LGA.
 - There are approximately ten native vegetation remnants the same size or marginally larger in the LGA but none possess the same vegetation types as Dowds Hill, an uncommon landform in the LGA. The BOA captures alluvial plains (Fuzzy Box EEC), undulating plains / lower slopes (Box Gum Woodland EEC) and steep hills (Tumbledown Gum Woodland) and hill top (Western Heath communities). Dubbo LGA is topographically flat. Dowds Hill is a 'special natural feature' in the landscape.
 - Under the current ecosystem credit deficit scenario CW112 Box Gum Woodland and Fuzzy Box surplus credits have not been considered as 'available' as they have been attributed to CW213 (**Table 16**). CW212 White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270) has 2,619 surplus credits but this vegetation type is not an allowable type (no matching Vegetation Class or Formation). If CW212 ecosystem credits available in the Biodiversity Area could be used it would fulfil ecosystem credit requirements outstanding for CW213 and CW145 (2240.7 and 62 respectively, collectively 2,302.7) and leave 316.3 surplus ecosystem credits.
 - CW145 is represented in the NSW National Parks local conservation reserve systems (Goonoo Goonoo National Park and State Conservation Area [in the Dubbo LGA circa 49,500 hectares], Beni [1816.6 hectares] and Little Beni [31.5 hectares] State Conservation Areas, Coolbaggie Nature Reserve [1,775 hectares]), Wongarbone Nature Reserve [94.7 hectares], Sappa Bulga Community Conservation Area (200 hectares). Most of the reserves have Inland Grey Box / Mugga Ironbark Cypress Communities and less so Box-gum Woodland / Fuzzy Box EECs. CW213 Derived Grasslands (>50% weeds, used for rotational cropping) would not be available in the reserve systems as cropping is not an allowable activity in this land tenure.
 - Dubbo Council reserves managed for conservation have similar / comparable vegetation types as CW145 (or allowable vegetation types). These are located in Cumboogle Nature Reserve (the closest, circa 15 kilometres north (29.3 hectares Box Gum Woodland), Jones Creek circa 30 kilometres north (59.6 hectares mostly iron bark / cypress in part Box Gum Woodland) and Wongarbone Reserve circa 30 kilometres northeast (30.8 hectares, Inland Grey Box Woodland and a small area, circa two hectares of Fuzzy Box). All Council reserves are in the order of 10s of hectares and don't offer the same volume of protection of the same EECs within the significant 'patch size' offered by the BOA (1,021 hectares within the BOA with an additional circa 200 hectares outside of the BOA on Dowds Hill on adjoining properties).
 - Dowds Hill is considered to be a 'special natural feature' generally due to vegetation and landforms but specifically due to rocky habitat, underlying

geology and large patch size of the remnant vegetation and the suite and densities of listed species recorded on site¹⁷. Similar rocky habitats (and underlying geology) are not represented in the National Parks reserve systems in the Dubbo LGA.

- The Buddigower Nature Reserve and Goulburn River National Park, Cooma North Ridge Reserve, Googong Foreshore Reserve and Nail Can Hill Reserve has isolated records (one or two recorded) of Pink-tailed Worm-lizards (TSC Act, EPBC Act). The underlying geology is unknown, none of these populations are more than one or two, rarely more records.
- Dubbo City Council has CW145 habitat with the Gibraltar Rock Reserve (4.5 hectares it is approximately 15 kilometres northwest of the DZP Site). Rest of rock is 28.2 hectares. The total volume of similar land to that requiring offsetting at the DZP Site is 123 hectares and all is privately owned. This is dwarfed by Dowds Hill at circa 600 hectares. The privately owned land is not for sale (search of Dubbo real estate websites 7.6.2013).
- Dowds Hill provides the only known habitat for a large population of Pink-tailed Worm-lizard (TSC Act, EPBC Act), **Section 7.5** has been dedicated to discuss management and conservation measures for this species. **Appendix 13** provides a Plan of Management. Similar or larger size and extent of the population is not provided in a conservation reserve elsewhere in NSW.

The interim policy states that should any of these circumstances apply, then it is reasonable to apply the variation criteria to the point that:

a) suitable offset sites can be found within a reasonable timeframe.

- The Applicant can use the offsetting criteria and apply the variation because:
 - The 1,021 hectare BOA is owned by the Applicant and is immediately available for use as a conservation reserve. Actions have already begun to protect the species that was an immediate detrimental threat and conservation measures (feral pig control and artificial habitat trials).
 - A *Pink-tailed Worm-lizard Plan of Management* (**Appendix 13**) and BOA Management Plan will underpin an agreed, auditable management system as a condition of consent for Project approval for the 1,021 hectare BOA.
 - The Applicant has started negotiations with the Central West Catchment Management Authority to facilitate a Conservation Property Vegetation Plan under Part 4 of the *Native Vegetation Act 2003* to ensure in perpetuity conservation outcomes for the BOA.
 - the costs of offsetting is brought within a reasonable range.
 - The Applicant can use the offsetting criteria and apply the variation because the Offset Area is owned by the Applicant and the money invested is within a reasonable range for economic development, social outcomes and environmental contribution for the Dubbo LGA and the NSW State government.

¹⁷ Dowds Hill is been considered by the principal author as a Dubbo LGA Biodiversity Hot Spot.

b) an offset to clearing ratio of at least 2:1 vegetated to cleared hectares is achieved.

- The Applicant can use the offsetting criteria and apply the variation because an offsetting ratio of 2:1 are exceeded as demonstrated in **Table 18**. Derived Grasslands (>50% weeds, used for rotational cropping) does not meet the 2:1 criteria, this issue has been discussed in detail in **Section 8.3.9.4** and **8.3.9.5**.

Table 18: Tier 3 Outcomes 2:1 Offsetting Ratios

Community	Veg Type ID	Veg Type Name	% cleared in CMA	Total Area Mapped	Total within DZP Site	Total Disturbed	Total within BOA	OFFSET RATIO. The number of ha to be offset for 1 ha to be disturbed (i.e. 219:1). Green = meets 2:1, red = does not meet 2:1
1	CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)	95% (Red flag, an over cleared veg type, EEC TSC Act, EPBC Act)	127.1	3.2	0	39.2	39.2 ha offered with no impact to EEC
2	CW121	Bullock - White Cypress Pine woodland mainly in the NSW South Western Slopes Bioregion (Benson 54)	95% (Red flag and an over cleared veg type)	3.9	3.9	0	3.9	3.9 ha offered with no impact
3	CW138	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	95% (Red flag and an over cleared veg type, EEC TSC Act)	43.3	23.4	0.1 ¹⁸	21.9	219.0
4	CW143	CW143 Heathy shrublands on rocky outcrops of the western slopes	10%	25.5	2.6	0	25.5	25.5 ha offered with no impact
5	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes (Benson 270)	40%	539	289	27.1	256.1	9.5

¹⁸ Alteration to over cleared vegetation can occur if they are part of an over cleared remnant that is also less than four hectares (as in this case).

Community	Veg Type ID	Veg Type Name	% cleared in CMA	Total Area Mapped	Total within DZP Site	Total Disturbed	Total within BOA	OFFSET RATIO. The number of ha to be offset for 1 ha to be disturbed (i.e. 219:1). Green = meets 2:1, red = does not meet 2:1
6	CW213	White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267)	90% (red flag, EEC TSC Act)	520.5	433	43.7	306.5	7.0
8	CW213	Derived Grassland, Scattered trees and tree clumps	>50% weeds, used for rotational cropping	674.8	532.4	414	306.8	0.7
7	N/A	Cleared / Grazed Crop (remainder)	N/A	1208.2	1208.2	313	53.7	N/A ¹⁹
9	N/A	White Cypress Pine monoculture	N/A	67.9	8.9	9.6	7.4	N/A
				3210.2	2504.6	807.5	1,021	

8.3.10 Securing an Offset Site

8.3.10.1 Criteria for Determining Suitability of an Offset Site

OEH offset principles require offsets to be managed under effective and secure long term management arrangements. Dedication of land under the *National Parks and Wildlife Act 1974* and the establishment of BioBanking sites with BioBanking Agreements under the TSC Act, meet this requirement because:

- The unambiguous principal objective of ongoing site management is biodiversity conservation with Pink-tailed Worm-lizard (TSC Act, EPBC Act) as the flagship species, many other listed species recorded on site will benefit under management of this species.
- Management will be undertaken in accordance with a *Biodiversity Offset Strategy (Section 7.3.3)* and *Pink-tailed Worm-lizard Plan of Management (Appendix 13)*.
- There is reasonable likelihood that sufficient resourcing will be available to implement the *Biodiversity Offset Strategy* and *Pink-tailed Worm-lizard Plan of Management* over time.

¹⁹ Tier 3 removes the need for offsets where clearing is minimal and confined to non-threatened vegetation (Cleared Cropped Land, Derived Grassland, White Cypress Pine Monoculture).

- The arrangements are in-perpetuity, and conservation obligations are transparently transferred and disclosed to any new owners of the land through appropriate administrative procedures.
- There are appropriate accountability mechanisms to secure the outcomes and these mechanisms cannot be altered without alternative and comparable offsetting arrangements being put in place.

An alternative to establishing BioBanking sites is to retire BioBanking credits, where appropriate credits are available. S.89I and 115ZC of the EP&A Act allow approvals for all State significant projects to include conditions that require biodiversity credits to be obtained and retired by the Applicant. In these instances 'shifting' offsetting requirements elsewhere (i.e. another property outside the Dubbo LGA) do not address effects to local species, populations and communities that can predominantly be achieved within the BOA.

Other conservation mechanisms may also meet the criteria in certain circumstances. These include:

- Conservation Agreements under the NPW Act.
- Trust Agreements under the Nature Conservation Trust Act 2001 (NCT Act).
- A Property Vegetation Plan registered on title under the Native Vegetation Act 2003 (NV Act).
- A Planning agreement under s93F of the EPA Act.

The suitability of these mechanisms (or any other mechanism) depends on whether the proposed arrangements are likely to result in the management of the land in accordance with the five criteria above.

8.3.10.2 Determining Suitability of the Biodiversity Offset Area

The BioBanking Scheme is voluntary, BBAM has been used as a transparent way to facilitate biodiversity offsetting for this project.

The proposed BOA is shown on **Figure 21**, in-perpetuity conservation of this area meets the criteria for suitability because:

- The Applicant is entering into A Conservation Property Vegetation Plan registered on title under the *Native Vegetation Act 2003*. This will be a condition of consent for project approvals.
- The Applicant has committed 1,021 hectares identified in this report as the BOA. CW212 and outstanding species identified on **Table 16** meet Tier 1 criterion. CW138 meets Tier 2. CW213 and CW145 meet Tier 3 if variation of the offset for surplus species credits is allowed to extinguish the ecosystem debit.
- The Biodiversity Offset Area:
 - The principal objective is to facilitate ongoing site management for biodiversity conservation.
 - Will be managed in accordance with a Integrated Land Management Plan and the Pink-tailed Worm-lizard PoM. The PoM been attached to this report as **Appendix 13**. Framework of the Integrated Land Management Plan template for management actions has been provided in **Section 7.5** and **Appendix 17**.

- Will have sufficient resourcing available to implement the Plans of Management over-time.
- Will have in-perpetuity conservation obligations transparently transferred to the land titles that will be disclosed to any new owners of the land through appropriate administrative procedures.
- Will have appropriate accountability mechanisms to secure the outcomes and these mechanisms cannot be altered without alternative and comparable offsetting arrangements being put in place.

8.3.10.3 Significant Effects if the Biodiversity Offset Area is NOT Approved

The Applicant has fully embraced Avoid, followed by Mitigate and Offset as a last resort (**Section 7**). Without adopting the BOA as proposed in this report:

- Additional areas of occupancy of EPBC Act and TSC Act EECs would not be managed for conservation.
 - No impact to critically endangered Box Gum Woodland (CW112) will occur as a result of the Proposal. 61.8 hectares would be voluntarily protected within the BOA. This EEC meets the criterion to be listed under the EPBC Act and TSC Acts. Including this EEC into an area managed for conservation is consistent with the draft National Recovery Plan. Locally this EEC is represented in NPWS and Council reserves, however, given its critically endangered status increasing the area of occupancy without need to offset an impact is a conservation outcome that would otherwise not be achieved and should be promoted as an example to others.
 - 0.1 hectares of Fuzzy Box - Inland Grey Box will be affected by the activity. 21.9 hectares of this TSC Act EEC would be voluntarily protected within the BOA at an offset ratio of 219 hectares offsetting every one hectare affected. The consultant has undertaken recent work trying to find Fuzzy Box EEC for offsetting for unrelated projects and considers this EEC should be upgraded to 'critically endangered' in Central West CMA. Not affording a 21.9 hectare Fuzzy Box remnant protection in perpetuity is unlikely to be ever achieved elsewhere in the LGA again.
- Biodiversity links would not be facilitated.
 - Linking Dowds Hill to the Obley Road (Local biodiversity link) via the Wambangalang Creek (Regional biodiversity link) and in turn to the Macquarie River (State biodiversity link) would not be facilitated. Linking habitat as proposed in the BOA is consistent with the *National Wildlife Corridors Plan*.
- Protection a NSW significant population of Pink-tailed Worm-lizard (TSC Act, EPBC Act) would not occur.
 - The BOA has been specifically designed to increase the natural area of occupancy of this species through direct and indirect habitat management, linking isolated habitats and eliminating feral pests. In 2012 to 2013 feral pigs were causing a significant impact to Pink-tailed Worm-lizard habitat. 40 pigs (the entire population) have been removed from the DZP Site in partnership with the current and previous landowners. Without approval of the BOA, long term decline of the population would occur. This is the largest population in NSW to be actively managed for conservation.

8.4 EPBC ACT ENVIRONMENTAL OFFSETS POLICY

8.4.1 Aims of the Policy and Overarching Offsetting Requirements

Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012 (hereafter the 'EPBC Offset Policy') has five key aims, to:

1. ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
2. provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
3. deliver improved environmental outcomes by consistently applying the policy;
4. outline the appropriate nature and scale of offsets and how they are determined.
5. provide guidance on acceptable delivery mechanisms for offsets.

8.4.2 What Are Environmental Offsets?

EPBC Offset Policy requires an offsets package to be developed including a suite of actions that a Proponent undertakes in order to compensate for the residual significant impact²⁰ of a project. It can comprise a combination of direct offsets and other compensatory measures.

Direct offsets are an essential component of a suitable offsets package. A minimum of 90% of the offset requirements for any given impact must be met through direct offsets.

Deviation from the 90% direct offset requirement will only be considered where:

- it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package; **or**
- scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter. Compensatory offsets include research.

Other compensatory measures are actions that do not directly offset the impacts on the protected matter i.e. funding for research, educational programs, a Plan of Management etc. These are poorly weighted in the determination of the offsetting package to ensure direct offsets are achieved.

²⁰ Residual impacts are effects to the environment after avoidance and mitigation measures have been exhausted and a 'significant impact' to an EPBC listed item will still occur. This protected matter would have been subject to a Referral to DSEWPaC.

The offsetting package must deliver a conservation gain. A conservation gain is the benefit that a direct offset delivers to the protected matter which maintains or increases its viability or reduces any threats of damage, destruction or extinction by:

- improving existing habitat for the protected matter.
- creating new habitat for the protected matter.
- reducing threats to the protected matter.
- increasing the values of a heritage place /or
- averting the loss of a protected matter or its habitat that is under threat.

Advanced offsets (offsets that can be implemented prior to or within a short period of time post impact) are given higher weighting but must meet all requirements in the EPBC Offset Policy.

8.4.3 Delivering Social, Economic and / or Environmental Co-benefits

8.4.3.1 Introduction

While the primary consideration in determining suitable offsets is delivering a conservation gain for the impacted protected matter, the delivery of offsets that establish positive social or economic co-benefits is encouraged.

Social and economic or environmental co-benefits may be delivered where an offset aligns with broader strategic environmental objectives such as those outlined in the *National Wildlife Corridors Plan*, the Indigenous health strategy *Closing the gap*, or policies that enhance the environment of regional Australia.

The *National Wildlife Corridors Plan* and other policies that enhance the environment of regional Australia relevant to the Proposal are discussed in the following sections.

8.4.3.2 National Wildlife Corridors Plan

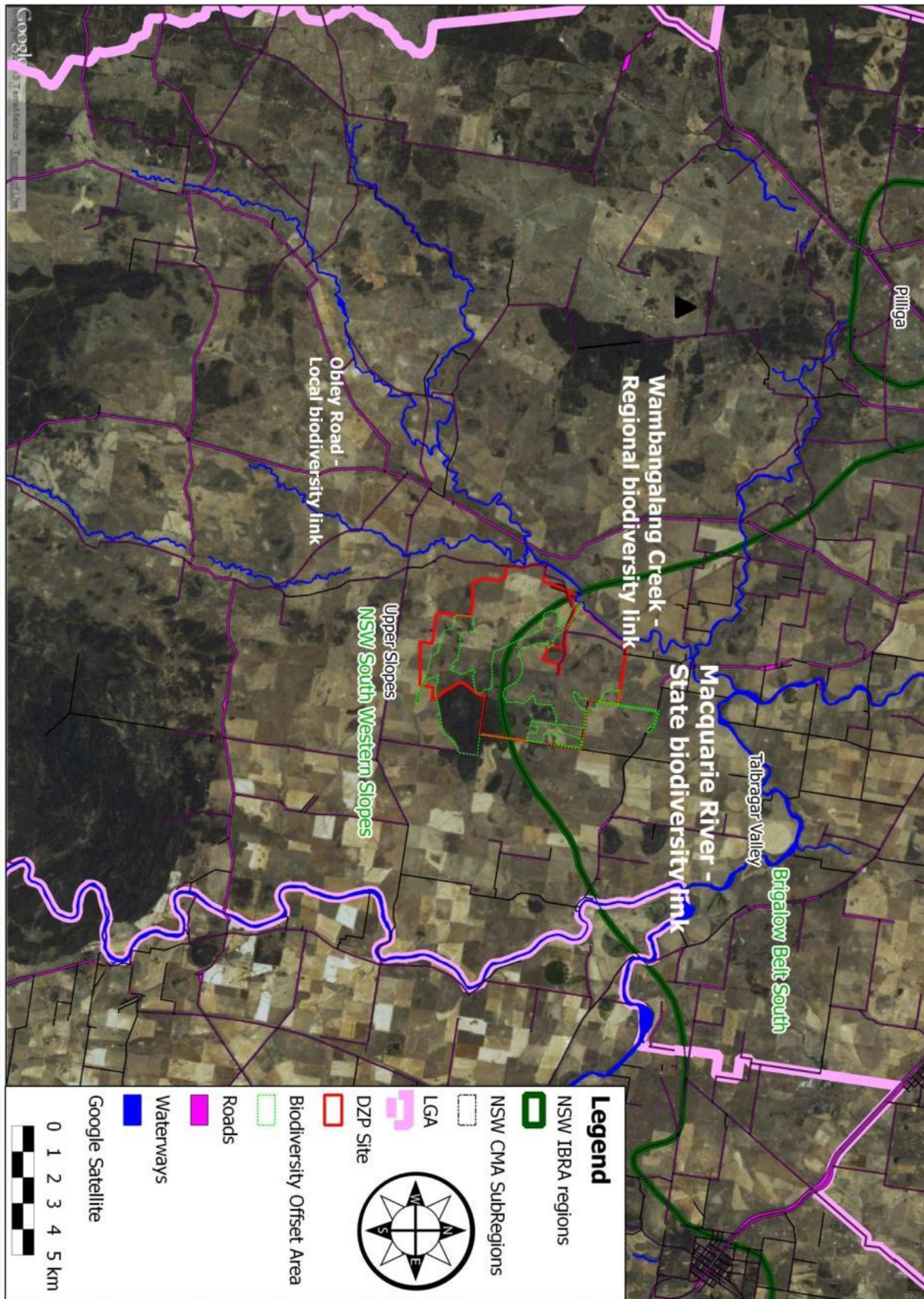
Wildlife corridors are connections across the landscape that link up areas of habitat. They support natural processes that occur in a healthy environment, including the movement of species to find resources, such as food and water.

Corridors can contribute to the resilience of the landscape in a changing climate and help to reduce future greenhouse gas emissions by storing carbon in native vegetation. They can also support multiple land uses such as conservation, farming and forestry.

Types of biodiversity links (wildlife corridors) are defined in BCAM (2011: 23), these definitions have been applied to the BOA (**Table 20, Figure 22**) and have been cross referenced against the objectives of the *National Wildlife Corridors Plan* in **Tables 21 and 22**.

The BOA once approved and fenced from stock will become a local biodiversity link connecting to another local biodiversity link (Obley Road) via the regional biodiversity link (Wambangalang Creek). Wambangalang Creek connects to a state biodiversity link (Macquarie River) (see **Figure 22**).

Figure 22: Regional Biodiversity Links.



Note: Image presents the DZP Site assessed area.

Table 19: Biodiversity Link Terminology

Connectivity value class	Defining criteria	Comment
State biodiversity link	An area identified as being part of a state biodiversity corridor and in a plan approved by the Director General OR A riparian buffer 40 m either side of a major river	The Macquarie River is a State biodiversity link. Wambangalang Creek drains into the Macquarie River.
Regional biodiversity link	An area identified as being part of a regional biodiversity corridor and in a plan approved by the Director General OR A riparian buffer 30 m either side of a minor river or major creek	Wambangalang Creek is a named creek adjoining the DZP Site. It is a Regional biodiversity link.
Local biodiversity link	Links areas of native vegetation in moderate to good condition greater than 30 ha AND Width of vegetation in moderate to good condition (in accordance with BBAM 2008) is greater than 30 m AND/OR A riparian buffer 20 m either side of a minor creek or 10 m either side of minor watercourse	Dowds Hill within the DZP Site is a greater than 30 hectares (circa 600 hectares); its width of vegetation in moderate to good condition is greater than 30 metres wide. Minor unnamed drainage, lines and creeks are within the DZP Site. Obley Road is also a Local biodiversity link, as it is part of the Travelling Stock Reserve System it is generally wider than 30 metres and is in moderate to good condition. Dowds Hill is within the BOA.
Nil	None of the above	

Landscape elements that contribute to wildlife corridors within the *National Wildlife Corridors Plan* include the objectives listed in the left hand column of **Table 20**, contextualisation with the BOA have been provided in the right hand column.

Land use practices that contribute to wildlife corridors can be created by adjusting land use practices to help retain, restore and manage natural connections and interactions across the landscape. Land use practices contributing to wildlife corridors include within the *National Wildlife Corridors Plan* include the items listed in the left hand column of **Table 21**, contextualisation with the BOA have been provided in the right hand column.

Table 20: Landscape Elements That Contribute to Wildlife Corridors.

Landscape elements that contribute to wildlife corridors objectives	Comment
Native grasslands provide habitat and pasture	Vegetation communities described and mapped in this report according to the NSW Biometric system have grassy component with greater than 50% native species. Grassy areas with greater than 50% weeds have been described and mapped as 'derived grassland', these areas are rotationally cropped. The <i>Biodiversity Offset Strategy</i> and Pink-tailed Worm-lizard Plans of Management include weed control as a measurable outcome within the BOA. The aim is to restore all grassland within the BOA as having greater than 50% native species. This action is directly relevant to increasing the area of occupancy for the protected matter.
Linear strips of roadside and fence line vegetation form important links in the landscape	BOA links Dowds Hill to Wambangalang Creek which at Toongi is adjacent to Obley Road a local biodiversity link (Figure 22).
'Stepping stones' of native vegetation	The BOA links Dowds Hill to Wambangalang Creek (Regional biodiversity

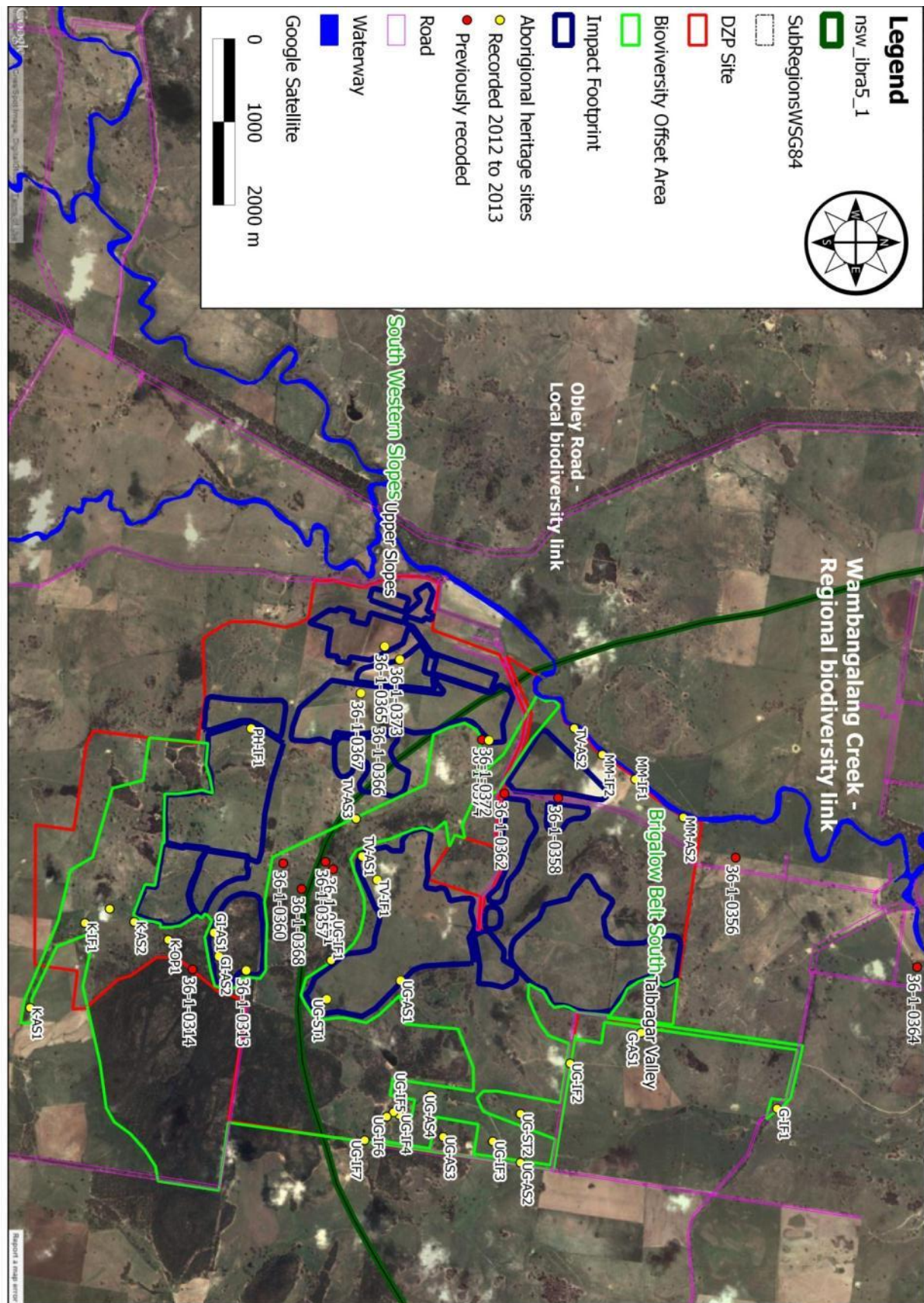
Landscape elements that contribute to wildlife corridors objectives	Comment
such as paddock trees link larger patches	link) / Obley Road (local biodiversity link), Figure 22 through stepping stones of existing isolated remnants. The design of the BOA was selected to link known populations of the protected matter (Pink-tailed Worm-lizard) or mapped moderate to high quality habitat where the species has not been recorded to date (See <i>Pink-tailed Worm-lizard Plan of Management Appendix 13</i>).
Sensitively designed urban parks and gardens contribute habitat for native species	The design of the BOA was selected to link known populations of the protected matter (Pink-tailed Worm-lizard) or mapped moderate to high quality habitat where the species has not been recorded to date (See <i>Pink-tailed Worm-lizard Plan of Management Appendix 13</i>).
Free-flowing rivers transport nutrients and sediment to the sea	Not relevant
Fish travel between fresh and saltwater environments at different lifecycle stages	Not relevant
Migratory bird species rely on important wetland and shore habitats	Not relevant
Fauna moving through the landscape disperse pollen and seed	The BOA links Dowds Hill to Wambangalang Creek (Regional biodiversity link) / Obley Road (local biodiversity link). Wambangalang Creek drains into the Macquarie River (State biodiversity link) Figure 22 . The narrowest point of the link width to the creek is 200 metres, the link will provide a suitable functional fauna movement corridor.
Floodplain inundation triggers plant regeneration and provides habitat for aquatic species	Not relevant
Large patches of native vegetation provide core habitat	The design of the BOA was selected to protect core habitat for the (Pink-tailed Worm-lizard) or mapped moderate to high quality habitat where the species has not been recorded to date (See <i>Pink-tailed Worm-lizard Plan of Management Appendix 13</i>). Other areas not identified as habitat for the protected matter are included in the BOA as they provide important habitat for other NSW listed threatened species. <i>Philothea ericifolia</i> (V EPBC Act) historically recorded in the DZP Site (pre 1960s, now in cultivated areas, Figure 7) demonstrate that habitat is available. <i>Philothea ericifolia</i> was recorded by GCNRC in 2000 on Dowds Hill, the location for the population is within the BOA. The design of the BOA protects 39.2 ha of Box Gum Woodland, all components of this CEEC in the DZP Site have been 100% avoided by the activity. Core habitat for NSW TSC Act species populations and communities listed in the NSW TSC Act will also be protected in the BOA.
'Buffers' around natural areas protect them from external threats	Buffers where possible are a feature of the BOA. Property boundaries and existing agricultural land use are occasional constraints.
Long distance movement of migratory species	Not relevant

Table 21: Land Use Practices Contributing to Wildlife Corridors

Land use practices contributing to wildlife corridors objectives	Comment
Indigenous Protected Areas managed for cultural and ecological values	52 Aboriginal sites were recorded during in 2000 to 2001 and the 2012 to 2013 assessments. Registered Aboriginal Parties (RAPs) were involved in all aspects to identify and manage these sites. 13 Aboriginal objects will be affected by the Proposal in the DZP Site and two along the Macquarie River Water Pipeline. Avoid, Mitigate Offset measures undertaken have been detailed in Section 7 of this report. All sites not directly affected will be protected. Of the 37 sites to be protected, 19 (G-IF1, K-AS1, K-AS2, K-IF1, K-OP1, 36-1-0314, 36-1-0361, 36-1-0360, 36-1-0357, 36-1-0368, TV-AS3, UG-AS2, UG-AS3, UG-IF1, UG-IF2, UG-IF4, UG-IF5, UG-IF7, UG-ST2) will be located within the 1,021 hectare BOA (Figure 23). The sites types located in the BOA range from scarred

Land use practices contributing to wildlife corridors objectives	Comment
	trees, artefact sites, grinding grooves and an ochre resource area.
Restoration efforts such as revegetation link core habitat patches	Habitats for the Pink-tailed Worm-lizard and records of local populations have been mapped in the <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13). The primary goal of the BOA is to create a local biodiversity link to connect existing isolated populations and have a dual outcome to have connectivity with other local, regional and state biodiversity links (Figure 22).
National parks managed to preserve values and minimise impacts of invasive species	Not relevant
Private land conservation and stewardship	BOA will protect 1,021 hectares of native vegetation under Conservation Property Vegetation Plan under Part 4 of the NSW <i>Native Vegetation Act 2003</i> . This mechanism will promote private land conservation and stewardship.
Development offsets contribute to habitat restoration and management	BOA has been designed to protect remnant vegetation. The <i>Biodiversity Offset Strategy</i> Plan of Management will increase the area of occupancy for 61.8 hectares of Box Gum Woodland (EPBC and TSC Acts) and 21.9 hectares of Fuzzy Box Woodland (TSC Act) in land managed for conservation. No tree planting etc. will occur in the BOA as grassy woodlands are the key priority. Breakdown of rehabilitation of 808 hectares outside of the BOA is as follows. 198 hectares will be excluded from agriculture (SRSF, WRE, SEC, o/c complex), the remainder to be returned to agriculture.
Periodic wetland inundation from environmental flows	Not relevant
Landcare and Coastcare groups manage local areas	Not relevant
Local governments incorporate connectivity conservation in land planning and management	Not relevant
Urban landholders create biodiverse gardens friendly to wildlife	Not relevant
Natural resource management grants and other incentives assist landholders to manage threats and restore habitat	The Applicant is privately funded and has not sought grants or other incentives to establish or maintain the BOA.
Roadside vegetation managed by state and local governments connect core habitat patches	The BOA aims to connect Dowds Hill to Obley Road (local biodiversity link). Obley Road possesses some of the best examples of the regions NSW and EPBC listed EECs (Box Gum Woodland and Inland Grey Box Woodland) in the Travelling Stock Reserve.
Holistic farm management plans assist private landholders	The BOA will be operated under an Integrated Land Management Plan (ILMP), the PoM will be within the Mining Operations Plan (MOP).
Biodiverse plantings by landholders contribute to long-term carbon stores	BOA has been designed to protect remnant vegetation in a grassy woodland state and thin woody weeds to increase the area of occupancy of native grassland.
Paddock tree protection helps natural regeneration	BOA has been designed to 'capture' as many paddock trees as possible to link remnant vegetation.
Invasive species management keeps landscapes healthy	The BOA will be operated under a Plan of Management. Invasive species will be managed under this plan.

Figure 23: Indigenous Protected Areas managed for cultural and ecological values.



Note: Image presents the DZP Site assessed area.

8.4.3.3 National Recovery Plan White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland A critically endangered ecological community Draft for Public Comment February 2010

The overall objective of this recovery plan is to promote the recovery and prevent the extinction of the critically endangered ecological community, known as Box Gum Woodland. The specific objective to be achieved within the life-span of this recovery plan is to minimise the risk of extinction of the ecological community through objectives listed in **Table 22**, contextualisation with the BOA have been provided in the right hand column.

Table 22: Box-Gum Grassy Woodland National Recovery Plan Objectives.

Objective	Comment
achieving no net loss in extent and condition of the ecological community throughout its geographic distribution.	The design of the BOA protects 61.8 hectares of CW213 / Box Gum Woodland (Figure 18), all components of this CEEC in the DZP Site have been 100% avoided by the activity. Core habitat for NSW TSC Act species populations and communities listed in the NSW TSC Act will also be protected in the BOA.
increasing protection of sites in good condition.	The design of the BOA protects 61.8 hectares of Box Gum Woodland that meets the criterion to be listed as the EPBC CEEC (Figure 18).
increasing landscape functionality of the ecological community through management and restoration of degraded sites.	The design of the BOA aims to reinstate connectivity (a local biodiversity link) under a Plan of Management. Medium term goal is to manage areas that do not meet the EPBC criterion to be improved to meet the criterion. The focus is on restoring native grasslands as enough 'paddock trees' remain in the area.
increasing transitional areas around remnants and linkages between remnants. and	The BOA links Dowds Hill to Wambangalang Creek (regional biodiversity link) / Obley Road (local biodiversity link), Figure 22 through stepping stones of existing isolated remnants. The design of the BOA was selected to link known populations of the protected matter (Pink-tailed Worm-lizard) or mapped moderate to high quality habitat where the species has not been recorded to date (See <i>Pink-tailed Worm-lizard Plan of Management Appendix 13</i>).
bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.	The BOA through its objective to increase the area of occupancy of the Pink-tailed Worm-lizard and Box Gum Woodland habitat will be the Applicants showcase for the successful management of balancing mining, farming and environment.

The objectives would be achieved across the geographic distribution of Box Gum Woodland within the BOA, actions have already started and will be fully achieved within five years of project approvals.

8.4.4 The Role of EPBC Offsets in Environmental Impact Assessments

8.4.4.1 Referral Stage – Significant Impact to a MNES

The Pink-tailed Worm-lizard (*Aprasia parapulchella*) was originally recorded within the DZP Site in 2001. A sample specimen was sent to the Australian Museum and initially incorrectly identified as Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*). After a request in 2012 for the specimen to be cross checked, the sample specimen was subsequently reclassified as *Aprasia parapulchella* by the Australian Museum in January 2012.

35 individuals have since been recorded during a series of surveys ending in autumn – March 2013. Notably, with the exception of the open cut, most records of the species occur outside of the proposed areas of disturbance.

After Avoid, Mitigate and Offset measures were undertaken (**Section 7**), residual effects were considered to be significant to the Pink-tailed Worm-lizard (*Aprasia parapulchella*, Vulnerable EPBC Act).

The protected matter was referred to the Minister of DSEWPac for consideration (EPBC REF: 2012/6625) under Part 7 of the EPBC Act (**Appendix 12**).

The Minister or Ministers delegate (the decision maker) decided on the 4th of January 2013 the proposed action is a 'Controlled Action' and requires full assessment under Part 9 of the EPBC Act.

The EPBC Offsetting Policy applies to the action.

8.4.4.2 Assessment Stage

In order to determine if an offset is necessary, the impacts of a proposed action need to be fully understood. At the assessment stage the decision maker considers the following issues detailed in **Table 23**, contextualisation with the Proposal have been provided in the right hand column to assist the decision maker.

Table 23: Impacts of the Proposed Action.

EPBC consideration	Contextualisation with the Proposal
What is the nature of the likely impacts on protected matters? – which protected matters are likely to be impacted by the action? What is the scale and size of impacts? What are the risks to the viability of protected matters arising from the action? Will impacts on protected matters be permanent or temporary?	<ul style="list-style-type: none"> Pink-tailed Worm-lizard (<i>Aprasia parapulchella</i>, Vulnerable EPBC Act) is the only protected matter to be impacted by the action. Potential impacts are detailed in Section 4 of Appendix 13 and the size and scale of the impacts are detailed in Section 6 of this report. A <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13) identifies the risks to the viability of protected matters arising from the action as well as impacts on the protected matters (permanent or temporary, Chapters 4 to 6).
Can impacts on protected matters be avoided? – can the proposed action be redesigned to avoid impacting protected matters? What alternatives have been considered? Have environmental considerations been factored into the project's design?	<ul style="list-style-type: none"> Section 7 of this report details 'Avoid' measures undertaken to determine the residual impacts and to provide potted history of alternatives considered. Environmental considerations are detailed in 8.3.9 and 8.4.4 Appendix 13 Section 5.2. provides further species specific 'Avoid' history.
Can impacts on protected matters be mitigated? – what actions can take place that will reduce the impacts arising from the proposed action? For example, developing environmental management plans, implementing	<ul style="list-style-type: none"> General Mitigation measures are detailed in Section 7.4, specific mitigation is detailed in Section 7.5 and 8.1. A <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13, Section 5) provides specific mitigation measures currently being undertaken and those proposed over time to protect existing

EPBC consideration	Contextualisation with the Proposal
erosion control measures, fencing off environmentally sensitive areas etc.	populations and increase the area of its area of occupancy.
<p>Are the residual impacts likely to be significant? – what are the residual impacts on protected matters that are still likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account? E.g. will the proposed action only slightly disturb an area of potential habitat for a threatened species or will it destroy an area of habitat known to be used by a threatened species?</p>	<ul style="list-style-type: none"> • The Proposal would destroy an area of known habitat for the protected matter. • Based on the habitat identification, assessment and evaluation methodology described in Appendix 13, Pink-tailed Worm-lizard habitat has been mapped on the DZP Site and immediate surrounds as follows (Figure 10 in Appendix 13). <ul style="list-style-type: none"> • 107.8ha of high quality habitat. • 179.2ha of medium quality habitat. • 367.3ha of low quality habitat. • On the basis of the mapped Pink-tailed Worm-lizard habitat (see Figure 10 in Appendix 13), and the proposed impact footprint of the DZP, the impact would be as follows. <ul style="list-style-type: none"> • 25.5ha of high quality habitat. • 9.8ha of medium quality habitat. • The BOA would protect and manage in perpetuity for conservation: <ul style="list-style-type: none"> • 82.3ha of high quality habitat (76.3% of all mapped high quality habitat). • 114.7ha of medium quality habitat (64% of all mapped medium quality habitat). • 42ha of low quality habitat (11.43% of all mapped low quality habitat). • It is noted that the majority of this disturbance occurs over the proposed open cut site and that approximately 50% of this would not be impacted for at least 10 years (based on a staged open cut development plan – see also Appendix 13 Figure 3 and Section 5.2). • The establishment and operation of the open cut and associated waste management facilities associated with the DZP will impact on some habitat areas occupied by the Pink-tailed Worm-lizard. • A variety of measures will be adopted to ameliorate many of the impacts, but some habitat will still be lost as a result of the DZP. • A large area of enhanced habitat within a 1,021 hectare BOA managed for conservation in perpetuity will be created immediately adjacent to known high quality habitat areas that are to be affected. • Given the apparent success of similar habitat enhancement projects in the ACT, it is highly likely that the habitat enhancement works at Toongi will also result in the wider establishment of this species, and permit the connection of previously isolated populations. • Vegetation management to increase the biodiversity value of Pink-tailed Worm-lizard habitat will deliver results within five years (Appendix 15, Cameron [1999]). <p>In conclusion residual impacts would not be significant as the objective of the <i>Pink-tailed Worm-lizard Plan of Management</i> is to increase the area of occupancy for the species in an area managed in perpetuity for conservation.</p>
<p>Are offsets a suitable approach? – are offsets needed to help compensate for residual impacts on the protected matter and are they feasible?</p>	<ul style="list-style-type: none"> • Offsetting residual impacts are considered essential because implementation of the <i>Pink-tailed Worm-lizard Plan of Management</i> within a BOA managed in perpetuity for conservation will: <ul style="list-style-type: none"> ➢ improve existing habitat for the protected matter. ➢ create new habitat for the protected matter. ➢ reduce threats (especially feral pigs and invasive species) to the protected matter. ➢ increase the values of the heritage places recorded in the DZP Site. ➢ avert the loss of the protected matters habitat that is under the current threat of feral animals, isolation / habitat fragmentation and natural degradation of biodiversity by invasive native woody weeds removal of refuge habitat and invasion of weeds.

EPBC consideration	Contextualisation with the Proposal
	<ul style="list-style-type: none"> ➤ result in establishment of a biodiversity corridor that is consistent with the <i>National Wildlife Corridors Plan</i>. ➤ Result in establishment of a 1,021 hectare BOA managed in perpetuity for conservation that will protect 61.8 hectares of critically endangered Box Gum Woodland. This outcome is consistent with the National Recovery Plan White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland A critically endangered ecological community Draft for Public Comment February 2010.

8.4.4.3 Decision Stage

Following assessment, the decision maker considers the offset Proposal in deciding whether the proposed action should be approved. In some cases, a suitable offset may not be proposed or available and a decision on the overall acceptability of the project will need to be made.

The offset Proposal is one of many considerations that are weighed at the decision stage in determining the overall acceptability of the proposed action, including economic and social matters. These considerations are outlined in the EPBC Act in Sections 136 to 140A.

Economic and social matters have been provided in **Section 8.3.9.2**. Offset requirements have included as a condition of approval under section 134 of the EPBC Act in **Section 7.4 and 7.5**.

8.4.4.4 Post Approval Stage

If an approval has been granted that incorporates offsets into the conditions of approval, the Applicant accepts responsibility for ensuring that the offsets are delivered in accordance with the approved conditions.

The Applicant has an active monitoring and audit program within the *Biodiversity Offset Strategy* and *Pink-tailed Worm-lizard Plan of Management* as conditions of consent. This ensures that conditions of approval will be implemented. The Applicant will welcome DSEWPac to audit implementation and progress of the *Biodiversity Offset Strategy* and *Pink-tailed Worm-lizard Plan of Management*.

Where the Applicant becomes aware that they may not be able to fulfil a condition of approval, they accept responsibility to approach the department in the first instance to discuss the matter and see what options are available to remedy the situation.

The Applicant is aware that breaches of approval conditions, including those relating to offsets, can incur significant penalties as detailed on the department's *EPBC Act Compliance and Enforcement Policy* on **Error! Hyperlink reference not valid.** www.environment.gov.au/epbc/publications/index.html.

8.4.5 The Offset Proposal

There are two key types of information utilised in planning an offset Proposal:

1. Determining what types of activities would be appropriate as offsets for a given impact.
2. Determining the specific size and scope of an offsets package.

In determining the appropriateness of the offset activities proposed, the Commonwealth approved recovery plan for the Pink-tailed Worm-lizard Technical Report 10 (Osborne and

Jones 1995), threat abatement and recovery section on the Species Profile, conservation advice, ecological character description, management plan and/or listing documents have been reviewed (**Table 24**).

Table 24: National Pink-tailed Worm-lizard Recovery Plan Criteria

Criterion	Contextualisation with the Proposal
National Recovery plan for the Pink-tailed Worm-lizard Recovery Criteria	
1. Minimum of ten high quality sites protected by specific management in each of the following reserves in the ACT: Canberra Nature Park, Murrumbidgee River Corridor and proposed Lower Molonglo Nature Reserve.	<ul style="list-style-type: none"> Not relevant
2. Protection, or conservation agreements with landholders, of at least one viable population near Bathurst (at the time only one site was known), two sites near Tarcutta (at the time only two sites were known) and two sites near Bendigo (at the time only two sites were known).	<ul style="list-style-type: none"> Relevant as the 1,021 hectare BOA to be established under an in perpetuity on title conservation mechanism will protect N.S.W largest known population of the Pink-tailed Worm-lizard. The BOA will be managed under a BOA Plan of Management. The protected matter will be subject to a <i>Pink-tailed Worm-lizard Plan of Management</i>. Single or two rarely more than three records are known in NSW within each of the following locations - Buddigower Nature Reserve, Goulburn River National Park, Cooma North Ridge Reserve, Googong Foreshore Reserve and Nail Can Hill Reserve.
3. Monitoring program established for representative sites in the ACT and sites at Tarcutta, Bathurst and Bendigo	<ul style="list-style-type: none"> Relevant as the protected matters population within the 1,021 hectare BOA will be subject to monitoring detailed in the <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13 Section 5.6).
Threat Abatement and Recovery (DSEWPaC web site (following Wong and colleagues (2011))).	
<ul style="list-style-type: none"> further targeted surveys in NSW and Victoria 	The <i>Pink-tailed Worm-lizard Plan of Management</i> is consistent with this criterion (Appendix 13 Section 3).
<ul style="list-style-type: none"> research into the relationship between persistence in the landscape and land disturbance (agriculture) 	The <i>Pink-tailed Worm-lizard Plan of Management</i> is consistent with this criterion (Appendix 13 Section 2 and 3).
<ul style="list-style-type: none"> taxonomic and genetic work between populations 	Genetic work is not a feature of the <i>Pink-tailed Worm-lizard Plan of Management</i> .
<ul style="list-style-type: none"> dispersal capability and the role of connectivity in the landscape. 	The <i>Pink-tailed Worm-lizard Plan of Management</i> is consistent with this criterion (Appendix 13 Section 5.3).

In determining the appropriateness of the offset activities proposed, the NSW OEH listed threats to the Pink-tailed Worm-lizard have been reviewed (**Table 25**).

Table 25: NSW OEH Listed Threats to the Pink-tailed Worm-lizard

NSW OEH listed threats to the Pink-tailed Worm-lizard	Contextualisation with the Proposal
Habitat loss and fragmentation as land is cleared for residential, agricultural and industrial developments.	Establishment of the 1,021 hectare BOA directly addresses this existing threat to the DZP Site population. (Appendix 13 Section 5.3).
Removal of rocks, which are a vital habitat element.	Implementation of the <i>Pink-tailed Worm-lizard Plan of Management</i> will see a net increase of vital habitat elements in areas mapped as high and moderate quality habitat (Appendix 13, Section 5.3).
Heavy grazing and trampling by stock and rabbits, causing habitat degradation through root damage, prevention of	Establishment of the 1,021 hectare BOA BOS directly addresses this existing threat to the DZP Site population.

NSW OEH listed threats to the Pink-tailed Worm-lizard	Contextualisation with the Proposal
seedling establishment and erosion.	
Invasion of habitat by weeds or escaped pasture species that degrade habitat.	Establishment of the 1,021 hectare BOA BOS directly addresses this existing threat to the DZP Site population.
Habitat degradation through slashing for hazard reduction, ploughing and rock removal.	Establishment of the 1,021 hectare BOA BOS directly addresses this existing threat to the DZP Site population.
Modification of habitat through tree-planting in native grasslands.	The <i>Pink-tailed Worm-lizard Plan of Management</i> will see monocultures of White Cypress Pine and Black Cypress Opine thinned to promote the growth of native grasses in areas identified as suitable to increase the area of occupancy for the species (Appendix 13, Section 5.3) an example of the expected outcome to be achieved within five years is presented in Appendix 15 (Cameron 1999). Tree planting has not been recommended in the BOA.
Changed fire regimes that result in changes to vegetation structure and composition.	Fire regimes that maintain structure and floristic diversity (e.g. patch burning) is a recommendation of the BOA Plan of Management (Section 7.4) and is consistent with manipulating habitat to increase the area of occupancy for a grassy ground stratum for Pink-tailed Worm-lizard.

In determining the appropriateness of the offset activities proposed, the NSW OEH listed NSW OEH Priority actions for the Pink-tailed Worm-lizard has been reviewed (**Table 26**).

Table 26: NSW OEH Priority Actions for the Pink-tailed Worm-lizard

NSW OEH Priority actions for the Pink-tailed Worm-lizard	Priority	Contextualisation with the Proposal
Implement habitat management guidelines in Buddigower NR and Goulburn River NP.	High	Not relevant
Undertake surveys for the species in areas of identified potential habitat using survey guidelines.	High	Relevant, the DZP population was identified in potential habitat using the requisite survey guidelines.
Undertake a review of threats at known sites.	High	<i>Pink-tailed Worm-lizard Plan of Management</i> has identified threats to the local population and provided management recommendations to address them (Appendix 13 Section 5).
Reserve or ensure long-term management of known populations.	High	BOA will protect 1,021 hectares of native vegetation under Conservation Property Vegetation Plan under Part 4 of the NSW <i>Native Vegetation Act 2003</i> . Single, two or rarely more than three records are known in NSW within Buddigower Nature Reserve, Goulburn River National Park, Cooma North Ridge Reserve, Googong Foreshore Reserve and Nail Can Hill Reserve.
Provide incentive payments for protection and enhanced management of known sites (see DEC for details).	High	The Applicant will self-fund for the protection and enhancement of the known population.
Undertake distribution modelling or remote sensing to identify potential distribution and habitat.	Medium	<i>Pink-tailed Worm-lizard Plan of Management</i> has mapped distribution of the species and modelled the distribution of potential habitat (Appendix 13, Section 3).
Undertake survey in Buddigower NR to determine presence and distribution of species in reserve.	Medium	Not relevant
Implement monitoring regime at 6 sites across the range of the species	Medium	<i>Pink-tailed Worm-lizard Plan of Management</i> includes annual population monitoring of N.S.W largest population.

NSW OEH Priority actions for the Pink-tailed Worm-lizard	Priority	Contextualisation with the Proposal
on a three year rotational basis.		
Undertake survey in Goulburn River NP to determine presence and distribution of species in reserve.	Medium	Not relevant
Develop and implement a site management plan for Cooma North Ridge Reserve.	Medium	Not relevant
Develop and implement a site management plan for Eedy's New TSR.	Medium	Not relevant
Develop minimum disturbance survey and monitoring guidelines.	Medium	<i>Pink-tailed Worm-lizard Plan of Management</i> provides disturbance and monitoring guidelines (Appendix 13 Section 5).
Develop and implement a site management plan for Googong Foreshore Reserve.	Medium	Not relevant
Develop guidelines for habitat identification, enhancement and management.	Medium	<i>Pink-tailed Worm-lizard Plan of Management</i> provides disturbance and monitoring guidelines (Appendix 13 Section 5).
Develop and implement a site management plan for Nail Can Hill Reserve.	Medium	Not relevant
Undertake research into biology, ecology and management.	Low	<i>Pink-tailed Worm-lizard Plan of Management</i> provides research into biology, ecology and management (Appendix 13).
Investigate the genetic differences between populations and determine if revisions of taxonomy and status are warranted.	Low	Genetic work is not a feature of the <i>Pink-tailed Worm-lizard Plan of Management</i>

In determining the appropriateness of the offset activities proposed, the NSW OEH listed NSW OEH listed activities to assist Pink-tailed Worm-lizard has been reviewed (**Table 27**).

Table 27: NSW OEH Listed Activities to Assist Pink-tailed Worm-lizard

NSW OEH listed activities to assist Pink-tailed Worm-lizard	Contextualisation with the Proposal
Keep domestic dogs and cats indoors at night.	Dogs will be controlled in the BOA. Cats will be targeted in sheds / buildings etc. The <i>Biodiversity Offset Strategy</i> (Section 7.4) will provide a detailed management plan for invasive species.
Undertake feral animal control.	The <i>Biodiversity Offset Strategy</i> (Section 8.1) will provide a detailed management plan for invasive species.
Apply fire regimes that maintain structure and floristic diversity (e.g. patch burning).	The <i>Biodiversity Offset Strategy</i> (Section 8.1) will provide a detailed management plan fire regimes that maintain structure and floristic diversity (e.g. patch burning).
Search for the species in suitable habitat in areas that are proposed for development or management actions, and mark sites onto maps or plans.	This has been undertaken as a component of the Proposal (See Appendix 13 Section 3.5).
Do not collect bush rock or remove rocks for pasture management purposes.	Conservation and enhancement of rock habitat and passive relocation of Pink-tailed Worm-lizards has been detailed in Appendix 13 Sections 5.3 to 5.5 .
Do not destroy habitat and surrounding areas by ploughing.	Ploughing will cease in any land within the BOA.
Do not allow heavy, prolonged grazing on habitat.	Heavy, prolonged grazing on Pink-tailed Worm-lizard habitat within the BOA will not occur.

NSW OEH listed activities to assist Pink-tailed Worm-lizard	Contextualisation with the Proposal
Do not plant trees and shrubs into habitat.	The <i>Pink-tailed Worm-lizard Plan of Management</i> states that trees / shrubs will not be planted within the BOA and White Cypress Pine / Black Cypress Pine monocultures will be thinned to eight metre spacing restore a native grassy stratum following Cameron (1999), Appendix 15 .
Control invasions of weeds and pasture species (but be wary of the impact of herbicide use in habitat).where possible use methods that directly target weeds, such as spot spraying and hand removal.	The <i>Biodiversity Offset Strategy</i> (Section 7.4) will provide a detailed weed management strategy.
Protect natural grassland remnants within the known distribution of the species.	Increasing the area of occupancy of native grassland is a key outcome of the <i>Biodiversity Offset Strategy</i> .
Ensure remnant populations remain connected or linked to each other. In cases where remnants have lost connective links, re-establish links by revegetating sites to act as stepping stones for dispersal.	The BOA links Dowds Hill to Wambangalang Creek (Regional biodiversity link) which is adjacent to Obley Road (local biodiversity link), Figure 22 through stepping stones of existing isolated remnants. The design of the BOA was selected to link known populations of the protected matter (Pink-tailed Worm-lizard) or mapped moderate to high quality habitat where the species has not been recorded to date (See <i>Pink-tailed Worm-lizard Plan of Management</i> Appendix 13).
Mark sites and potential habitat onto maps used for planning hazard reduction burns.	<i>Pink-tailed Worm-lizard Plan of Management</i> has mapped distribution of the species and modelled potential distribution and habitat has been undertaken (Appendix 13, Section 5).

8.4.5.1 Matters Considered at the Impact Site

There are a range of considerations taken into account at both the impact site and the proposed offset site. Detailed information pertaining to these considerations in the offset Proposal has been provided in this section. The *Offsets assessment guide* has been consulted as the impacted protected matter is a threatened species.

Matters considered at the impact site have been detailed and addressed in **Table 28**.

Table 28: Matters Considered at the Pink-tailed Worm-lizard Habitat Impact Site

Matters considered at the impact site include:	Contextualisation with the Proposal
Presence and conservation status of protected matters likely to be impacted by the proposed action	<ul style="list-style-type: none"> Pink-tailed Worm-lizard (<i>Aprasia parapulchella</i>) is Vulnerable EPBC Act and Vulnerable in the NSW TSC Act). Appendix 13 Chapter 2.2, 3.5 and 4 define the presence of Pink-tailed Worm-lizard and the nature and extent of residual impacts to the local population. The protected matter was referred to the Minister of DSEWPac for consideration (EPBC REF: 2012/6625) under Part 7 of the EPBC Act. The Minister or Ministers delegate (the decision maker) decided on the 4th of January 2013 the proposed action is a 'Controlled Action' and requires full assessment under Part 9 of the EPBC Act.
Specific attributes of the protected matter being impacted at a site, for example: the type of threatened species or ecological community habitat, the quality of habitat, population attributes such as recruitment or mortality, landscape attributes such as habitat connectivity, or heritage values	<ul style="list-style-type: none"> Appendix 13 <i>Pink-tailed Worm-lizard Plan of Management</i> written by Dr Arthur White a reptile specialist, contributors were Dr Gilbert Whyte (Entomologist) and Mr Phillip Cameron (principal ecologist based in Dubbo NSW) addresses these considerations. Section 8.4.3 and Tables 21 to 25 addresses habitat connectivity issues and the Proposals heritage values.
Scale and nature of the impacts of the proposed action – including direct and	<ul style="list-style-type: none"> Section 6 provides details of the Proposals impacts, Section 6.3 details impacts to the protected matter, 6.5 discusses indirect

Matters considered at the impact site include:	Contextualisation with the Proposal
indirect impacts	<p>impacts.</p> <ul style="list-style-type: none"> • Appendix 13 Pink-tailed Worm-lizard Plan of Management provides specific impacts to the protected matter. In summary: • Pink-tailed Worm-lizard habitat has been mapped on the DZP Site and immediate surrounds as follows (see Figure 10 in Appendix 13). <ul style="list-style-type: none"> ○ 107.8 hectares of high quality habitat. ○ 179.2 hectares of medium quality habitat. ○ 367.3 hectares of low quality habitat. • The proposed impact to Pink-tailed Worm-lizard habitat would be. <ul style="list-style-type: none"> ○ 25.5 hectares of high quality habitat. ○ 9.8 hectares of medium quality habitat.
Duration of the impact (not of the action).	<ul style="list-style-type: none"> • 35.3 hectares of Pink-tailed Worm-lizard habitat would be affected by the activity. Extraction of approximately 19.5Mt of ore at a maximum rate of 1.1Mt per year from a shallow open cut developed to a maximum depth of 32m (355m AHD) (remaining above the groundwater table) will occur. • At the proposed rate of mining, the open cut design proposed would provide for a mine life of 20 to 22 years. • The open cut will be dug in two separate stages. The western half of the ore body will be dug in stages over the first ten years. This will allow for the enhancement of existing habitat out of the impact footprint and creation of additional habitat for the Pink-tailed Worm-lizard adjoining the impact area and elsewhere on the DZP Site. Passive or artificial relocation of individuals from the impact footprint, incorporating, enhancing and conserving all other areas of moderate or high quality habitat within the DZP BOA will be undertaken at the same time (Appendix 13 Section 5).

8.4.5.2 Matters considered at the offset site

Matters considered at the offset site have been detailed and addressed in **Table 29**.

Table 29: Matters Considered at the Pink-tailed Worm-lizard Habitat Offset Site

Matters considered at the offset site include:	Contextualisation with the Proposal
extent to which the proposed offset actions correlate to, and adequately compensate for, the impacts on the attributes for the protected matter	<ul style="list-style-type: none"> • The 1,021 hectare BOA would protect and manage in perpetuity for conservation: <ul style="list-style-type: none"> ▪ 82.3 hectares of high quality habitat (76.3% of all mapped high quality habitat). ▪ 114.7 hectares of medium quality habitat (64% of all mapped medium quality habitat). ▪ 42 hectares of low quality habitat (11.43% of all mapped low quality habitat). • The Offsets Assessment Guide credit calculator (October 2012, Appendix 9) was used to determine that: <ul style="list-style-type: none"> ▪ The quantum of the impact was 31.77 hectares ▪ Net present value of the offset is 50.39 hectares ▪ The percentage of the impact offset is 158.6% ▪ The direct offset s adequate.
conservation gain to be achieved by the offset. This may be through positive management activities that improve the viability of the protected matter or averting the future loss, degradation or damage of	<ul style="list-style-type: none"> • The offset will protect in perpetuity habitat for the Pink-tailed Worm-Lizard. The <i>Pink-tailed Worm-Lizard Plan of Management</i> objectives are that the Pink-tailed Worm-lizards continue to survive and thrive at Toongi, and to minimise the disturbance to

Matters considered at the offset site include:	Contextualisation with the Proposal
the protected matter	the local population as a result of the Proposal.
current land tenure of the offset and the proposed method of securing and managing the offset for the life of the impact	<ul style="list-style-type: none"> The Offset Assessment Guide was populated with DZP Site data, the percentage of the impact offset is 158.6%, the offset is adequate.
time it will take to achieve the proposed conservation gain	<ul style="list-style-type: none"> The Applicant owns the 1,021 hectare BOA. Actions to address immediate direct threats to known extent of the Pink-tailed Worm Lizard population (feral pigs moving into the area and destroying habitat) were enacted as soon as they were evident in March 2012. Feral pig control is ongoing. Actively manipulating existing vegetation for biodiversity outcomes will achieve full conservation gain in five years. The same action required in the BOS was undertaken in similar vegetation types in the same LGA. A five year goal has a high degree of confidence (Cameron 1999, Appendix 15).
level of certainty that the proposed offset will be successful. In the case of uncertainty, such as using a previously untested conservation technique, a greater variety and/or quantity of offsets may be required to minimise risk	<ul style="list-style-type: none"> There is a high degree of confidence to achieve the goal for increasing the area of occupancy for Pink-tailed Worm-lizards because: <ul style="list-style-type: none"> Dr Arthur White, the lead author of the <i>Pink-tailed Worm-lizard Plan of Management</i> is both an expert in his field and has substantive practical hands on experience. Dr Gilbert Whyte (entomologist) studied ants, the species food supply within known habitat areas and areas with no Pink-tailed Worm-lizards. Mr Phil Cameron, principal ecologist and Alex Irwin Senior Project Manager coordinated the development of habitat scoring systems and techniques for habitat manipulation for biodiversity. CVs of the Pink-tailed Worm-lizard team have been provided in Appendix 16. Actively manipulating existing vegetation for biodiversity outcomes has been successfully undertaken in the same LGA in similar vegetation types (Cameron 1999, Appendix 15). Achieving full conservation gain in five years is a 'reasonable' time period and the degree of success has been previously demonstrated.
suitability of the location of the offset site. In most cases this will be as close to the impact site as possible. However, if it can be shown that a greater conservation benefit for the impacted protected matter can be achieved by providing an offset further away, then this will be considered.	<ul style="list-style-type: none"> The 1,021 hectare BOA is suitable for increasing the area of occupancy for Pink-tailed Worm-lizards because: <ul style="list-style-type: none"> It is immediately adjacent to the impact footprint of the effected population. Where it is further afield the known populations are isolated and will be reconnected through establishing the BOA (See Appendix 13 Section 5.3 and Section 5.6). The Offset Assessment Guide was populated with DZP Site data, the percentage of the impact offset is 158.6%, and the offset is adequate.

8.4.6 Offset Requirements

The EPBC Offsets Policy identifies 11 requirements that address suitability of the offset as part of the determination process (pp 18). Detailed information pertaining to these considerations in the offset Proposal has been provided in this section (**Table 30**).

Table 30: Suitability of the Offset

EPBC Offset Policy Requirement	Contextualisation with the Proposal
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	<ul style="list-style-type: none"> The establishment and operation of the open cut and associated waste management facilities associated with the Dubbo Zirconia Project will impact on some habitat areas occupied by the Pink-tailed Worm-lizard. A variety of measures will be adopted to ameliorate many of the impacts, but some habitat will still be lost as a result of the DZP. A large area of enhanced habitat will be created close by to known high quality habitat areas that are to be affected. Given the apparent success of similar habitat enhancement projects in the ACT, it is highly likely that the habitat enhancement works at Toongi will also result in the wider establishment of this species, and permit the connection of previously isolated populations (Appendix 13).
Suitable offsets must be built around direct offsets but may include other compensatory measures	<ul style="list-style-type: none"> The 1,021 hectare BOA would protect and manage in perpetuity for conservation: <ul style="list-style-type: none"> 82.3 hectares of high quality habitat (76.3% of all mapped high quality habitat). 114.7 hectares of medium quality habitat (64% of all mapped medium quality habitat). 42ha of low quality habitat (11.43% of all mapped habitat). The Offsets Assessment Guide credit calculator (October 2012, Appendix 9) was used to determine that: <ul style="list-style-type: none"> The quantum of the impact was 31.77 hectares Net present value of the offset is 50.39 hectares The percentage of the impact offset is 158.6% The direct offset s adequate.
Tenure for direct offsets	<ul style="list-style-type: none"> BOA will protect 1,021 hectares of native vegetation under Conservation Property Vegetation Plan under Part 4 of the NSW Native Vegetation Act 2003.
Impacting on existing EPBC Act offsets	<ul style="list-style-type: none"> No existing EPBC offsets would be affected by the activity.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	<ul style="list-style-type: none"> The level of offsets meets EPBC and NSW TSC Act requirements (Appendix 8 and 9).
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	<ul style="list-style-type: none"> Based on the habitat identification, assessment and evaluation methodology described in Appendix 13, Pink-tailed Worm-lizard habitat has been mapped on the DZP Site and immediate surrounds as follows (see Figure 10 in Appendix 13). <ul style="list-style-type: none"> 107.8 hectares of high quality habitat. 179.2 hectares of medium quality habitat. 367.3 hectares of low quality habitat. On the basis of the mapped Pink-tailed Worm-lizard habitat (see Figure 10 in Appendix 13), and the proposed impact footprint of the DZP, the impact would be as follows. <ul style="list-style-type: none"> 25.5 hectares of high quality habitat. 9.8 hectares of medium quality habitat. The BOA would protect and manage in perpetuity for conservation: <ul style="list-style-type: none"> 82.3 hectares of high quality habitat (76.3% of all mapped high quality habitat / 3.2 times larger than the size of the area to be affected). 114.7 hectares of medium quality habitat (64% of all mapped medium quality habitat / 11.7 times larger than the size of the area to be affected). 42 hectares of low quality habitat (11.43% of all mapped low quality habitat). This quality category is not affected by the activity.
Suitable offsets must effectively account for and manage the risks of	<ul style="list-style-type: none"> The worst case scenario is the Biodiversity Conservation Area protected in perpetuity but no direct management occurs. This

EPBC Offset Policy Requirement	Contextualisation with the Proposal
the offset not succeeding	would: <ul style="list-style-type: none"> Separate agriculture, especially ploughing, from areas to be managed for conservation of the Pink-tailed Worm-lizard. Result in an increase of occupancy for native grassland. Reconnect populations that are currently isolated from each other due to conflicting agricultural land uses.
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	<ul style="list-style-type: none"> The level of offsets for Pink-tailed Worm-lizard meets and exceeds EPBC and NSW TSC Act requirements (Appendix 8 and 9). As the BOA is owned by the Applicant and Pink-tailed Worm-lizard population protection measures have already begun it would meet the 'Advanced Offset' criterion.
Links with state and territory approval processes	<ul style="list-style-type: none"> Offsetting has been undertaken and documented in this report to be consistent with: <ul style="list-style-type: none"> The EPBC Offsetting Policy. The NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects Approved by the Chief Executive Officer 25 June 2011 (Appendix 12).
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	<ul style="list-style-type: none"> The <i>Pink-tailed Worm-lizard Plan of Management</i> to be implemented within the 1,021 hectare BOA requires a relatively low level of resources to achieve a relatively quick and measurable conservation outcome, it is considered to be efficient and effective. The BOA is owned by the Applicant, actions have already begun and have addressed immediate threats to the Pink-tailed Worm-lizard population (feral pig control implemented March 2013, by March 2013 40 pigs shot and no more signs of a residual population have been detected. The ability to set up land for the offsets can officially immediately occur as soon as approvals are granted. The time required to effectively manage vegetation within the BOA for biodiversity will be achieved in five years post treatment (Cameron 1999). This time period is relatively short in terms of landscape management. This report, Dr A Whites survey work and <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13), Dr G Whyte's ant / soil report (Appendix 13, Attachment 1) and Cameron (1999, Appendix 15) provides evidence that the plan developed to increase the area of occupancy for the Pink-tailed Worm-lizard will work and all recommendations are reasonable.
Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	<ul style="list-style-type: none"> Two levels of governance will be auditable and measureable: <ul style="list-style-type: none"> Those within the BOA Plan of Management (Chapter 7.3.2) Those within the <i>Pink-tailed Worm-lizard Plan of Management</i> (Appendix 13).

8.4.7 The Offsets Assessment

The EPBC publication "*How to use the Offsets Assessment Guide*" was used to populate the Offsets Assessment Guide Credit Calculator (October 2012).

To ensure transparency calculations used, explanations / additional information have been provided in the following sections as supporting evidence.

8.4.7.1 Annual Probability of Extinction

The *annual probability of extinction* rate of 0.2% for Pink-tailed Worm-lizard has been used as it is a vulnerable species. The *annual probability of extinction* rate is an estimate of the average chance that a species or ecological community that will be completely lost in the wild each year, given recent rates of decline (**Table 31**).

Table 31: Annual Probability of Extinction Rate for Pink-tailed Worm-lizard

Conservation status of MNES	IUCN criteria for probability of extinction in the wild	Annual probability of extinction (geometric mean)	Annual probability of extinction (geometric mean) + probability of catastrophe
Critically Endangered	At least 50% in 10 yrs.	6.7%	6.8%
Endangered	At least 20% in 20 yrs.	1.1%	1.2%
Vulnerable	At least 10% in 100 yrs.	0.1%	0.2%

As there is a short time lag between an impact occurring and an offset delivering a conservation gain, there is a low risk that a threatened species will be completely lost in the wild in the DZP Site.

8.4.7.2 Protected Matter Attributes

Protected matter attributes used in the calculations has been area of habitat using the number of hectares of low, medium and high quality habitat.

Based on the habitat identification, assessment and evaluation methodology described in **Appendix 13**, Pink-tailed Worm-lizard habitat has been mapped on the DZP Site and immediate surrounds as follows (see **Figure 10** in **Appendix 13** or **Figure 20** in this report).

- 107.8 hectares of high quality habitat.
- 179.2 hectares of medium quality habitat.
- 367.3 hectares of low quality habitat.

On the basis of the mapped Pink-tailed Worm-lizard habitat (see **Figure 10** in **Appendix 13**), and the proposed impact footprint of the DZP, the impact would be as follows.

- 25.5 hectares of high quality habitat.
- 9.8 hectares of medium quality habitat.

The BOA would protect and manage in perpetuity for conservation:

- 82.3 hectares of high quality habitat (76.3% of all mapped high quality habitat / 3.2 times larger than the size of the area to be affected).
- 114.7 hectares of medium quality habitat (64% of all mapped medium quality habitat / 11.7 times larger than the size of the area to be affected).
- 42 hectares of low quality habitat (11.43% of all mapped low quality habitat). This quality category is not affected by the activity

8.4.7.3 Quality

The quality score for *area of habitat* or *area of community* has been determined by field survey conducted by Dr Arthur White of Biosphere Environmental Consultants (BEC). Habitat

assessment were undertaken by Dr White (reptile habitat attributes), Dr Gilbert Whyte of Ecobiological (entomological and soil attributes) and Mr Phillip Cameron of OzArk EHM (Botanical, habitat composition attributes). Refer to Pink-tail Worm-lizard Plan of Management **Appendix 13** Attachment 1 "Ant Population Monitoring and Soil Surveys within the Habitat of the Pink-tailed Worm Lizard Dubbo Zirconia Project Toongi, NSW" prepared by Klienfelder Ecobiological and Habitat Assessment Score Sheets generated by OzArk with input from BEC and Klienfelder Ecobiological (**Appendix 13, Table 2**).

Mapped habitat has been shown as **Figure 6** in **Appendix 13** and as **Figure 20** in this report.

It is important to note that the project team assessment of quality for the Pink-tailed Worm-lizard considered three components that contribute to the calculation of habitat quality:

- *Site condition*: This is the condition of a site in relation to the ecological requirements of a threatened species or ecological community. This includes considerations such as vegetation condition and structure, the diversity of habitat species present, and the number of relevant habitat features.
- *Site context*: This is the relative importance of a site in terms of its position in the landscape, taking into account the connectivity needs of a threatened species or ecological community. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community.
- *Species stocking rate*: This is the usage and/or density of a species at a particular site. The principle acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It includes considerations such as survey data for a site in regards to a particular species population or, in the case of a threatened ecological community this may be a number of different populations. It also includes consideration of the role of the site population in regards to the overall species population viability or community extent.

The three attributes listed above were considered when developing the habitat scoring assessment system that was developed based on the expertise and experience of those involved. The final score was then determined based on the proportional representation of high, medium and low quality habitat areas. The final habitat quality score and consistency that the scoring system provided was applied to ensure both the impact and offset calculators of the guide were achieved.

When determining the suitability of a proposed offset using the guide, the minimum requirement was considered where the quality score of the offset site (*future value with offset*) must at least reach the same value as the quality score of the impact site. The work undertaken by Cameron (1999), **Appendix 15**, was reviewed to substantiate improving an offset site area from a lower score, such as a '6', to a '9' over a specified time period through the proposed management actions.

8.4.7.4 Time over which loss is averted

The *time over which loss is averted* is the foreseeable timeframe (in years) over which changes in the level of risk to a proposed offset site has been considered and quantified as 20 years (the life of mine is minimum 20 years).

8.4.7.5 Time until ecological benefit

The *time until ecological benefit* is the estimated time (in years) that it will take for the habitat quality improvement of the proposed offset to be realised. Five years has been estimated based upon Cameron (1999), **Appendix 15**, where White Cypress Pine thinning trials showed a significant increase to biodiversity within five years of treatment. These trials were undertaken in similar vegetation types on similar landforms within the Dubbo LGA (approximately 20 kilometres from the DZP Site). Further, Dr Arthur White has demonstrated that Pink-Tailed Worm-lizards will utilise roof tiles as habitat within six months of placement which is consistent with studies undertaken at the Canberra sites (**Appendix 13**).

8.4.7.6 Risk of loss

The *risk of loss* is a percentage figure that describes the chance that the habitat on the proposed offset site would be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (either the life of the offset or 20 years, whichever is shorter).

The *risk of loss (%)* with, and without the proposed offset has been estimated at 25% because without intervention feral pigs would re-occupy Dowds Hill and destroy rock habitat (by continuously disturbing home ranges for protected matter species). These effects would be multiplied by 'woody weeds' (Cypress Pine Monocultures) suppressing mid and lower stratum diversity over a longer time period.

The risk of loss also recognises:

- The proposed 1,021 hectare BOA is currently zoned as 'agricultural land', there are no conservation covenants over the property.
- All areas mapped as 'Derived Grasslands' are rotationally cropped. Currently these areas are greater than 50% weedy, however, if the BOA is approved then weed management will occur and with an effective weed management system aiming for fewer than 50% weeds will be achieved within five years. If the Proposal is not approved the potential for weeds to increase their dominance will increase (not including effects of current management regimes).
- The risk of loss to smaller known 'island' populations within the proposed 1,021 hectare BOA to stochastic events.

Degradation to the quality of a site due to current management practises have not been incorporated as they have been addressed in the quality score.

A consistent approach has been adopted in calculating the *risk of loss* for both the business as usual (i.e. without offset) and with offset future scenarios.

8.4.7.7 Confidence in result

The *confidence in result* is a percentage figure that describes the level of certainty about the success of the proposed offset. For the *area of community* and *area of habitat* attributes, there are two components to which *confidence in result* relates - change in habitat quality and averted loss.

For the change in habitat quality component, the *confidence in result* captures the level of certainty about the successful achievement of the proposed change in quality. This includes

the degree to which the proposed offset actions can be achieved and how likely they are to provide a benefit to the protected matter. For the averted loss component, *confidence in result* captures the level of certainty about the strength and effectiveness of the proposed risk-mitigation measures and the capacity of these measures to mitigate the risk of loss of the site.

Two mechanisms will be simultaneously employed to provide confidence in achieving a measurable outcome; both are conditions of consent for the Proposal:

1. *Integrated Land Management Plan* (**Section 8.1**, template for management actions provided as **Appendix 17**).
2. *Pink-tail Worm-lizard Plan of Management* (**Appendix 13**).

Both plans of management are based on scientifically sound evidence and knowledge. The improvements in quality scores have been evidenced by development of a Pink-tailed Worm-lizard habitat scoring template and the expectation of time frames to deliver an increase in biodiversity from habitat manipulation has been provided as **Appendix 15**, Cameron (1999).

The past record of the Applicant's environmental performance has also been taken into account in determining this figure. That is, *confidence in result* takes into account not only the confidence in being able to achieve the conservation gain but also take into account the risk that the offset may not be delivered.

Alkane Resources Limited

Australian Zirconia Ltd is a subsidiary of Alkane Resources Ltd (Alkane). Alkane owned and operated the Peak Hill Gold Mine from 1996 to 2005. Environmental Management of Alkane's projects since 1995 has been and still is provided by Michael Sutherland (General Manager NSW). Mr Sutherland (BSc) has spent most of his working life farming and mining in the Dubbo-Peak Hill district.

Mr Sutherland's mixed farm, "Genaren"²¹ was an example of a balance between productive sheep/cropping enterprise and nature conservation. In 1993, the Sutherland's signed one of the largest Voluntary Conservation Agreements (at the time) over 12% of the landholding and were involved in successful mammal re-introductions and research collaborations with University of Melbourne, CSIRO and Charles Sturt University.

Mr Sutherland has been a landcare volunteer since 1992, Director of the Central West Catchment Management Authority (2004 to 2008) and was an inaugural member of the Commonwealth Threatened Species Scientific Committee (2000 to 2003).

The Peak Hill Gold Mine is a demonstration of biodiversity enhancement of a formerly degraded woodland and farmland landscape. Birds and two macropod species that were not present at the commencement of mining have colonised the now closed mine site. The mined landscape has been restored and interpreted as a tourist mine and is unique in NSW for this innovation.

²¹ See: Australia State of the Environment Report 2001 (Theme Report) and Pages 159-162 in CONSERVATION OUTSIDE NATURE RESERVES, ed. by P. Hale and D. Lamb. Centre for Conservation Biology, The University of Queensland. 1997.

Woodland birds were nesting in rehabilitations plantings on the mine site with ten years of planting locally provenance trees and shrubs. River red gums planted in 1996 are now up to 15 metres tall and have species such as White-winged Choughs and Grey Crowned Babbler (V TSC Act) nesting in them. Many declining species identified by Reid (1999) that were identified on site had their natural area of occupancy increased.

Alkane has honoured its environmental commitments with the Tomingley Gold Project (50 kilometres south of Dubbo) which received Major Project Approval in 2012. The same DZP project team (R.W. Corkery and Co and OzArk Environmental & Heritage Management) facilitated environmental project approvals where:

- The Proposal was assessed by NSW DP&I under the Part 3A, SSD or SSI provisions of the EP&A Act.
- The NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects Approved by the Chief Executive Officer 25 June 2011, was used to facilitate environmental offsetting.
- Biobanking Assessment Methodology (2008) was used to transparently quantify the nature and extent of offsets required the BOA for impacts within the Application Area (the BBAM 'Development Site').

The BOA Management Plan was a condition of consent for project approvals and the parcel of land required to offset was secured under an in perpetuity conservation agreement.

30 hectares of offset plantings were sown even before major earthworks commenced on site. The environment team at Tomingley Gold Operations will ensure that existing remnant vegetation is enhanced through additional plantings and maintenance of weeds and feral animals. Hundreds of hectares of land, infested with African Boxthorn, have been de-stocked and rehabilitated in 2013.

Alkane is confident that in-house corporate knowledge and commitment to leading practice natural resource management will ensure that the Dubbo Zirconia Project reaches its potential as a long-life mining/mineral processing project encompassing components of agriculture, biodiversity and cultural heritage conservation.

8.4.8 Net present value (adjusted hectares)

The calculation of the *net present value* is a form of discounting that incorporates the *annual probability of extinction* and the relevant time horizons (*time over which loss is averted* and *time until ecological benefit*). It is used to reflect the fact that a given benefit (i.e. improving habitat quality or averting loss) today holds more value for a protected matter than the same benefit realised in the future. Discounting is an important component, as it allows impacts and benefits at different times to be compared using equivalent units.

The discount factor used in the guide is the *annual probability of extinction* for specific listed threatened species categories. Discounting by this factor adjusted the value of the future benefit according to the likelihood that the protected matter will be extant at the time that the main benefit of the proposed offset becomes available.

8.4.9 Effectiveness of Offsets

The BBAM and BioBanking calculator was used to develop the effectiveness of NSW offsetting (**Section 8.3, Appendix 8**). Attainment of a 'maintain or improve' is achievable as OEH offset

requirements can be achieved for affected threatened biota to a Tier 1, 2 and Tier 3 outcome, however 'Variation of the Offset Rules' was used to negotiate a deficit of credits associated with CW213 Derived Grasslands (>50% weeds, rotationally cropped). It is noted that after the initial assessment in 2012 the majority of CW213 Derived Grasslands (>50% weeds, rotationally cropped) was returned to cropping by winter 2012. These areas were still included in offsetting calculations as a 'community' requiring offsetting for transparency as cropped areas have potential to return to the initially described community when left fallow again.

The EPBC publication "*How to use the Offsets Assessment Guide*" was used to populate the Offsets Assessment Guide Credit Calculator (October 2012). Details of values used in the calculator have been provided in **Section 8.4.7** and a copy of the completed calculator has been provided in **Appendix 9**.

DSEWPaC offset requirements for the Pink-tailed Worm-lizard can be met with both direct and compensatory offset.

The quantum of the impact was 31.77 hectares, the net present value of the offset is 50.39 hectares, the percentage of the impact offset is 158.6%.

The direct offset is adequate.

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