Appendix E

Impact assessments

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Significance assessments

For Threatened biodiversity listed under the *Threatened Species Conservation Act 1995* (TSC Act), this appendix details the heads of consideration for Threatened species assessment as suggested in the Department of Environment, Climate Change and Water/Department of Primary Industries draft *Guidelines for Threatened Species Assessment* (Department of Environment and Conservation 2005b). The guidelines present methods to consider the impacts on biodiversity of Projects assessed under Part 3A of the *Environmental Planning and Assessment Act 1979,* including presenting heads of consideration for determining the significance of impacts.

For Threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) significance assessment have been completed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Significant Impact Guidelines* (Department of the Environment and Heritage 2006a).

The following Threatened biodiversity have been assessed:

- Box-Gum Woodland
- Plains Grassland
- Weeping Myall Woodland
- Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River
- *Digitaria porrecta*
- *Diuris tricolor*
- *Pomaderris queenslandica*
- *Pultenaea setulosa* (EPBC Act Assessment only)
- Sloane's Froglet
- Threatened woodland birds. Assessed together as a group, including Brown Treecreeper (eastern subspecies), Hooded Robin, Black-chinned Honeyeater (eastern subspecies), Painted Honeyeater, Grey-crowned Babbler (eastern subspecies), Speckled Warbler, Diamond Firetail and Varied Sittella.
- White-browed Woodswallow
- Spotted Harrier
- Little Lorikeet
- Swift Parrot
- Square-tailed Kite
- Turquoise Parrot
- Barking Owl and Masked Owl (assessed together)
- Superb Parrot
- Regent Honeyeater
- Microchiropteran bats (hollow-dependent). Assessed together as a group, including Greater Long-eared Bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat.

- Microchiropteran bats (cave-dependent). Assessed together as a group, including Large-eared Pied Bat, Little Pied Bat, Eastern Bent-wing Bat and Eastern Cave Bat
- Spotted-tailed Quoll
- Squirrel Glider
- Koala
- Border Thick-tailed Gecko.

E1. Box-Gum Woodland

White Box-Yellow Box-Blakely's-Red Gum grassy woodlands and derived native grasslands is an ecological community listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and White Box Yellow Box Blakely's Red Gum woodland has been listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995.* Several vegetation communities that occur within the Project boundary have been identified as being commensurate with both the federal and state listing of Box-gum woodlands and would be directly affected by the proposed mine expansion and rail corridor. These include the following:

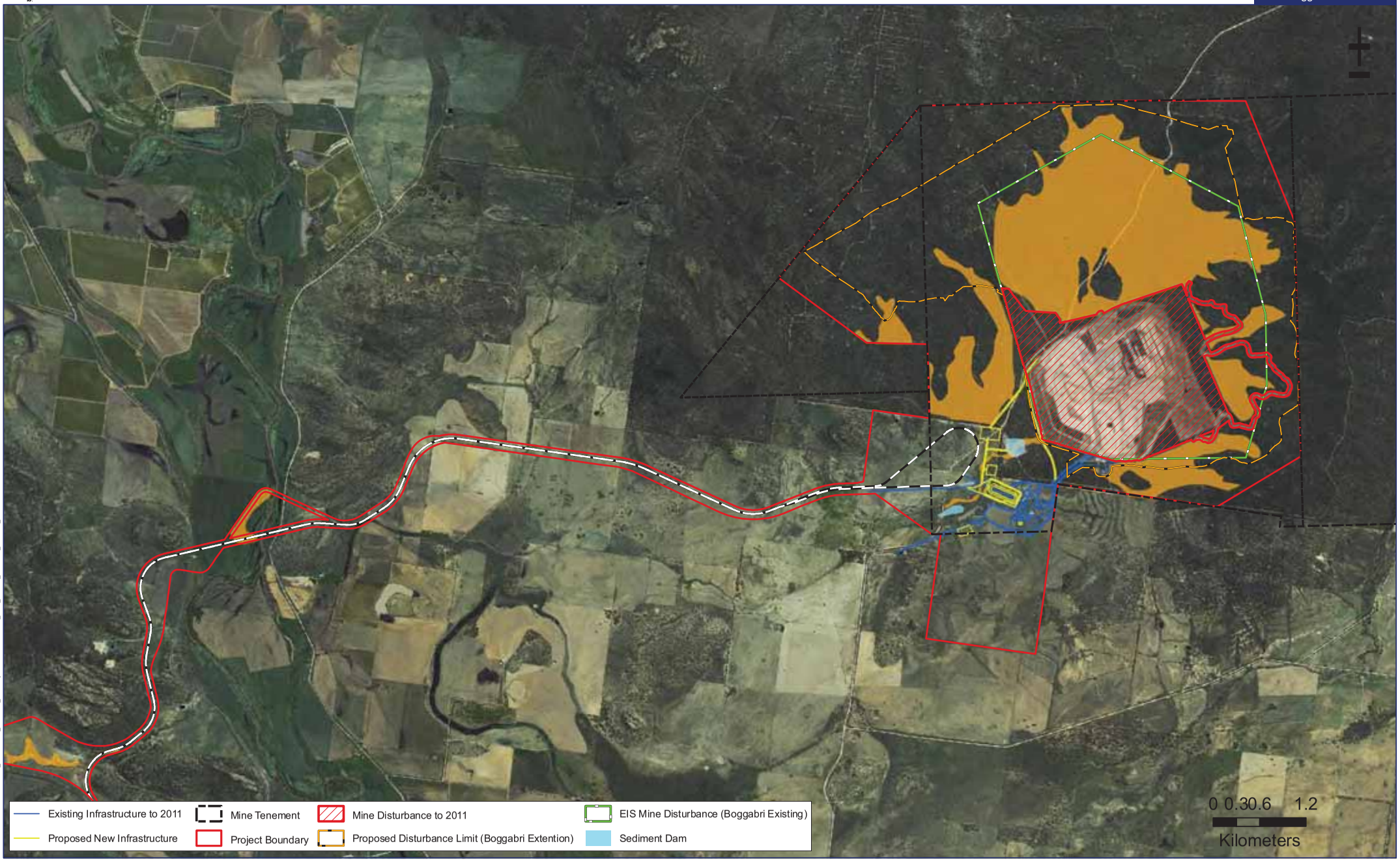
1. Yellow box –Blakely's Red gum grassy woodland
2. White box – White Cypress Pine grassy woodland
3. White box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest.

The above communities have been discussed in further detail in Section 4.1 of the Ecological Assessment Report.

This community occurs along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW to central Victoria (Threatened Species Scientific Committee 2006). The community is generally found on moderate to highly fertile soils on tablelands and the western slopes of NSW (NSW Scientific Committee 2002). This community canopy layer is dominated by one or more of *Eucalyptus albens* (White Box) *E. melliodora* (Yellow Box) and *E. blakeyi* (Blakey's Red Gum). Vegetation communities where the canopy layer of the aforementioned eucalypts has been removed and the grassy native understorey is present are also considered to be included as the Threatened community in both the federal and state listings. Therefore the structure of this community can be variable from grassy woodland to derived grasslands and the structure will often be a result of past land use practices. In western NSW the community intergrades with *Eucalyptus microcarpa* (Western Grey Box) or *Eucalyptus moluccana* (Grey Box) without the three aforementioned canopy trees present. The federal listing includes these vegetation assemblages as part of the Critically Endangered Community, where they occur within the Nandewar Bioregion only. The dominant understorey species of herbs and grasses vary across the range of the community due to latitudinal and climatic conditions. However, *Themeda australis* (Kangaroo Grass) and *Poa sieberiana* (Snow Grass) were originally dominant across a large part of the community's range, but these species are sensitive to grazing pressure and have declined in recent years (Cole & Lunt 2005).

E1.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The following assessment has been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment and Heritage 2006a) and is related to those remnants of the ecological community as defined by the *EPBC Act Policy Statement - White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived native grasslands* (Department of Environment and Heritage 2006) and the Commonwealth Threatened Species Scientific Committee (Department of Environment and Heritage 2004).



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Identified Vegetation Communites within study area

White Box -Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Glassland (CEEC)

Figure E1 - Box-gum Woodlands

An action is likely to have a significant impact on a community if there is a real chance or possibility that it will result in one or more of the following:

Reduce the extent of an ecological community

The Project would result in a reduction of the extent of the Box-gum Woodlands within the Project boundary.

Approximately 623.6 ha of the community would be cleared as a result of the Project for the mine expansion and the rail corridor. Approximately 3,214 ha of vegetation potentially characteristic of this community have been previously mapped within the Leard State Forest (James B. Croft and Associates 1983). Therefore 19 % of this community within the Leard State Forest will be removed as part of the Project.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

Box-gum Woodlands are already fragmented in the Project locality and in the wider region as a result of past land uses which include, grazing and other agricultural practices.

The Leard State Forest contains large areas of Box-gum Woodlands which adjoins larger areas of native vegetation which cover an area of over 8,000 ha. This area includes the Leard National Park located to the north west of the Project boundary. The area to be removed is located at the southern portion of the Project boundary and whilst it will reduce the area of this community it will not completely isolate the community from other areas of Box-gum Woodlands. An area of continuous vegetation extends from the south east through to the North West to Leard National Park. This connectivity will maintain important linkages for both flora and fauna and allow fauna movement and genetic exchange. This will maintain ecosystem function to other areas of Leard State Forest.

The proposed rail corridor will remove a small area of low condition Box-Gum Woodlands in the south west of the Project boundary, which occurs outside the Leard State Forest. While this area is small, these small patches are however important in maintaining linkages across modified landscapes for fauna movement and genetic exchange (for both fauna and flora) (Gibbons & Boak 2002). The removal of this area would increase the distance between patches of the ecological community at a landscape scale, thereby increasing fragmentation of the ecological community. The *EPBC Act Policy Statement on White Box Yellow Box Blakely's Red Gum Woodland* (Department of the Environment and Heritage 2006c) indicates that at distances smaller than 75 m, separated vegetation can be considered as part of a single patch. The proposed rail corridor is estimated to be 50 m and currently this community is fragmented by an existing haul road. Therefore the Project is unlikely to increase the barrier effect for some species in the rail corridor area however the project may isolate remaining remnant vegetation on either side of the rail/road corridor.

Adversely affect habitat critical to the survival of an ecological community

No critical habitat has been listed for the Box-gum Woodlands ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment and Heritage 2006d).

Habitat critical to the survival of an ecological community may, however, also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The extent of the ecological community that would be cleared as a result of the Project does not represent habitat critical to the survival of the ecological community, however it is important.

The Project will remove 623.6 ha of Box-gum Woodlands within the Leard State Forest. Previously 3,214 ha of this community has been mapped within the Leard State Forest. Therefore 19 % of this community within the Leard State Forest will be removed as part of the Project. The area to be removed contains a high understorey diversity of native species, with minor disturbances from feral animals and past logging uses. Thus the area to be removed contains a valuable source of genetic diversity for this community, both in terms of flora and fauna that inhabit this ecosystem.

The majority of the remaining areas of the community both at a state and national level, are highly degraded and fragmented primarily from past land uses such as grazing, clearing, pasture improvement, weed invasion and inappropriate fire regimes, therefore such a large area of relatively intact vegetation it is considered to be important to the survival of this community. Whilst it is unlikely that this area is critical to the survival of this community it must be considered to be of significance due to the large size of the remnant.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

The Project would not modify or adversely affect abiotic factors necessary for the survival of Box-gum Woodlands within the Project boundary. Soil would be disturbed in the construction footprint, however the extent of this area is not essential for the survival of this community.

The Project would result in some localised modification to surface water hydrology, however not to an extent that would affect the survival of the ecological community. These impacts include a potential increase sediment and water runoff from the proposed rail corridor and proposed open cut mine extension. In addition to these there is the potential for oil spills to occur both along the rail corridor and within the proposed mine extension, which will adjoin existing areas of Box-gum Woodlands. These adjoining areas may be impacted upon by these indirect effects, however sediment and control measures and oil spill mitigation measures will be implemented as part of the mine's operation and environmental management plans. The changes to the surface water hydrology would not result in significant changes to the groundwater recharge, nor is the ecological community considered a groundwater dependant ecosystem. Therefore these potential impacts are considered to be minor and that they would affect the survival of this community.

Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of to date functionally important species for example through regular burning or flora or fauna harvesting?

Past logging activities have modified the shrublayer composition and density and numerous unformed tracks have been constructed throughout this community in the Project boundary. Along the unformed road this community has been subject to earthworks involved in regrading the unformed tracks and small areas of clearing for drainage. These minor earthworks have resulted in some pasture weed incursions along the edges of the roads. Feral animals such as pigs and hares are common throughout the Leard State Forest and soil disturbance and herbivory of native plants is occurring throughout this community.

The removal of 623.6 ha of this community may introduce edge effects from the mine operations into remaining areas of intact vegetation. Currently a flora and fauna monitoring program has been implemented and is proposed for the expansion of the mine, and this program will monitor any ongoing mine impacts within the remaining areas of the Leard State Forest. The results have recorded decreases in Invertebrate and Microbat diversity, however these were likely to be a result of natural seasonal variation rather than any adverse affects from the mining operations. The conclusions from the monitoring sessions completed to date (2006-2008) indicate that Leard State Forest remains in a relatively similar condition following the commencement of coal mining by the Boggabri Coal Project (Parsons Brinckerhoff 2008).

The Box-gum Woodlands within the proposed rail corridor within the south west of the Project boundary is characterised by a dominance of native grasses but has minor pasture weed invasion as a result of past land-uses, and edge effects from the adjoining vegetation assemblages. Edge effects from the existing haul road are currently having a small impact with minor pasture weed incursions occurring where the community adjoins the haul road alignment. The proposed rail corridor will not substantially change the species composition but it will widen the existing corridor through the community.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The expansion of the open cut coal mine within Leard State Forest will introduce edge effects into new areas where the mine adjoins Box-gum Woodlands in the retained areas of Leard State Forest. It is unlikely that the Project will assist invasive species, more than is occurring already from the current mining and recreation activities. The Project may introduce invasive weeds into new areas it is likely to amplify the conditions that are already modifying the community within the Project boundary. This is due to the mine expansion and thus an increase area of edge effects. However, to help mitigate these impacts an ongoing monitoring program has been implemented to ensure that any further impacts into the retained areas of Leard State Forest from the proposed expansion of open cut operations are detected in the future life of the mine.

In the proposed rail corridor in the south west of the Project boundary adjoining the existing haul road corridor, the Box-gum Woodlands have been subject to earthworks (during construction of the road and clearing of the drains), herbicides from roadside weed control and establishment of pasture improvement species. While the rail corridor is unlikely to introduce new adverse impacts, it is likely to widen the linear corridor and

possibly amplify the existing pasture weed incursions that are already occurring where the haul road adjoins existing areas of Box-gum Woodlands.

Will the action interfere with the recovery of an ecological community

The removal of 623.6 ha of this community is unlikely to interfere with the recovery of the community given the extent of clearing in relation to the broader extent at a national level. However at the state and local scale, such a large area of relatively undisturbed community does contain important species such as those that are grazing sensitive and may function as an important source of species for the wider area.

Conclusions

The proposed mine expansion would result in the reduction in the extent of Box-gum Woodlands. Based the above assessment, within the local area and wider region this community has been extensively cleared in the past and the loss of a further a large area of 623.6 ha would be significant.

E1.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

White Box Yellow Box Blakely's Red Gum Woodland is an Endangered Ecological Community listed under the *Threatened Species Conservation Act 1995* that occurs in the Project boundary and would be directly affected by the proposed mine expansion and rail corridor.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

The Project would result in a reduction of the overall extent of Box-gum Woodland within the Project boundary. A further area maybe effected by indirect edge effects into the surrounding native vegetation of the proposed mine extension.

Approximately 623.6 ha of this community would be cleared in the Project boundary as a result of the Project (Figure E1) for the mine expansion and the rail corridor. Approximately 3,214 ha of this community have been previously mapped within the Leard State Forest (James B. Croft and Associates 1983). Therefore 19 % of this community within the Leard State Forest will be removed as part of the Project.

How is the Project likely to affect current disturbance regimes?

The Box-gum Woodland within Leard State Forest has been subjected past land uses such as logging, disturbance from unformed tracks and feral animal invasion. The only weeds that are present within the Leard State Forest are located along the unformed roads which criss cross through the vegetation communities. The noxious weeds of *Opuntia stricta* (Prickly Pear) and *Opuntia aurantiaca* (Tiger Pear) were present in minor occurrences throughout the Box-gum Woodlands within the Leard State Forest. The Box-gum Woodlands which occur outside of the Leard State Forest have been subjected to fragmentation as a result of past land uses that include, grazing and other agricultural practices.

The removal of 623.6 ha of this community may introduce edge effects from the proposed increase in size of the proposed extension to the open cut mine operations into remaining areas of intact vegetation. Currently a flora and fauna monitoring program has been implemented and is proposed to be continued for the expansion of the mine. This

program monitors whether any impacts from the mine operations are affecting the remaining areas of Leard State Forest. The results have recorded decreases in Invertebrate and Microbat diversity, however these were likely to be a result of natural seasonal variation rather than any adverse affects from the mining operations. The conclusions from the monitoring sessions completed to date (2006-2008) indicate that Leard State Forest remains in a relatively similar condition following the commencement of coal mining by the Boggabri Coal Project (Parsons Brinckerhoff 2008). Whilst, the mine may introduce further disturbance regimes into other sections of this community within the Leard State Forest it is unlikely to amplify the conditions that are already modifying the community within the Project boundary.

In the proposed rail corridor in the south west of the Project boundary adjoining the existing haul road corridor, the Box-gum Woodlands have been subject to earthworks (during construction of the road and clearing of the drains), herbicides from roadside weed control and establishment of pasture improvement species. While the rail corridor is unlikely to introduce new adverse impacts, it is will widen the linear corridor and possibly amplify the existing pasture weed incursions, and other associated impacts from the haul road that are already occurring where the haul road adjoins existing areas of Box-gum Woodlands.

How is the Project likely to affect habitat connectivity?

Box-gum Woodlands is highly fragmented across its former extent, however the Leard State Forest contains large areas of Box-gum Woodlands which adjoins larger areas of native vegetation which cover an area of over 8,000 ha. This area includes the Leard National Park located to the north west of the Project boundary. The area to be removed is located at the southern portion of the Project boundary and whilst it will reduce the area of this community it will not completely isolate the community from other areas of Box-gum Woodlands. An area of the continuous vegetation extends from the south east through to the North west to Leard National Park. This connectivity will maintain important linkages for both flora and fauna and allow fauna movement and genetic exchange. This will maintain ecosystem function to other areas of Leard State Forest.

The proposed rail corridor will remove a small area of degraded Box-gum Woodlands within the south west of the Project boundary, which occurs outside the Leard State Forest. This area is small and these small patches are however important in maintaining linkages across modified landscapes for fauna movement and genetic exchange (for both fauna and flora) (Gibbons & Boak 2002). The removal of this area would however increase the distance between patches of the ecological community at a landscape scale, thereby increasing fragmentation of the ecological community. The *EPBC Act Policy Statement on White Box Yellow Box Blakely's Red Gum Woodland* (Threatened Species Scientific Committee 2006) indicates that at distances smaller than 75 m, separated vegetation can be considered as part of a single patch. The proposed rail corridor is estimated to be 30 m and currently this community is fragmented by an existing haul road. Therefore the Project is likely to increase the barrier effect for some species in the rail corridor area and may effectively isolate remaining vegetation on either side of the rail/road corridor.

How is the Project likely to affect critical habitat?

The Department of Environment and Conservation maintains a register of critical habitat. While the land within the Project boundary is not listed as a critical habitat and it is not considered critical to the survival of Box-gum Woodlands, it is however important.

The Project will remove 623.6 ha of Box-gum Woodlands within the Leard State Forest. Previously 3,214 ha of this community has been mapped within the Leard State Forest. Therefore 19 % of this community within the Leard State Forest will be removed as part of the Project. The area to be removed contains a high understorey biodiversity of natives, with minor disturbances from feral animals and past logging uses. Thus the area to be removed contains a large source of genetic diversity for this community, in both terms of flora and fauna which inhabit this ecosystem. In addition the majority of the remaining areas of the community both at a regional and state level are highly degraded and fragmented primarily from past land uses such as grazing, clearing, pasture improvement, weed invasion and inappropriate fire regimes (Department of Environment and Heritage 2004), therefore such a large area of relatively intact community it is considered to be important to the survival of this community. Whilst it is unlikely that this area is critical to the survival of this community it must be considered to be of significance due to the large size of the community.

Conclusion

The proposed mine expansion would result in the reduction in the extent of Box-gum Woodlands. Within the local area and wider region this community has been extensively cleared in the past and the loss of a further a large area of 623.6 ha would be significant.

E2. Plains Grassland

The Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland is listed as a Critically Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999* and the Native vegetation on cracking clay soils of the Liverpool Plains is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.

This community occurs from the Darling Downs in Queensland to Dubbo in NSW and includes the Liverpool and Moree Plains. This community has a strong affiliation with the soil type and occurs on fine textured often cracking clays derived from either basalt or quaternary alluvium, on flat to very low slopes (Department of Environment Water Heritage and the Arts 2008b). In NSW these include the Mooki River, Coxs Creek and their tributaries which drain into the Namoi Catchment (NSW Scientific Committee 2001a). The floristic structure is that of native Grassland, with a canopy of less than 10% projective foliage cover. The community is dominated by *Austrostipa aristiglumis,* with other native grasses such as *Dichanthium sericeum, Panicum queenslandicum* and *Aristida leptopoda* are often present as co-dominants.

The original extent and floristic composition of plains grassland has been the subject of a recent study by (Lang R. D. 2008). This study found that the treeless nature of the community was attributed to a mixture of fine-textured soil, climate and topography restricting water availability. The distribution of the grasslands has been mapped to Old Warrah in the south-east, to Boggabri in the North and to Goolhi in the west. Review of historical records found that the dominance *Austrostipa aristiglumis* could possibly be a result of agricultural practices and that the original areas of grasslands before European settlement could have been dominated by grasses such as *Eulalia aurea, Astrebla lappacea* and *Themeda avenacea* (Lang R. D. 2008). If agriculture techniques are altered to mimic kangaroo grazing these three aforementioned native grass species become dominant over *Austrostipa aristiglumis*. This finding could have implications for further management of this community.

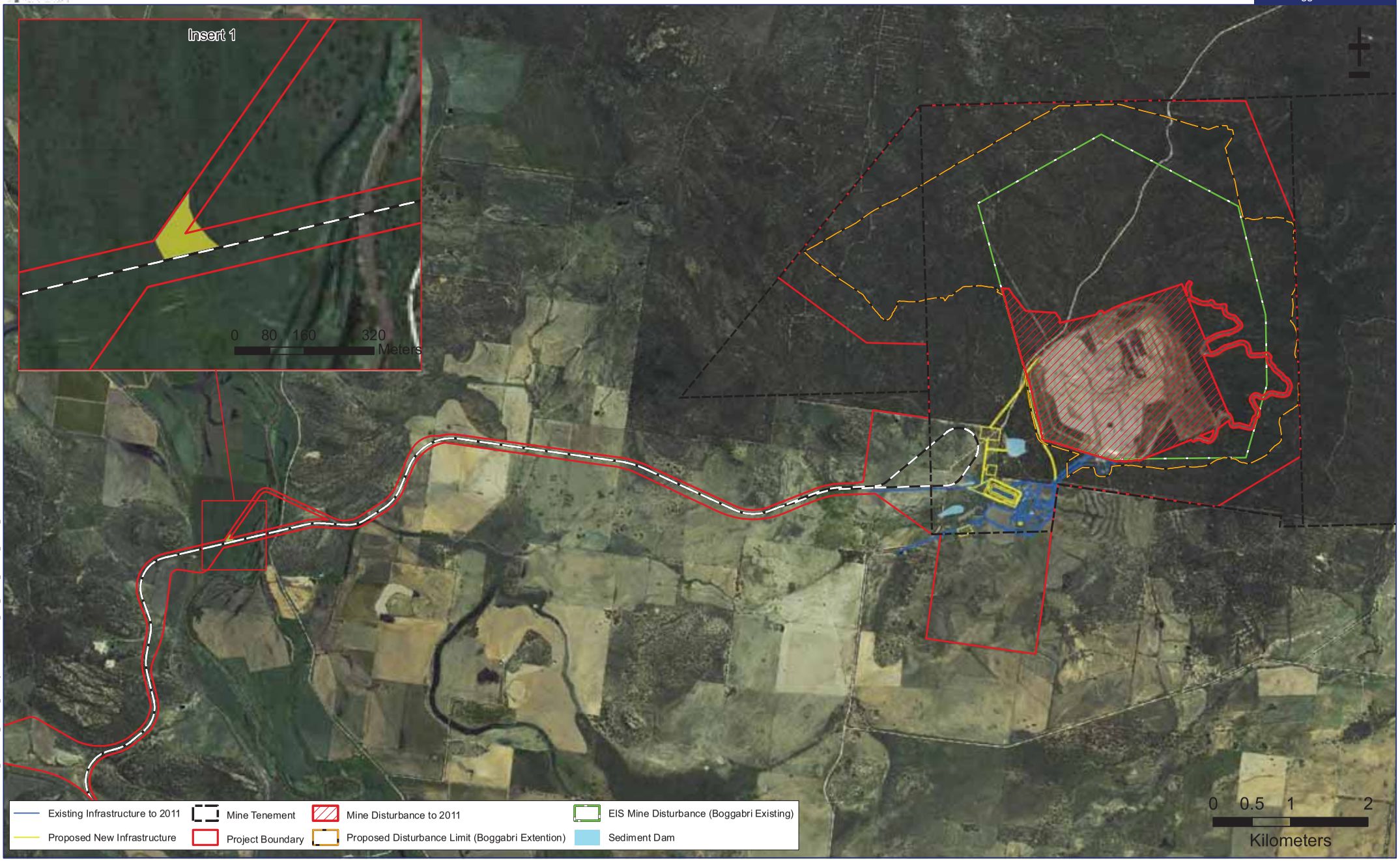
Within the Project boundary this community has been identified as Plains Grassland and occurs on the alluvial floodplains of the Namoi River, along the existing Haul Road.

E2.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland is listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the Act, an action is likely to have a significant impact on a critically Endangered Ecological Community if there is a real chance or possibility that it will:

Reduce the extent of an ecological community?

Approximately 0.4 ha of plains grassland would be affected by the Project (Figure E2) therefore the action will reduce the extent of this community.



Identified Vegetation Communites within study area

Plains Grassland

Figure E2- Plains Grassland

The plains grassland on the Project boundary is part of a larger area of plains grassland of approximately 15 ha, which has been mapped to the north and south. Furthermore, approximately 25,000 ha of this critically Endangered Ecological Community has been mapped within the Liverpool and Moree Plains (Carter *et al.* 2003), and the removal of 0.4 ha within the Project boundary will equate to 0.0016 % of plains grassland within the region.

Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?

The majority of the patches of this community within the Liverpool Plains are estimated to be less than 100 ha and this is likely to be due to land clearing since European settlement (Department of Environment Water Heritage and the Arts 2008b).

The Project would involve the removal of approximately 0.4 ha of this community for a proposed rail corridor. The existing community is currently fragmented by an existing haul road that separates the community by approximately 50 m, the Project will further widen this linear corridor by another 30 m for the proposed rail corridor. The Project may increase the barrier effect for some component species, due to the widening of the existing corridor.

Will the action adversely affect habitat critical to the survival of an ecological community?

No critical habitat is listed for this critically Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 0.4 ha of this critically endangered community. However, the area to be removed is small this equates to 0.0016% being removed within the wider Liverpool and Moree plains region.

Therefore, habitat in the Project boundary is not considered critical to the survival of the critically Endangered Ecological Community.

Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?

The Project would not modify or adversely affect abiotic factors necessary for the survival of plains grassland within the Project boundary. Soil would be disturbed in the construction footprint, however the extent of this area is not essential for the survival of the ecological community.

Plains grassland is located on the lower lying plains and this community is considered to be associated with shallow perched water tables over impermeable clay lenses rather

than groundwater fed by subsurface aquifers (Parsons Brinckerhoff, 2009a). Therefore this community has been classed as having some proportional dependence upon groundwater. The Project would require the excavation and shaping of the upper soil profile and minor alterations to the existing surface water drainage however is unlikely to require groundwater extraction or significant impacts on the existing subsurface aquifers and their associated groundwater dependent ecosystems. Therefore it is unlikely that the project will modify the groundwater levels such to an extent to effect this community's survival.

The Project would result in some localised modification to surface water hydrology, however not to an extent that would affect the survival of the ecological community. These impacts include a potential increase sediment and water runoff from the proposed rail corridor and the potential for oil spills. Therefore it is considered that there is potential for the project to modify abiotic factors; however the modifications are not considered unlikely to be of a significant impact that they would affect the survival of this community.

Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species for example through regular burning or flora or fauna harvesting?

The Project is not likely to cause a substantial change in the species composition of the plains grassland within the Project boundary. The Plains Grassland within the Project boundary is characterised by a dominance of native grasses but has minor pasture weed invasion as a result of past land-uses, and edge effects from the adjoining exotic grasslands. Edge effects from the existing haul road are currently having a small impact with minor pasture weed incursions occurring where the community adjoins the haul road alignment. The proposed rail corridor will not substantially change the species composition but it will widen the existing corridor through the community.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the ecological community, to become established; or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?**

The Plains Grassland has been subjected to numerous past land use activities including vegetation clearing, grazing, and pasture improvement. Therefore, it is highly unlikely that the plains grassland within the Project boundary is in the pre-european condition. However, in saying this it is likely that very few examples of this community remain relatively intact throughout its range. Within the existing haul road corridor the plains grasslands have been subjected to earthworks (during construction of the road and clearing of the drains), herbicides from roadside weed control and establishment of pasture improvement species.

The construction and operation of the Project may amplify the conditions that have resulted in the modification of the community as the extension and widening of the linear corridor.

Will the action interfere with the recovery of the ecological community?

The removal of 0.4 ha is unlikely to interfere with the recovery of the community given the extent of clearing in relation to the broader extent within the region. However at the local scale, small patches of plains grassland vegetation do contain important species such as those that are grazing sensitive and may function as an important source of species for the wider area.

Conclusion

The proposed rail corridor would remove approximately 0.4 ha of this community. However, given that over 25,000 ha (Carter *et al.* 2003) have been mapped within the within the Moree and Liverpool Plains region, the Project is not likely to have a significant impact on this community.

E2.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

The Project will remove a linear strip of approximately 0.4 ha, and widen the existing fragmentation of this community. Approximately 15 ha of this community occur along the floodplains of the Namoi River to the north and south of the Project. The removal of approximately 0.4 ha of plains grassland would not significantly affect the habitat and ecosystem function of this community occurring along the Namoi River and its' floodplain in the locality.

How is the Project likely to affect current disturbance regimes?

The proposed rail corridor will cross the Namoi River and its floodplain. The Namoi River currently exhibits disturbance regimes associated with the surrounding agricultural landscape including riparian vegetation clearance, erosion/ sedimentation and bank instability due to stock access. The plains grasslands community has small weed invasion along the edges with the exotic grassland community and from the existing haul road. The Project is likely to introduce edge effects into new areas, due to the rail alignment construction further to the north of the existing haul road. If weed management practices and sediment control measures are implemented post construction then these edge effects have the potential to be minimised.

How is the Project likely to affect habitat connectivity?

The Project would involve the removal of approximately 0.4 ha of this community. The majority of this impact would occur as a linear strip and while the construction of the Project is likely widen the already fragmented community, by an additional 30 m and the Project may increase the barrier effect for some component species, due to the widening of the existing corridor. Approximately 15 ha of this community occurs to the north and south of the proposed rail corridor and 25,000 ha has been mapped within the Liverpool and Moree Plains (Carter *et al.* 2003).

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this community.

While the Project would affect approximately 0.4 ha of this community, however 15 ha of this community have been mapped to the north and south of the Project boundary. Therefore, it is not likely that this community would be affected by the Project.

Conclusion

Approximately 0.4 ha of plains grassland has been mapped within the Project boundary. The proposed rail corridor would remove approximately 0.4 ha of this community. However, given that approximately 15 ha have been mapped within the locality and 25,000 ha within the region, the Project is not likely to have a significant impact on this community.

E3. Weeping Myall Woodlands

Weeping Myall Woodlands is listed as an Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999* and the Myall Woodland in the Darling Riverine Plain, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW south western slopes Bioregions is listed as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.

This ecological community occurs from the Western Plains on the NSW-Victorian border into southern Queensland and currently occurs as isolated pockets of small remnant stands throughout this range. Typically, the ecological community occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland (Department of Environment Water Heritage and the Arts 2008c). Weeping Myall generally occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving average rainfall of between 375 and 500 mm. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history (NSW Scientific Committee 2005). *Acacia pendula* is the dominant overstorey species, with the understorey containing an open layer of chenopod shrubs and other wood species. The groundlayer is open to continuous cover of grasses and herbs (NSW Scientific Committee 2005).

Threats to this community include, clearing, fragmentation, modification, heavy grazing, lopping, invasive plant species, herbivory by the caterpillar *Ochrogaster lunifer* (Bag-shelter moth), fertiliser and herbicide application and loss of fauna from the ecological community (Department of the Environment Water Heritage and the Arts 2009).

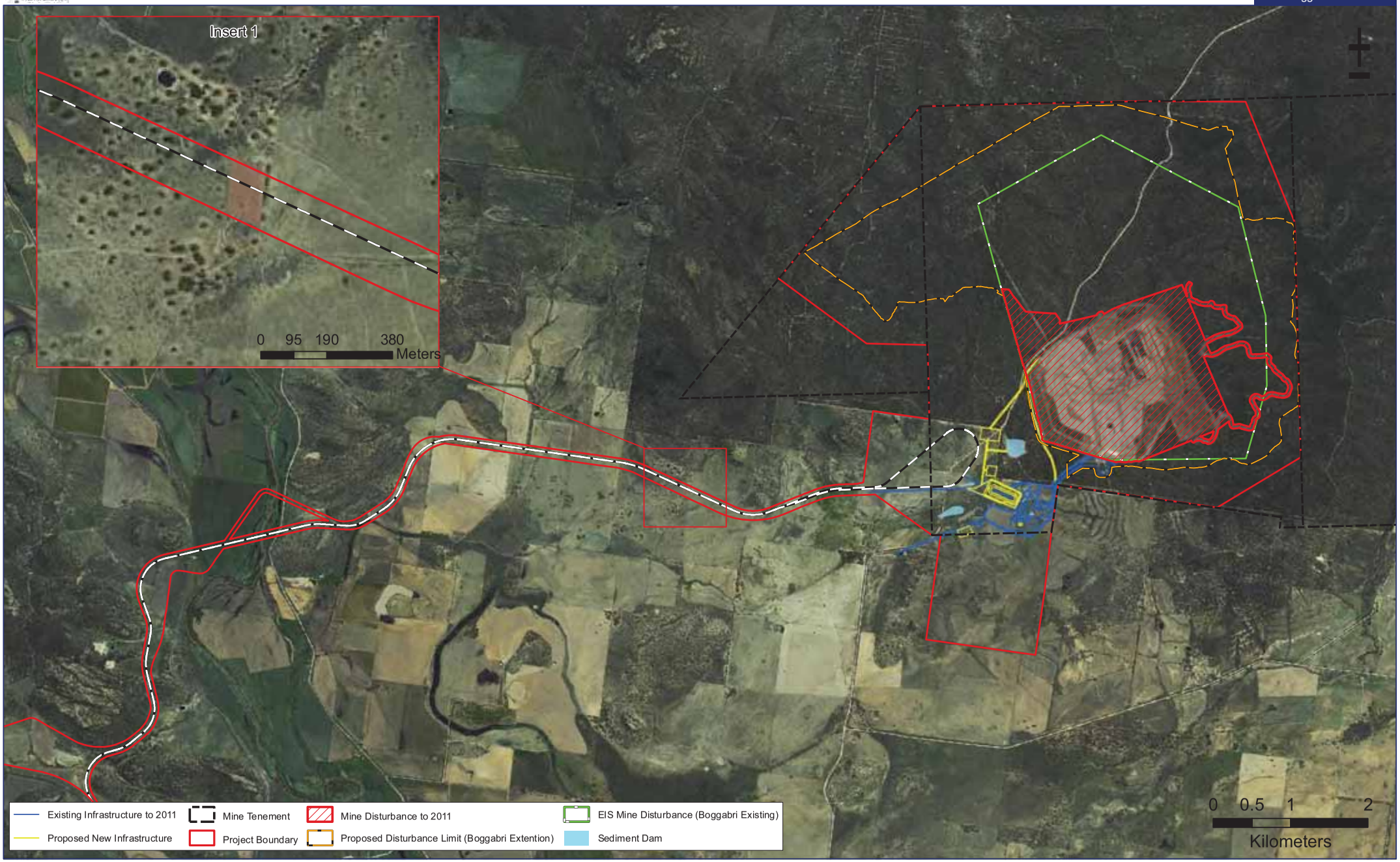
Within the Project boundary both the state and federal listings are commensurate with the vegetation community identified as Weeping Myall grassy open woodland. This community occurs in one area on the floodplains of the Namoi River, along the existing Haul Road. Assessments under both state and federal legislation been undertaken for the vegetation mapped as Weeping Myall grassy open woodland in the following two sections.

E3.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Weeping Myall Woodlands is listed as an Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the Act, an action is likely to have a significant impact on a Endangered Ecological Community if there is a real chance or possibility that it will:

Reduce the extent of an ecological community?

Approximately 1.7 ha of Weeping Myall Woodland has been recorded within the Project boundary and 0.3 ha would be affected by the Project (Figure E3) therefore the action will reduce the extent of this Endangered Ecological Community. In the locality to the north of Boggabri there is a relatively large stand of approximately 35 ha mapped (Department of Land and Water Conservation 2002).



Identified Vegetation Communites within study area

Weeping Myall grassy open woodland

Figure E3 - Weeping Myall Woodlands

Furthermore, within NSW it has been estimated that over 190,000 ha of this Endangered Ecological Community occurs (Department of Environment Water Heritage and the Arts 2008c).

Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?

The existing community occurs in a small patch in the south west of the Project boundary along the existing haul road. The current haul road occurs along the southern extent of the community and the rail corridor is proposed to be constructed adjoining the haul road, and will remove a further 0.3 ha at the southern extent. The current linear corridor is approximately 50 m in width and the proposal will further widen this linear corridor by another 30 m. The Project may increase the barrier effect for some component species, due to the widening of the existing corridor.

Will the action adversely affect habitat critical to the survival of an ecological community?

No critical habitat is listed for this Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 0.3 ha of this endangered community. However, the area to be removed is small and equates to 0.9 % being removed within the Boggabri locality and 0.0002 % within the wider region of NSW.

Therefore, habitat in the Project boundary is not considered critical to the survival of the Endangered Ecological Community.

Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?

The Project would not modify or adversely affect abiotic factors necessary for the survival of Myall Woodlands within the Project boundary. Soil would be disturbed in the construction footprint, however the extent of this area is not essential for the survival of the ecological community.

The Project would result in some localised modification to surface water hydrology, however not to an extent that would affect the survival of the ecological community. These impacts include a potential increase sediment and water runoff from the proposed rail corridor and the potential for oil spills. The changes to the surface water hydrology would not result in significant changes to the groundwater recharge, nor is the ecological community considered a groundwater dependant ecosystem. Therefore it is considered that there is potential for the project to modify abiotic factors; however the modifications

are not considered unlikely to be of a significant impact that they would affect the survival of this Endangered Ecological Community.

Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species for example through regular burning or flora or fauna harvesting?

The Project is not likely to cause a substantial change in the species composition of the Myall Woodlands within the Project boundary. The Myall Woodlands within the Project boundary is in poor condition with a moderate native species diversity and weed density. This vegetation community has been subjected past several land uses which include grazing and agricultural practices which have resulted in significant loss of native biodiversity. Edge effects from the existing haul road are currently having a small impact with pasture weed incursions occurring where the community adjoins the haul road alignment. The proposed rail corridor will not substantially change the species composition but it will increase the existing corridor through the community.

Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the ecological community, to become established; or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?**

The community has been subjected to past land activities including vegetation clearing, grazing, and pasture improvement, all of which have reduced and/or modified the species diversity. Sheep grazing is currently occurring within the Myall Woodlands.

Within the existing haul road corridor the Weeping Myall Woodlands have been subject to earthworks (during construction of the road and clearing of the drains), herbicides from roadside weed control and establishment of pasture improvement species. The construction and operation of the Project may amplify the conditions that have resulted in the modification of the ecological community as the extension and widening of the linear corridor will cause these impacts to affect new patches of this Endangered Ecological Community.

Will the action interfere with the recovery of the ecological community?

The removal of 0.3 ha of this Endangered Ecological Community is unlikely to interfere with the recovery of the community given the extent of clearing in relation to the broader extent within the region. However at the local scale, small patches of Myall Woodlands vegetation do contain important species such as those that are grazing sensitive and may function as an important source of species for the wider area.

Conclusion

The proposed rail corridor would remove approximately 0.3 ha of this endangered vegetation community. However, given that over 190,000 ha have been mapped within the within the NSW region, the Project is not likely to have a significant impact on this Endangered Ecological Community.

E3.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

The Project will remove a linear strip of approximately 0.3 ha of this Endangered Ecological Community, and 17 % of the Myall Woodlands within the Project boundary. In the locality to the north of Boggabri there is a relatively large stand of over approximately 35 ha being mapped (Department of Land and Water Conservation 2002). Furthermore, within NSW it has been estimated that over 190,000 ha of this Endangered Ecological Community has been estimated to occur throughout both NSW and QLD (Department of Environment Water Heritage and the Arts 2008c). The removal of approximately 0.3 ha of Myall Woodlands would not significantly affect the habitat and ecosystem function of this community occurring with the Boggabri locality.

How is the Project likely to affect current disturbance regimes?

The Myall Woodlands within the Project boundary is in poor condition with a moderate native species diversity and weed density. This vegetation community has been subjected to past land uses that include grazing and agricultural practices, resulting in significant loss of native biodiversity. The current condition of the community has been affected by minor weed incursions where it adjoins the existing haul road.

The proposed rail corridor adjoins the existing haul road corridor and the Myall Woodlands within the Project boundary have been subject to earthworks (during construction of the road and clearing of the drains), herbicides from roadside weed control, erosion/ sedimentation and establishment of pasture improvement species. The proposed rail corridor is likely to introduce these edge effects into new areas, due to the rail alignment construction further to the north of the existing haul road. If weed management practices and sediment control measures are implemented post construction then these edge effects have the potential to be minimised.

How is the Project likely to affect habitat connectivity?

The Project would involve the removal of approximately 0.3 ha along the southern edge of this Endangered Ecological Community. The majority of this impact would occur as a linear strip and the construction of the Project is likely widen the already fragmented endangered community, by an additional 30 m. Therefore the Project may increase the barrier effect for some component species, due to the widening of the existing corridor. Therefore it is not considered to significantly affect this community anymore than that currently occurring in the locality.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this Endangered Ecological Community. The Project boundary is unlikely to be critical to the survival of the Endangered Ecological Community.

The Project would remove approximately 0.3 ha of this endangered community. However, the area to be removed is small and equates to 0.9 % being removed within

the Boggabri locality and 0.0002 % within the wider region of NSW. Therefore, it is not likely that this Endangered Ecological Community would be affected by the Project.

Conclusion

Approximately 1.7 ha of Weeping Myall Woodland has been mapped within the Project boundary. The proposed rail corridor would remove approximately 0.3 ha of this Endangered Ecological community. However, given that approximately 35 ha (Department of Land and Water Conservation 2002) have been mapped within the Boggabri locality and 190,000 ha (Department of Environment Water Heritage and the Arts 2008c) within the region, the Project is not likely to have a significant impact on this Endangered Ecological Community.

E4. Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River

The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River is listed as an Endangered Ecological Community under the *Fisheries Management Act 1994*.

The lowland catchment of the Darling River ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams, and associated lagoons, billabongs, lakes, flow diversions to anabranches, and the floodplains of the Darling River including Menindee Lakes and the Barwon River. Specifically, these areas include the main Barwon-Darling channel from Mungindi (Qld-NSW border) to the confluence with the Murray River, the arid zone intermittent intersections streams (Warrego, Culgoa, and Narran Rivers), Border Rivers (Macintyre, Severn and Dumaresq Rivers), and regulated tributaries of the Gwydir, Namoi, Macquarie, Castlereagh, and Bogan Rivers (NSW Fisheries 2003).

Several Creeks and the Namoi River within the Project Boundary fall within this broad catchment (Figure E4).

E4.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

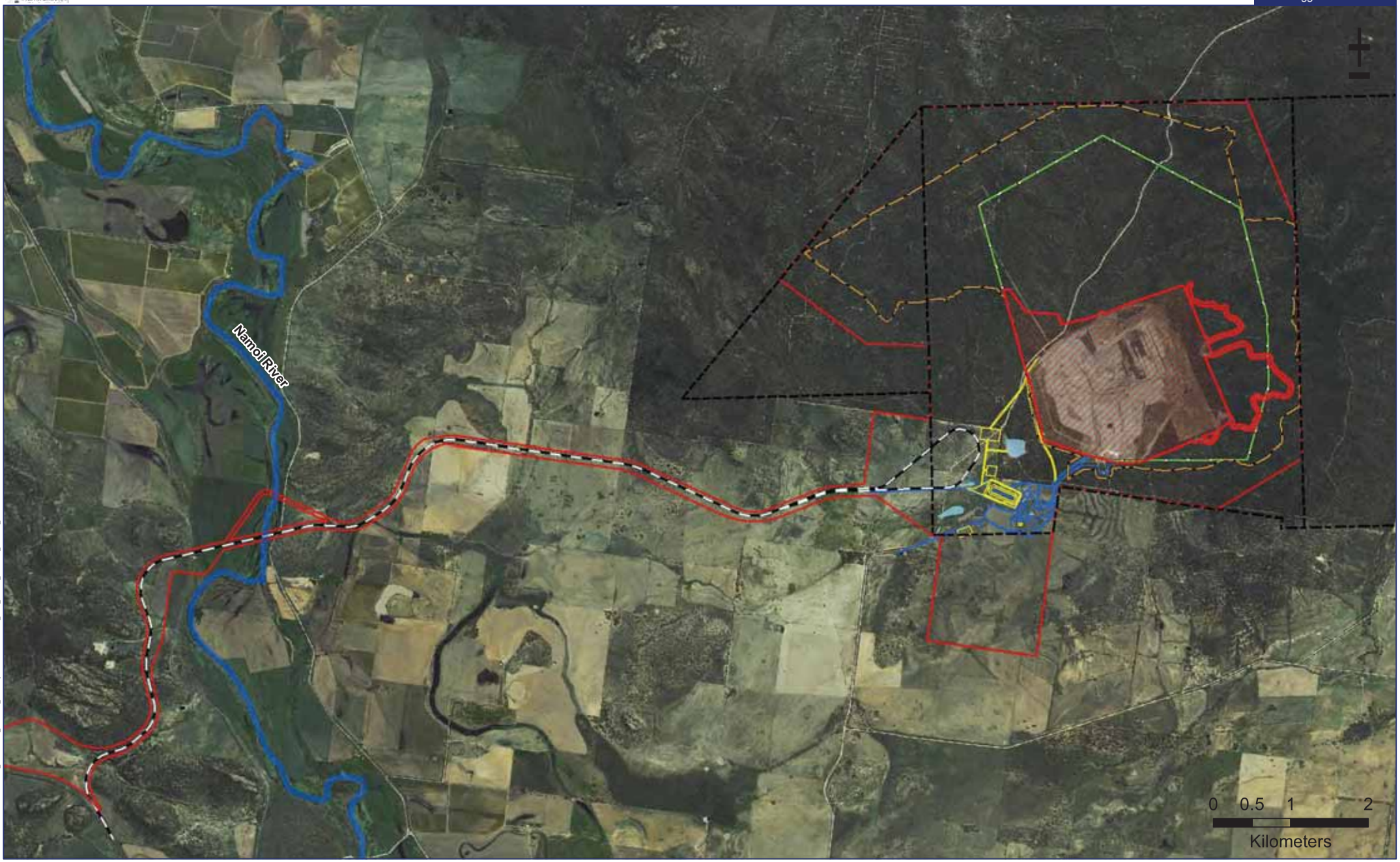
How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

The creeks and rivers within the Project Boundary and surrounding area fall within the broad catchment, and therefore, form part of this ecological community (Figure E4).

Fish and mobile invertebrate assemblages of the waterbodies sampled during this study were fairly typical of freshwater habitats within the region. Given that suitable habitat exists up and downstream of the Namoi River, no long-term impacts from the proposed waterway crossing is expected on the ecological community, if the crossings comply with NSW Fisheries guidelines (Fairfull & Witheridge 2003) and erosion and sedimentation controls are implemented in accordance with best practice management (Department of Environment and Climate Change 2008b).

How is the proposal likely to affect current disturbance regimes?

The project will add one new creek crossings, over the Namoi River, which is likely to add to the overall disturbance regimes within the Namoi River. However, the waterways within the Project boundary are currently affected by riparian vegetation clearance, erosion and sedimentation, alteration of flow and bank instability due to stock access and riparian removal. Given that suitable habitat exists up and downstream of the watercourses, no long-term impacts from the proposed waterway crossings are expected on the ecological community, if the crossings comply with NSW Fisheries guidelines (Fairfull & Witheridge 2003) and erosion and sediment controls are implemented in accordance with best practice management (Department of Environment and Climate Change 2008b).



Existing Infrastructure to 2011
Proposed New Infrastructure
Mine Tenement
Project Boundary
Mine Disturbance to 2011
Proposed Disturbance Limit (Boggabri Extention)
EIS Mine Disturbance (Boggabri Existing)
Namoi River (Habitat)
Sediment Dam

Figure E4 - Habitat for the Aquatic Ecological community in the Natural Drainage System of the Lowland Catchment of the Darling River

How is the proposal likely to affect habitat connectivity?

The waterways within the Project boundary would not become disconnected as a result of the project. However, the installation of bridges and culverts would have the potential to create barriers to fish passage. Provided that the propose waterway crossings are undertaken in accordance with NSW Fisheries guidelines (Fairfull & Witheridge 2003) it is unlikely that the project would result in any barriers to fish passage or habitat connectivity.

How is the proposal likely to affect critical habitat?

The Department of Primary Industries maintains a register of critical habitat. Water bodies within the Project boundary are generally in poor condition, are not listed as a critical habitat and are not considered critical to the survival of the ecological community.

Conclusion

The project would require minor modification of Namoi River to facilitate the construction of the Railway Bridge and that falls within the range of the Endangered Ecological Community. However, the creeks and the Namoi River do not contain unique or important assemblages of species and are in poor condition. As such the impacts on this community are not considered to be significant.

E5. *Digitaria porrecta*

Digitaria porrecta (Finger Panic Grass) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and Endangered under the *Threatened Species Conservation Act 1995*.

Digitaria porrecta is a perennial tussock forming grass which grows to 60 cm in height. This species has grey leaves which are 2-3 mm wide with sharp hairs along the middle of the leaf blade. Flowers are clustered together along a stalk in a cylinder shape (Department of Environment and Climate Change 2009). This species flowers in summer (Jan-Feb), inflorescences are exerted with racemes stiffly spreading at maturity, the lower flowers arranged whorls of four to six (Wheeler *et al.* 2002). Habitat is generally in native grassland on basaltic plains and on woodlands or open forest with a grassy understorey with underlying basaltic geology. Most frequency recorded associated with overstorey trees such as *Eucalyptus albens* and *Acacia pendula.* Common associated understorey species include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus tronum* and *Neptuna gracilis.* This species occurs on the North Western Slopes and Plains from near Moree south to Tambar Springs and from Tamworth to Coonabarabran in NSW (Department of Environment Water Heritage and the Arts 2008a). Threats include grazing, urban expansion, clearing of native habitat for cropping and pastures, destruction and disturbance of habitat for roadside maintenance, competition from introduced grasses such as *Chloris gayana* (Rhodes Grass) and *Urochloa panicoides* (Liverseed Grass) and frequent fires(Department of Environment Water Heritage and the Arts 2008a).

Habitat for *Digitaria porrecta* within the Project boundary (Figure E5) has been identified in the following vegetation communities:-

1. White box – Narrow-leaved Ironbark – White Cypress Pine grassy open forest
2. White Box – White Cypress Pine grassy woodland
3. Yellow Box – Blakely's Red Gum grassy woodland
4. Weeping Myall grassy open woodland
5. River Red Gum riparian woodlands and forests
6. White Box- Blakely's Red Gum - Melaleuca riparian forest
7. Derived native grassland
8. Plains Grassland

Targeted surveys via random meanders and plot based surveys have been undertaken throughout the abovementioned communities for this species. No individuals were identified within the Project boundary, however, several species of other *Digitaria* species were forwarded to the Royal Botanical Gardens Sydney for identification and confirmed not to be *Digitaria porrecta.*

E5.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Digitaria porrecta (Finger Panic Grass) is listed as an Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the

Environment and Heritage 2006a). Under the Act, an action is likely to have a significant impact on a endangered species if there is a real chance or possibility that it will:

Will the action lead to a long-term decrease in the size of a population of a species?

It is assumed that approximately 651.6 ha of potential habitat (Figure E5) would be affected by the Project. This species has been recorded within 20 km of the Project boundary, and despite targeted surveys during the flowering period and careful checking of other *Digitaria sp.* this species was not recorded within the Project boundary. There are large tracts of potentially suitable habitat, approximately 3507 ha (James B. Croft and Associates 1983), that occur in the remaining areas of Leard State Forest/ Leard National Park outside of the Project Boundary. Thus the project would impact upon potential habitat for this species it is unlikely to contribute to a long-term decrease in the size of a potential local population.

Will the action reduce the area of occupancy of the species?

Approximately 651.6 ha of potential habitat for this species would be affected by the Project. While this species was not recorded in the Project boundary during recent field surveys, there is currently 3507 ha of potential habitat within the Leard State Forest/ Leard National Park. The removal of 651.6 ha (19 %) of potential habitat could potentially reduce the area of potential occupancy for this species, however, given that it is unknown if the species occurs, the removal of this potential habitat is not considered significant. Moreover, a large (3507 ha) remnant patch of woodland (remaining Leard State Forest/ Leard National Park) would surround the Project to the north, east and west, which is likely to provide similar habitat for this species.

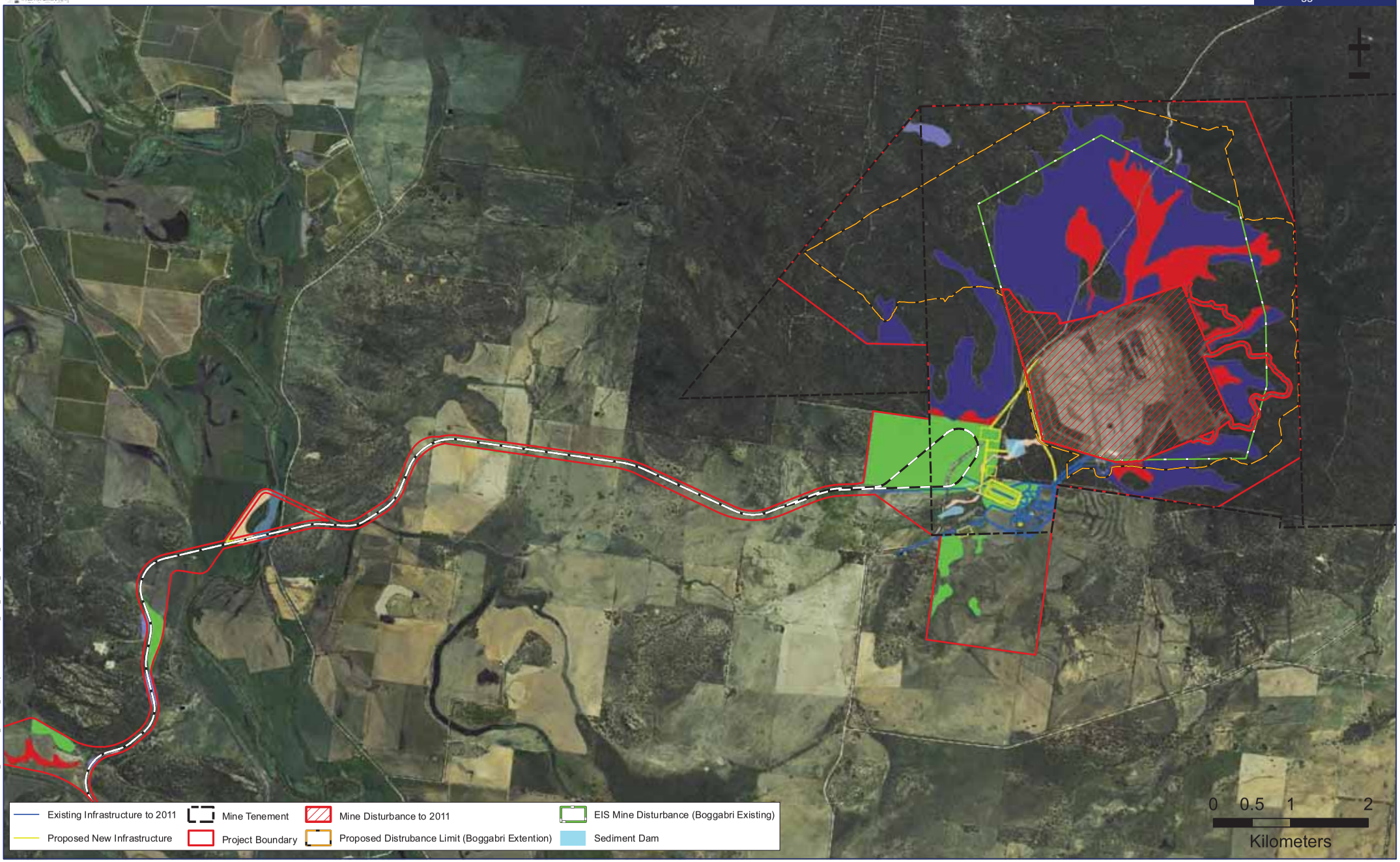
Will the action fragment an existing population into two or more populations?

The Leard State Forest contains large areas potential habitat for this species which adjoins larger areas of native vegetation which cover an area of over 8,000 ha. This area includes the Leard National Park located to the north west of the Project Boundary. The area to be removed for the extension of the existing open cut mine is located at the southern portion of the Project Boundary and whilst it will reduce the area of potential habitat for this species it will not completely isolate the area of habitat from other areas of native vegetation. An area of continuous vegetation extends from the south east through to the north west to Leard National Park and this connectivity will maintain important linkages for gene flow between any potential populations of this species.

The proposed rail corridor will remove a linear corridor of approximately 30 m of potential habitat for this species. While this area is small, this linear corridor has the potential to fragment two or more populations. Currently this vegetation is fragmented by an existing haul road and it is unknown if populations of this species is occurs within this habitat. Therefore the Project is may increase the barrier effect for in the rail corridor area and possibly isolate remaining remnant vegetation on either side of the rail/road corridor.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the *Digitaria porrecta* under the *Environment Protection and Biodiversity Conservation Act 1999*.



Identified Vegetation Communites within study area

- Silver-leaved Ironbark heathy woodland
- Derived native grassland
- Plains Grassland
- River Red Gum riparian woodlands and forests
- Weeping Myall grassy open woodland
- White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest
- White Box – White Cypress Pine grassy woodland
- White Box- Blakely's Red Gum - Melaleuca riparian forest
- Yellow Box - Blakely's Red Gum grassy woodland

Figure E5 - Digitaria porrecta habitat

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006b).

The potential habitats that would be affected as a result of the Proposal do not represent habitat critical to the survival of the *Digitaria porrecta.*

Will the action disrupt the breeding cycle of a population?

While the pollination mechanisms of *Digitaria porrecta* have not been identified, it is likely to be reliant on both pollination (possibly wind) and development or seeds and asexual (vegetative) reproduction. The Proposal is unlikely to affect these processes.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Proposal will remove and may modify some open forest, woodlands and grassland habitats that have potential for this species to occur. However, this is not a significant proportion of the habitat available within the region, and as such is unlikely to result in a decline in the species.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

The removal of 651.6 ha of potential habitat for this species may introduce edge effects from the mine operations into remaining areas of potential habitat for this species. The expansion of the mine operations may amplify the existing weed incursions due to the wider area where the proposed expanded mine operations will adjoin native vegetation.

The potential habitat for this species within the proposed rail corridor within the south west of the Project Boundary is characterised by varying levels of degradation as several of the habitats have severe weed incursions (ie River Red Gum riparian woodlands and forests). However, other communities have a dominance of native grasses with minor pasture weed invasions. However, all of the communities have been modified as a result of past land-uses, and edge effects from the adjoining vegetation assemblages. Edge effects from the existing haul road are currently having a small impact on the potential habitat with minor pasture weed incursions occurring where the habitats adjoins the haul road alignment. The proposed rail corridor unlikely to result in invasive species that is harmful to the endangered species becoming established in the endangered species' habitat that are not already occurring. However, the proposal will increase the existing corridor through the potential habitat.

If appropriate weed control management plans are implemented as part of the proposal these impacts can be minimised.

Will the action introduce disease that may cause the species to decline?

No, there are no known diseases associated with *Digitaria porrecta.*

Will the action interfere with the recovery of the species?

A recovery plan has not been prepared for *Digitaria porrecta* and the potential habitat is not considered to be important for the recovery of the species.

Conclusion

Based on the above assessment, *Digitaria porrecta* is unlikely to be significantly affected by the Proposal.

E5.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The lifecycle of *Digitaria porrecta* within the Project boundary is unlikely to be to be affected by the proposal. While the pollination mechanisms of *Digitaria porrecta* have not been identified, like other stoloniferous or rhizomatous grasses, it is likely to be reliant on both wind pollination and development or seeds and asexual (vegetative) reproduction. The Proposal is unlikely to affect these processes.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Digitaria porrecta is a tufted grass that occurs on rich soils of basaltic geologies within grassy woodlands and grassland communities (Department of Environment and Climate Change 2009). The Proposal will remove vegetation that has potential for this species to occur. However, this is not a significant proportion of the habitat available within the region (over 3,000 ha), and as such is unlikely to result in a decline in habitat availability.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Digitaria porrecta is naturally distributed throughout the Border Rivers-Gwydir, Namoi, Central West (NSW) and extends into Fitzroy and Condamine Regions in Queensland (Department of Environment Water Heritage and the Arts 2008a). The Project boundary is located in the mid to upper region of the natural distribution of this species.

How is the proposal likely to affect current disturbance regimes?

The Project boundary current disturbance regimes include minor weed incursions, feral animal invasion, and current mining activities. The proposal may increase the current disturbance regimes and it will move them into new areas. The area of habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the proposal is unlikely to alter the current disturbance regimes that are already in place. If sediment/erosion control measures and a weed management plan are implemented some of these impacts can be minimised.

How is the proposal likely to affect habitat connectivity?

Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. Reproduction of *Digitaria porrecta*, like many other grasses, is likely to be a combination of vegetative reproduction and cross or self pollination. Pollination vectors are unknown for this species, but other species of *Digitaria* utilise wind pollination, with seed dispersal mechanism most likely to be through seed attachment to fauna to allow seed dispersal through to new microsites for seed germination. The proposal will remove a large portion of potential habitat for this species, however connectivity will be

maintained via a east-west corridor to the north of Leard State Forest which will maintain gene flow between any potential populations which may be present.

In the proposed rail corridor will widen the existing linear haul road corridor by an additional 30m. However this species is likely to rely on wind pollination and this widening of the corridor is unlikely to significantly affect this process. Therefore it is concluded that habitat connectivity for *Digitaria porrecta* in the wider region would not be significantly affected.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species.

The project would remove approximately 651.6 ha of potential habitat for *Digitaria porrecta.* The DLWC (Department of Land and Water Conservation 2003) have mapped approximately 49,202 ha of potential habitat for *Digitaria porrecta* within the Boggabri Map sheet these habitats include the communities of Black Earth Grassland, Slopes Grassy woodlands, White Cypress and Ironbark Forests and Myall Woodlands. Whilst the area of potential habitat to be removed is large it equates to 1.3 % being removed within the Boggabri locality. Therefore it is considered unlikely that this species will be significantly affected by the proposal.

Conclusion

Based on the above assessment, *Digitaria porrecta* is unlikely to be significantly affected by the Proposal.

E6. *Diuris tricolor*

The *Diuris tricolor* (Pine Donkey Orchid) is listed as Vulnerable under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999.*

The Pine Donkey Orchid *(formerly known as Diuris sheaffiana)* is a terrestrial species (it grows from the ground rather than from rocks or vegetation).was not observed in the Project boundary during the field assessment, however, it is considered likely to occur due to availability of suitable habitat and known previous records in similar habitats in the region.

The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (Callitris spp.). It is found in sandy soils, either on flats or small rises. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta,* Ironbark and Acacia Shrubland (Jones 2006). The understorey is often grassy with herbaceous plants such as Bulbine species. Flowers from September to November or generally spring (Jones 2006).

Within the Project boundary habitat for *Diuris tricolor* (Figure E6) has been identified in the following nine vegetation communities:

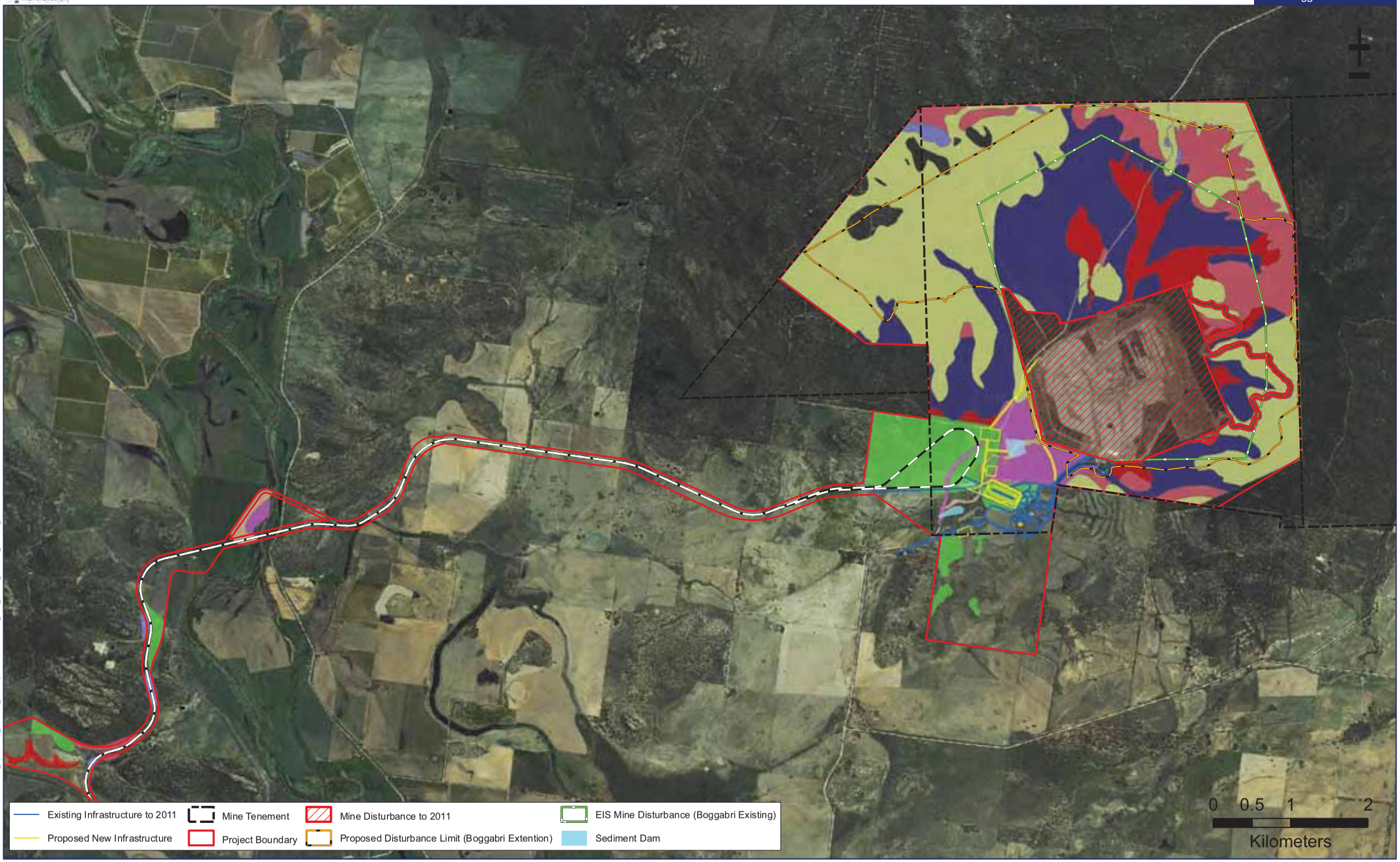
1. Yellow Box - Blakely's Red Gum grassy woodland
2. White Box – White Cypress Pine grassy woodland
3. White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest
4. White Box – Narrow-leaved Ironbark - White Cypress Pine Shrubby open forest
5. Silver-leaved Ironbark heathy woodland
6. Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland
7. Weeping Myall grassy open woodland
8. Derived native grassland
9. Narrow-leaved Ironbark - White Cypress Pine shrubby open forest

E6.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Diuris tricolor (Pine Donkey Orchid) is listed as an Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

If present, the population of *Diuris tricolor* (Pine Donkey Orchid) in the Project boundary would not be considered an important population.



Identified Vegetation Communites within study area

- Silver-leaved Ironbark heathy woodland
- Derived native grassland
- Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland
- Weeping Myall grassy open woodland
- White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest
- White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box – White Cypress Pine grassy woodland
- Yellow Box - Blakely's Red Gum grassy woodland

Figure E6 - Diuris tricolor habitat

Will the action lead to a long-term decrease in the size of an important population of a species?

No populations of *Diuris tricolor* (Pine Donkey Orchid) have been identified within the Project Boundary nor have they been identified as an important population. In the event that the *Diuris tricolor* (Pine Donkey Orchid) may be affected in the Project boundary, if present, this would not represent a significant decrease in the size of the known population in the region.

Will the action reduce the area of occupancy of an important population?

Diuris tricolor (Pine Donkey Orchid) within the Project boundary has not been identified as an important population. *Diuris tricolor* (Pine Donkey Orchid) that may be affected in the Project boundary, if present, would not represent a significant area of the known range of this species.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity for *Diuris tricolor* (Pine Donkey Orchid) in the Project boundary would not be significantly affected. Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. Thus for this to occur it would be important that maintaining vegetated corridors between populations to allow movement of pollinator vectors and seed dispersal mechanisms to allow gene flow between two populations. The pollinator vector for *Diuris tricolor* (Pine Donkey Orchid) is likely to be a wasp and seed dispersal is unknown. Despite targeted surveys, during the flowering period, for this species no individuals belonging to *Diuris tricolor* (Pine Donkey Orchid) were recorded. While the proposal will remove a large area of habitat connectivity will be maintained between the remaining areas of habitat in the north of Leard State Forest which will allow gene flow between potential populations. Therefore, no currently known populations are likely to be fragmented into two or more populations as a result of the proposal.

The Proposal is not likely to fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the *Diuris tricolor* (Pine Donkey Orchid) under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a)

The habitat that would be affected as a result of the Proposal do not represent habitat critical to the survival of the *Diuris tricolor* (Pine Donkey Orchid).

Will the action disrupt the breeding cycle of an important population?

No individuals of *Diuris tricolor* (Pine Donkey Orchid) have been recorded within the Project boundary or as an important population. *Diuris sp.* are usually pollinated by insect

pollinators (Bishop 2000) drawn to the flowers by scent mimicking via pheromones. Once in sight of the flower, the insects attempts to remove pollen, and effects pollination. The pollinator or pollinators for this species are likely to be a wasp but at present this is yet to be confirmed. Whilst the proposal will remove large areas of habitat connectivity will be maintained in the northern portion of Leard State Forest to allow gene flow between any potential populations and therefore the Proposal is unlikely to affect these processes.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

No *Diuris tricolor* (Pine Donkey Orchid) individuals were recorded during the targeted surveys despite targeted surveys being conducted during the flowering period for this is species September-November.

The action will impact 1368 ha of potential habitat for this species via the removal of habitat, the action will may also increase indirect disturbances such as weed incursions and sediment and erosion impacts into new areas of habitat within the Leard State Forest. Despite the presence of suitable habitat for this species it was not located during comprehensive targeted surveys undertaken during the flowering period for this cryptic orchid. Whilst, the proposal will remove a large area of habitat, this species has not been previously recorded in the immediate area with the closest record located approximately 20 km to the north and the majority of records for this species occur to the south in the Upper Hunter district. Within the Boggabri region over 90,000 ha of potential habitat for this species has been mapped (Department of Land and Water Conservation 2003). Therefore whilst the proposal will decrease the habitat for this species it is unlikely to lead to the decline of the species in the region.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

The removal of 1368 ha of potential habitat for this species may introduce edge effects from the mine operations into remaining areas of potential habitat for this species. The expansion of the mine operations may amplify the existing weed incursions due to the wider area where the proposed expanded mine operations will adjoin native vegetation.

The potential habitat for this species within the proposed rail corridor within the south west of the Project Boundary is characterised by varying levels of degradation as several of the habitats have severe weed incursions (i.e. River Red Gum riparian woodlands and forests). However, other communities have a dominance of native grasses with minor pasture weed invasions. However, all of the communities have been modified as a result of past land-uses, and edge effects from the adjoining vegetation assemblages. Edge effects from the existing haul road are currently having a small impact on the potential habitat with minor pasture weed incursions occurring where the habitats adjoins the haul road alignment. The proposed rail corridor unlikely to result in invasive species that is harmful to the vulnerable species becoming established in the vulnerable species' habitat that are not already occurring. However, the proposal will increase the existing corridor through the potential habitat.

Will the action introduce disease that may cause the species to decline?

No, there are no known diseases associated with *Diuris tricolor* (Pine Donkey Orchid).

Will the action interfere substantially with the recovery of the species?

No recovery plans have been prepared for *Diuris tricolor* (Pine Donkey Orchid) and the Project boundary has not been identified as important habitat for the recovery of the species.

Conclusion

The potential population of *Diuris tricolor* (Pine Donkey Orchid) in the Project boundary is not considered an important population. Based on the above assessment, *Diuris tricolor* (Pine Donkey Orchid) is unlikely to be significantly affected by the Proposal.

E6.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The lifecycle of *Diurus tricolor* (Pine Donkey Orchid) within the Project boundary is unlikely to be to be affected by the proposal.

While the pollinators (Insect species) for other terrestrial deciduous herbs, emerging annually from a subterranean tuber *Diurus tricolor* (Pine Donkey Orchid) is likely to be pollinated through a process called pseudocopulation (Jones 1988). The glands on the perianth segments are a source of the sexual attractants for the pollinators, usually male thynnine wasps drawn to the flowers by scent mimicking the femal thynnine wasp pheromone. Once in sight of the flower, the male attempts to copulate with the labellum of the flower, mistaking it for a female wasp, and effects pollination. Habitat for these pollinators is vital for the continuation of the life cycle of this cryptic orchid, whilst the proposal will remove a large area of habitat for both this species and its associated pollinator large areas of habitat will be retained in the Leard State Forest. The Proposal is unlikely to affect these processes.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Diurus tricolor (Pine Donkey Orchid) is a terrestrial deciduous herbs, emerging annually from a subterranean tuber that occurs in sclerophyll forest among grass, often with native Cypress Pine (*Callitris spp.*). It is found in sandy soils, either on flats or small rises (Jones 2006).

The Proposal may modify some of the habitats that have potential for this species to occur. However, this is not a significant proportion of the habitat available within the region, and as such is unlikely to result in a decline in habitat availability.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Diurus tricolor (Pine Donkey Orchid) current known habitat distribution is currently widespread throughout NSW occurring within the following Catchment Management Area (CMA's) Central West, Hawkesbury/ Nepean, Hunter/ Central Rivers, Lachlan, Murrumbidgee, Namoi and Western CMA's, usually recorded as common and locally frequent in populations. The most northerly occurrence of this species is located approximately 20km to the North of Boggabri, however it has been recorded further north in Toowoomba in Queensland (Jones 2006). Therefore this species is not at the limit of its known distribution within the Boggabri region.

How is the proposal likely to affect current disturbance regimes?

The Project boundary current disturbance regimes include minor weed incursions, feral animal invasion, and current mining activities. The proposal may increase the current disturbance regimes and it will move them into new areas. The area of habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the proposal is unlikely to alter the current disturbance regimes that are already in place. If sediment/erosion control measures and a weed management plan are implemented some of these impacts can be minimised.

How is the proposal likely to affect habitat connectivity?

Habitat connectivity for *Diurus tricolor* (Pine Donkey Orchid) is unlikely to be further fragmented as a result of the proposal due to the connectivity which will be maintained within the northern portion of Leard State Forest. However, the rail corridor does have the potential to fragment existing areas of potential habitat, however the potential habitat is already fragmented with an existing haul road and whilst the proposed rail corridor will widen the linear corridor by an addition 30 m it is considered habitat connectivity would not be significantly affected. Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. This species cross pollinates via insect pollinators (Wasps and Bees) which are capable of flying between populations of *Diuris sp.* Therefore it is concluded that habitat connectivity for *Diruis tricolor* in the wider region would not be significantly affected.

How is the proposal likely to affect critical habitat?

No critical habitat has been listed for the *Diurus tricolor* (Pine Donkey Orchid) under the *Threatened Species Conservation Act 1995*.

The action will impact 1368 ha of potential habitat for this species via the removal of habitat. Within the Boggabri region over 90,000 ha of potential habitat for this species has been mapped (Department of Land and Water Conservation 2003). Therefore the habitat that would be affected as a result of the Proposal is unlikely to represent habitat critical to the survival of the *Diurus tricolor* (Pine Donkey Orchid).

Conclusion

Based on the above assessment, *Diurus tricolor* (Pine Donkey Orchid*)* is unlikely to be significantly affected by the Proposal.

E7. *Pomaderris queenslandica*

The *Pomaderris queenslandica* (Scant Pomaderris) is listed as Endangered under the *Threatened Species Conservation Act 1995.*

The Scant Pomaderris is a medium sized shrub and a population was recorded within the Project boundary during the field assessment. This species grows in moist eucalypt forests and woodlands generally with a shrubby understorey (Department Environment and Conservation 2005). Occasionally this species is found in growing along creekbanks. Habitats within the Brigalow Belt Bioregion include, Black Cypress Pine - Narrow-leaved Stringybark heathy, Black Cypress Pine shrubby woodland, Blue-leaved Ironbark heathy woodland, Brown Bloodwood - cypress - ironbark heathy woodland, Dwyer's Red Gum woodland on siliceous substrates, Narrow-leaved Ironbark shrubby woodland, White Cypress Pine - Narrow-leaved Ironbark shrub/grass open forest, White Cypress Pine - Silver-leaved Ironbark - Tumbledown Red Gum shrubby open forest (Department Environment and Conservation 2005). Flowers in spring with buds apparent for many months before flowers open (Harden 2000).

In the Project boundary *Pomaderris queenslandica* was recorded (Figure E7) in the north western section and a further population was recorded to the north of the Project boundary in the Leard State Forest. This species has been recorded in the following two vegetation communities within the Project boundary:

1. Dwyer's Red Gum woodland
2. Narrow-leaved Ironbark - White Cypress Pine shrubby open forest

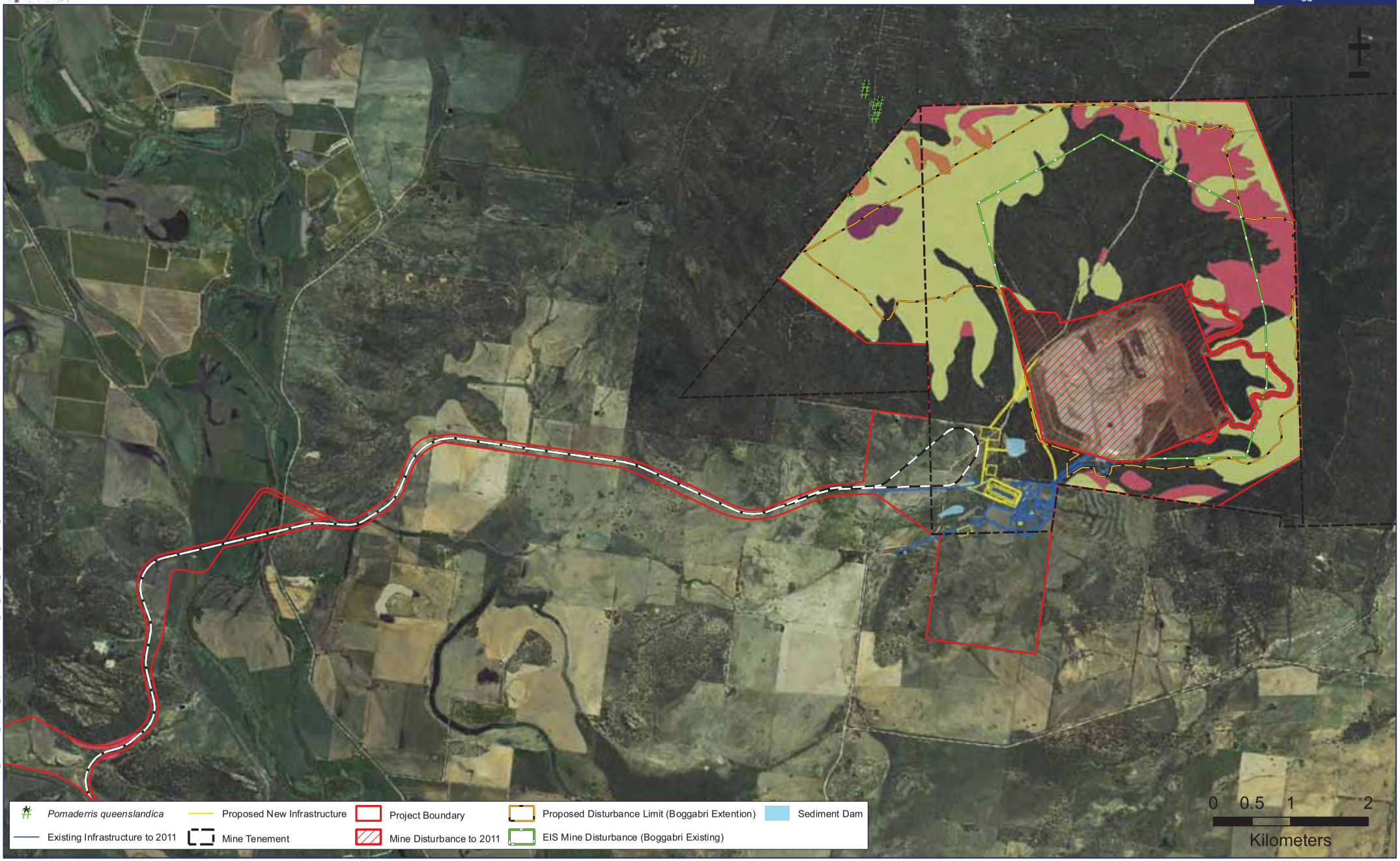
Two other vegetation communities have been recorded as being potential habitat but this species was not recorded and these include

1. Narrow-leaved Ironbark – Brown Bloodwood – White Cypress Pine shrubby open forest
2. White Box – Narrow-leaved Ironbark – White Cypress Pine shrubby open forest

Threats to this species include the following:

- Disturbance from roadworks and timber harvesting activities
- Invasion by introduced weeds.
- Risk of local extinction because populations are isolated.
- Clearing of habitat for agriculture.
- Inappropriate fire regime

Closest records are approximately 30 km to the north west of the Project boundary just outside Mount Kaptuar National Park. This species has also been recorded approximately 130 km to the north within Arakoola Nature Reserve (Hunter JT 2003)



Potential Pomaderris queenslandica habitat

- Dwyer's Red Gum woodland
- Narrow-leaved Ironbark - Brown Bloodwood -White Cypress Pine shrubby open forest
- Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest

Figure E7 - *Pomaderris queenslandica* Location and Habitat

E7.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

No individuals of *Pomaderris queenslandica* are to be removed as part of the proposal, however potential habitat will be affected. The lifecycle of *Pomaderris queenslandica* (Scant Pomaderris) within the Project boundary is unlikely to be to be affected by the proposal. While the pollination mechanisms of *Pomaderris queenslandica* have not been identified, like other *Pomaderris* sp.*,* it is likely to be reliant on insect pollination as this species has fertile hermaphrodite flowers. The seed dispersal mechanism is also unknown. The majority of the population which was recorded within Leard State Forest was present outside of the current Project Boundary, and large areas of habitat will be retained to the north of the Project boundary which will maintain the lifecycle processes to maintain a viable population of this species. The Proposal is therefore unlikely to affect these processes.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Pomaderris queenslandica is a small to medium shrub that occurs on rich soils of basaltic geologies within grassy woodlands and grassland communities (Department Environment and Conservation 2005). The Proposal will not remove any individuals of this species. However, potential habitat for this species will be removed as part of the proposal. The proposal may modify some of the habitats that have potential for this species to occur. However, this is not a significant proportion of the habitat available within the region and as such is unlikely to result in a decline in habitat availability.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Pomaderris queenslandica is naturally distributed throughout the Border Rivers-Gwydir, Namoi, Hunter/Central Rivers, Central West (NSW), Namoi and Northern Rivers and extends north into Queensland (Department Environment and Conservation 2005). The Project boundary is located in the mid region of the natural distribution of this species, and therefore it is considered that this species is not at the limit of its distribution.

How is the proposal likely to affect current disturbance regimes?

The Project boundary current disturbance regimes include minor weed incursions, feral animal invasion, and current mining activities. The proposal may increase the current disturbance regimes and it will move these disturbances into new areas. The area of habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the proposal is unlikely to alter the current disturbance regimes that are already in place. If sediment/erosion control measures and a weed management plan are implemented some of these impacts can be minimised.

How is the proposal likely to affect habitat connectivity?

Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. Reproduction of *Pomaderris queenslandica* is largely unknown however it is likely to be a combination of cross and/or self pollination. The pollination vector/s are unknown for this species, but it is likely to utilise insect pollination, with the seed dispersal

mechanism also unknown but likely to be wind borne. The proposal will remove a large portion of potential habitat for this species, however, connectivity will be maintained via a east-west corridor to the north of Leard State Forest which will maintain gene flow between the current populations and any potential populations which may be present. Therefore it is concluded that habitat connectivity for *Pomaderris queenslandica* in the wider region would not be significantly affected.

How is the proposal likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species.

The project would remove approximately 719 ha of potential habitat for *Pomaderris queenslandica.* No individuals of this species have been recorded within the proposal mine extension area or the proposed railway corridor. The DLWC (Department of Land and Water Conservation 2003) have mapped approximately 70,800 ha of potential habitat for *Pomaderris queenslandica* within the Boggabri Map sheet these habitats include the communities of Dry Scrub, Slopes Grassy woodlands, White Cypress and Ironbark Forests, Footslopes Woodland and Shrubby Sandstone Forest. Whilst the area of potential habitat for this species to be removed is large it equates to approximately 1 % being removed within the Boggabri locality. In addition, no individuals of this species will be removed as part of the proposal. Therefore it is considered unlikely that this species will be significantly affected by the proposal.

Conclusion

Based on the above assessment, *Pomaderris queenslandica* is unlikely to be significantly affected by the Proposal.

E8. *Pultenaea setulosa*

Pultenaea setulosa (Bush Pea) is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999.*

Pultenaea setulosa (Bush Pea) is an erect shrub which grows to 2.5 m in height with yellow to orange flowers. This species is known from Broad Sound to the Marlborough area in Queensland (Department of the Environment Water Heritage and the Arts 2008). In NSW this species distribution ranges from Wagga Wagga to Glen Innes in the north on both the Western Slopes and Tablelands. In QLD the species is known to grown on serpentinite substrates whilst in NSW the species grows in a variety of habitats including wet and dry sclerophyll forest on volcanic substrates (Harden 2002)

This species has undergone a taxonomic review by de Kok & Weston (2002) which now recognises five species of *Pultenaea* that occur within NSW within the *Pultenaea setulosa* species. These species include *Pultenaea campbellii, P. boormanii, P. lapidosa, Pultenaea* sp. I and *Pultenaea* sp. F. The plant specimen which was forwarded to the Royal Botanical Gardens Sydney for confirmation this species was confirmed to be previously *Pultenaea* sp. I. A search of the Atlas of NSW Wildlife (Department of Environment Climate Change and Water 2009) identified over 80 records of *Pultenaea setulosa* as occurring throughout NSW and the species is not listed under the TSC Act in NSW. Whilst the population of this species in QLD is restricted to the Broad Sound and Marlborough locality and is currently under threat from mining and development activities.

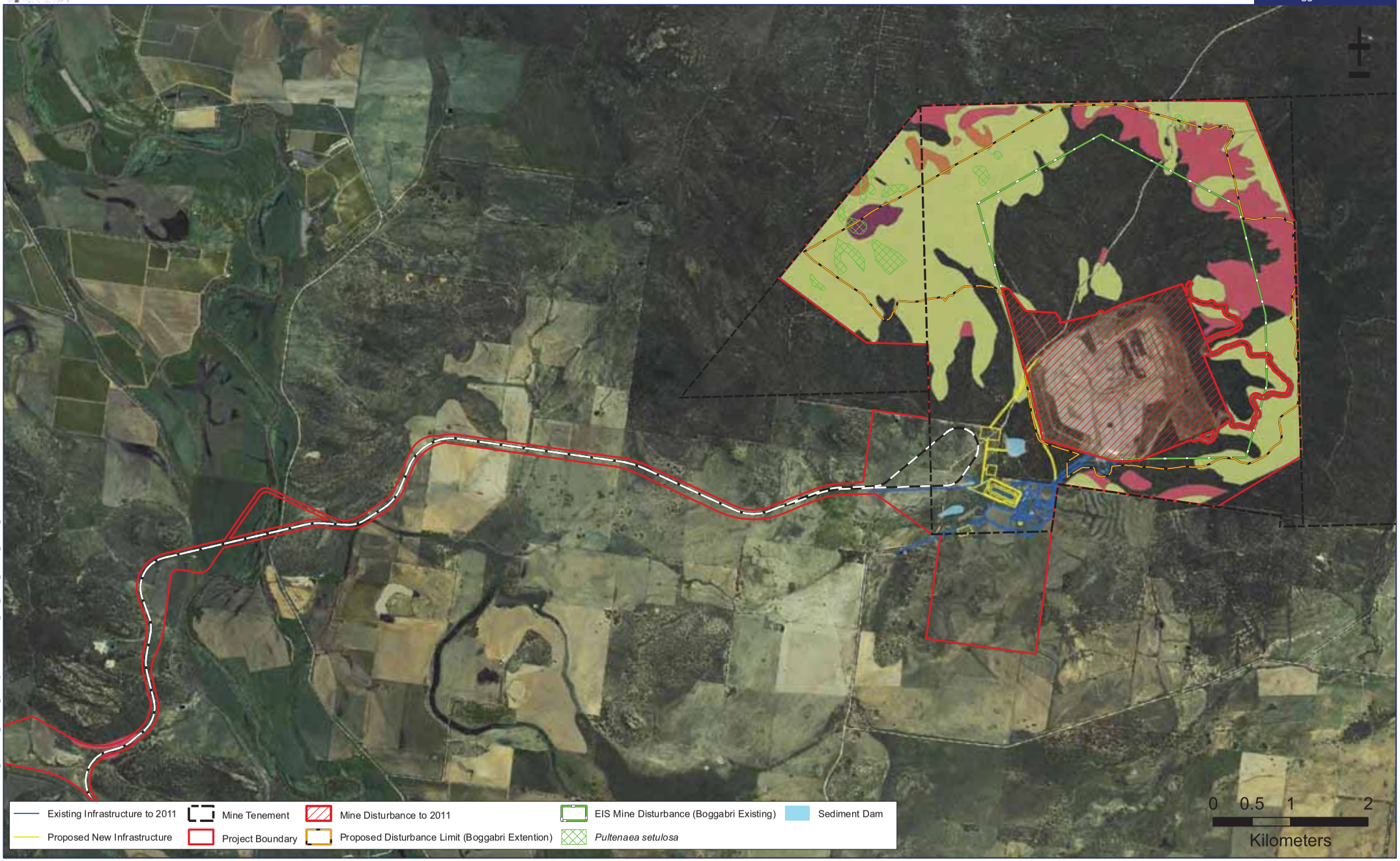
The conservation advice for *Pultenaea setulosa* states that “The taxon originally listed under the EPBC Act relates to the narrow concept of *Pultenaea setulosa*, not the broader concept of de Kok & West (2002)”. Advice was sought from the DEWHA on the clarification of the aforementioned statement and to confirm if *Pultenaea* sp. from NSW were part of the federal listing for *Pultenaea setulosa* and it was confirmed that the NSW species were included in the listing and therefore require assessment under the EPBC Act, even if the original listing was intended for the QLD population. However, this species is on DEWHA’s current workplan for a conservation status review.

Within the Project boundary *Pultenaea setulosa* occurs in eight populations, with the majority occurring along the drainage lines (Figure E8). This species has been recorded in the following three vegetation communities:

1. Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
2. Narrow-leaved Ironbark – Brown Bloodwood – White Cypress Pine shrubby open forest
3. Dwyer’s Red Gum Woodland

Habitat for this species also occurs within the White Box – Narrow-leaved Ironbark - White Cypress Pine Shrubby open forest, but *Pultenaea setulosa* was not recorded within this vegetation community in the Project boundary.

In the Boggabri locality this species has been recorded approximately 30 km to the north of the Project boundary in Mount Kaptuar National Park and approximately 50 km to the west in Pilliga East State Forest (Department of Environment Climate Change and Water 2009).



Potential Pultenaea setulosa habitat

- Dwyer's Red Gum woodland
- Narrow-leaved Ironbark - Brown Bloodwood -White Cypress Pine shrubby open forest
- Narrow-leaved Ironbark - White Cypress Pine shrubby open forest
- White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest

Figure E8 - *Pultenaea setulosa* Location and Habitat

E8.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Pultenaea setulosa (Bush Pea) is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the *Environment Protection and Biodiversity Conservation Act 1999*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

The populations of this species located in the project area are not a key source for breeding or dispersal or are they likely to be necessary for maintaining genetic diversity. *Pultenaea setulosa* is a commonly occurring species in NSW and is not at the limit of its range as this species occurs from Wagga Wagga in the south to Glen Innes in the north with a disjunction population occurring in QLD. Therefore the populations *Pultenaea setulosa* (Bush Pea) in the Project boundary is not be considered an important population.

Will the action lead to a long-term decrease in the size of an important population of a species?

The individuals to be removed as part of the proposal are not considered to be part of a significant population with large areas of similar known and potential habitat to be retained within the Project boundary, and locality. Whilst the populations are of a moderate size, they are currently naturally disjunct in the preference for creekline habitats. In the Boggabri locality *Pultenaea* sp. I (Now *Pultenaea setulosa*) was a diagnostic species in the vegetation community of Silvertop Stringybark Forest with a frequency of occurrence of 50 % (Department of Land and Water Conservation 2003).

Within the region this species was recorded as being a commonly occurring diagnostic species in five vegetation communities as part of the Bigalow Belt South Joint Vegetation Mapping Project (2004). At a state level a search of the NPWS database atlas revealed that there are over 80 records for this species occurring from Wagga Wagga in the south west to Glen Innes in the north.

Therefore *Pultenaea setulosa* is a commonly occurring species in the local area and the wider NSW region. Therefore, the removal of 27.7 ha area of occupied habitat is unlikely to represent a significant decrease in size of an important population.

Will the action reduce the area of occupancy of an important population?

Pultenaea setulosa (Bush Pea) within the Project boundary has not been identified as an important population. The removal of 27.7 ha area of occupied habitat is unlikely to represent a significant decrease in size of an important population.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity for *Pultenaea setulosa* (Bush Pea) in the Project boundary would not be significantly affected. Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. Thus for this to occur it would be important

that maintaining vegetated corridors between populations to allow movement of pollinator vectors and seed dispersal mechanisms to allow gene flow between two populations. The pollinator vector for *Pultenaea setulosa* (Bush Pea) as with other species of the Fabaceae family is likely to be by insects (Auld 1996). Whereas seed dispersal of most legumes is by ants (Auld 1996) and therefore any fragmentation of populations would require habitat for pollinators and seed dispersal vectors to maintain viable populations. While the proposal will remove 27.7 ha of occupied habitat, connectivity between the remaining populations will still be maintained with the retained areas of vegetation in the north of the Leard State Forest. This vegetation corridor between the remaining populations and areas of habitat will maintain gene flow and therefore maintain the life cycle of *Pultenaea setulosa.* Therefore, the removal of *Pultenaea setulosa* as a result of the proposal is not likely to fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for the *Pultenaea setulosa* (Bush Pea) under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a)

The habitat that would be affected as a result of the Proposal do not represent habitat critical to the survival of the *Pultenaea setulosa* (Bush Pea).

Will the action disrupt the breeding cycle of an important population?

The populations of *Pultenaea setulosa* (Bush Pea) that have been recorded within the Project boundary are not considered as an important population. *Pultenaea sp.* are usually pollinated by insect pollinators (Auld 1996), with the pollinator or pollinators for this species are likely to be bees, wasps, beetles or flies but at present the pollinator is unknown. The seed dispersal mechanism for this species is likely to ant dispersed due to the presence of an aril (Auld 1996). To maintain the life cycle of populations of *Pultenaea setulosa* the retention of habitat for these important life cycle components is vital to maintain a viable population. Whilst the proposal will remove areas of occupied habitat, connectivity will be maintained in the northern portion of Leard State Forest to allow gene flow and the retention of pollinator and seed dispersal vector habitat between the remaining populations. Furthermore it is highly likely that further populations of *Pultenaea setulosa* are present in the creekline habitat that occurs in the retained areas of Leard State Forest. Therefore it is considered that the Proposal is unlikely to disrupt the breeding cycle of an important population of *Pultenaea setuolsa*.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The action will impact 27.7 ha of occupied habitat for this species and will remove further 722 ha of unoccupied habitat. The action will may also increase indirect disturbances such as weed incursions and sediment and erosion impacts into new areas of both

occupied and unoccupied habitat of *Pultenaea setulosa* within the Leard State Forest. Whilst, the proposal will remove areas of occupied habitat, this species is a commonly occurring species within the wider NSW region, with over 80 records being recorded by the NPWS database atlas (Department of Environment Climate Change and Water 2009). In the Boggabri locality this species has been recorded as being a common diagnostic species in five vegetation communities by the Brigalow Belt South Joint Vegetation Mapping Project (2004) and the Department of Lands Boggabri Mapping Sheet (2002) has recorded the species as commonly occurring in one vegetation community. Therefore whilst the proposal has the potential to modify areas of occupied habitat for this species it is unlikely to lead to the decline of the species in the region or the wider locality.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

The removal of native vegetation for the proposal may introduce edge effects from the mine operations into remaining areas of both occupied and unoccupied habitat for this species. The expansion of the mine operations may amplify the existing weed incursions due to the wider area where the proposed expanded mine operations will adjoin native vegetation. This is likely to occur where the mine will adjoin populations of *Pultenaea setulosa* in the north western portion of the Project boundary.

Will the action introduce disease that may cause the species to decline?

No, there are no known diseases associated with *Pultenaea setulosa* (Bush Pea).

Will the action interfere substantially with the recovery of the species?

No recovery plans have been prepared for *Pultenaea setulosa* (Bush Pea) and the Project boundary has not been identified as important habitat for the recovery of the species.

Conclusion

The population of *Pultenaea setulosa* (Bush Pea) in the Project boundary is not considered an important population. Based on the above assessment, *Pultenaea setulosa* (Bush Pea) is unlikely to be significantly affected by the Proposal.

E9. Sloane's Froglet (*Crinia sloanei*)

Sloane's Froglet is listed as a Vulnerable species under the TSC Act. This species has been recorded from widely scattered sites on the floodplains of the Murray Darling Basin. The majority of records have occurred in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions of NSW (Department of Environment Climate Change and Water 2009). This species has not been recorded in the northern part of its range in more recent times. Sloane's Froglet is commonly associated with areas in grassland, woodland and disturbed habitats, which are periodically inundated. Males call throughout the year whilst floating in water, amongst vegetation, with breeding observed during winter to spring (Department of Environment Climate Change and Water 2009).

Targeted winter surveys were carried out for this species in potential habitat occurring along and in vicinity of the Namoi River. Although this species was not recorded during field surveys, suitable habitat existed in the form of swales and depressions occurring along the Namoi River floodplain at survey site S18 and S19 (refer Figure E9).

E9.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

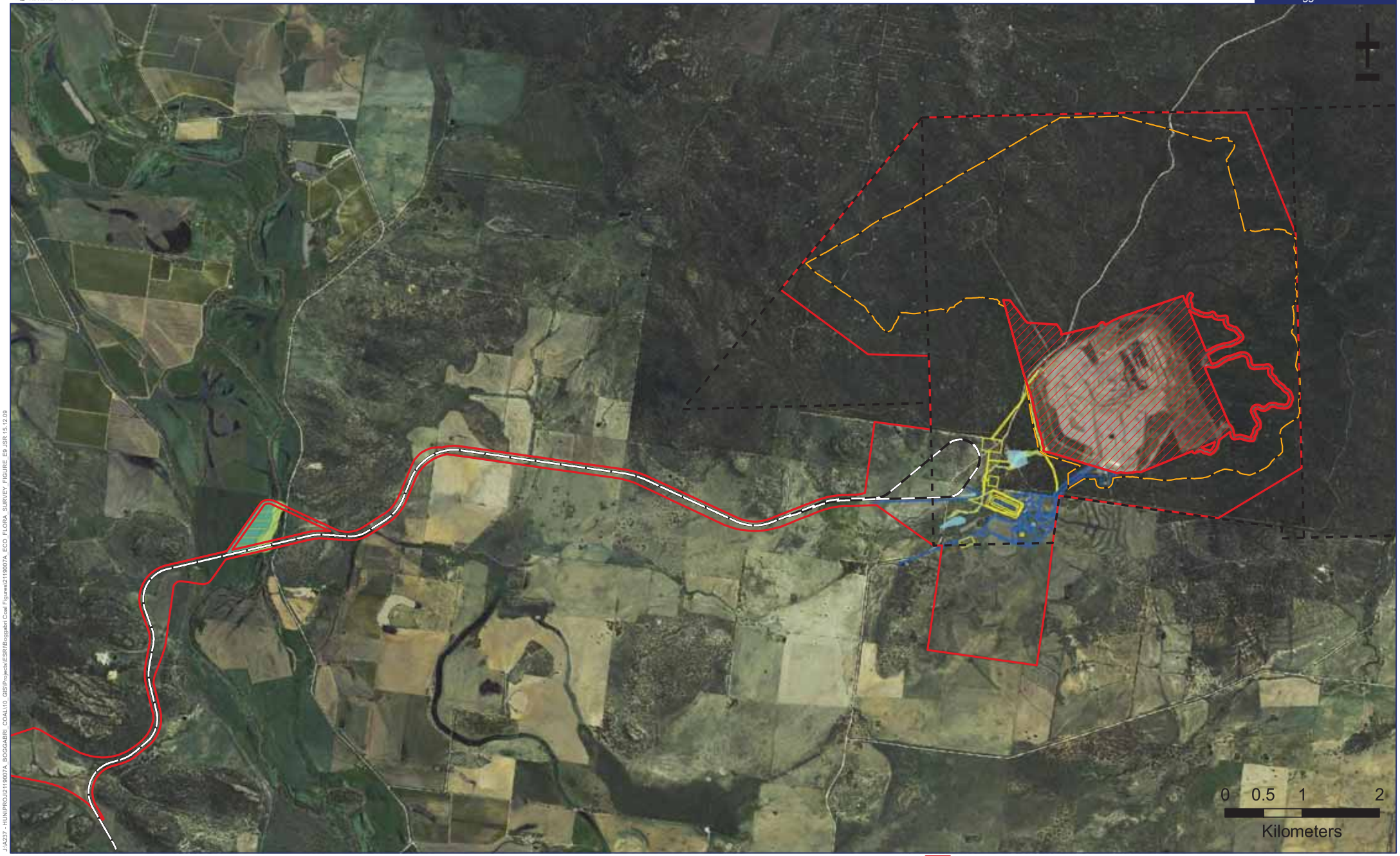
Part of the Project involves the construction of a rail corridor, required to cross the Namoi River and its' floodplain. While this species was not recorded during targeted winter surveys, potential habitat occurred along the Namoi River, adjacent to the proposed rail corridor river crossing. A total of two hectares of potential habitat would be affected by the Project. It is not likely that the lifecycle of this species would be significantly affected by the Project as suitable habitat exists up and downstream of the proposed Namoi River crossing.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

While this species was not recorded in the Project boundary during targeted winter surveys, potential habitat was recorded therein. Approximately two hectares of potential habitat for this species would be affected by the Project. The removal of approximately two ha of potential habitat would not significantly affect habitat features occurring along the Namoi River and its' floodplain in the locality.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

This species has been recorded from widely scattered sites on the floodplains of the Murray Darling Basin. Majority of records have occurred in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions of NSW. Although this species has not been recorded in the northern part of its range, where the Project is situated, in more recent times, it is not considered to occur at the limit of this species known distribution.



PB Threatened Species Survey
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Fauna Habitat Areas
- Riverine Woodland
- Grassy Woodlands on fertile soils

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E9 - Distribution of potential habitat for Sloane's Froglet

How is the Project likely to affect current disturbance regimes?

The proposed rail corridor will cross the Namoi River and its floodplain. The Namoi River currently exhibits disturbance regimes associated with the surrounding agricultural landscape including, riparian vegetation clearance, erosion/ sedimentation and bank instability due to stock access. Given that suitable habitat exists up and downstream of the proposed Namoi River crossing, no long-term impacts are expected on Sloane's Froglet. The Project would however increase the filling of potential habitat refuges along the Namoi River and its floodplain in order to raise the proposed rail corridor in compliance with flood data analysis. This is a recognised threat to this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

The Project would involve the removal of approximately two ha of potential habitat for this species. The majority of this impact would occur as a linear strip that would occupy potential habitat and while the construction of the Project is likely to fragment potential habitat, it is not considered to significantly affect this species anymore than that currently occurring in the locality. Furthermore, suitable habitat exists up and downstream of the proposed river crossing.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, population or ecological community. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

While Sloane's Froglet was not recorded in the Project boundary during targeted winter surveys, potential habitat was present. The proposed rail corridor crossing of the Namoi River and its floodplain would remove approximately two hectares of potential habitat. However, given that suitable habitat exists upstream and downstream of the subject site, the Project is not likely to have a significant impact on this species.

E10. Threatened woodland birds

Threatened woodland birds have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as result of the Project. Woodland species of bird considered under the Heads of Consideration for the current Project include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Hooded Robin (*Melanodryas cucullata cucullate*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Painted Honeyeater (*Grantiella picta*)
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)
- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Diamond Firetail (*Stagonopleura guttata*)
- Varied Sittella (*Daphoenositta chrysoptera*).

All eight species are part of a group of woodland birds considered to be declining within Australia (Reid 1999; Trail & Duncan 2000) and all are listed as Vulnerable under the TSC Act.

Threats that affect these species include clearing of woodland resulting in loss and fragmentation of habitat; modification and destruction of ground habitat through heavy grazing and compaction by stock; removal of litter and fallen timber; introduction of exotic pasture grasses; and frequent fire (Department of Environment and Conservation 2006c; Reid 1999; Trail & Duncan 2000).

Habitat for woodland birds within the Project boundary is shown in Figure E10. Descriptions of each species are presented below.

Brown Treecreeper (eastern subspecies) - *Climacteris picumnus victoriae*

Brown Treecreepers occur in eucalypt woodland and adjoining vegetation. Sometimes this species is recorded in semi-cleared pasture; in grasslands scattered with trees in cleared paddocks outside woodlands or in shelterbelts fringing cleared lands (Higgins, P.J & Peter 2002). It is sedentary and nests in tree hollows (Garnett & Crowley 2000) breeding in pairs or communally in small groups within territories ranging in size up to 11 ha. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site (Higgins, P.J *et al.* 2001). Birds forage on tree trunks and on the ground amongst leaf litter and on fallen logs for ants, beetles and larvae (Pizzey & Knight 2007).

This species was recorded during surveys conducted during January/ February 2009, March/ April 2009, May 2009, June 2009 and September 2009 (refer Figure E10).

Hooded Robin (south-eastern form) - *Melanodryas cucullata cucullate*

Hooded Robins occur in lightly wooded country, usually open eucalypt woodland, mallee and acacia shrublands. Movements are not well known, however, they are thought to be

resident or sedentary, but may undertake some local movements (Department of Environment and Conservation 2006c), possibly in response to drought and food availability (Pizzey & Knight 1997). Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than one to five metres above the ground (Higgins, P.J & Peter 2002).

This species was recorded during surveys conducted during September 2009 (refer Figure E10).

Black-chinned Honeyeater (eastern subspecies) - *Melithreptus gularis gularis*

This species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees (Department of Environment and Conservation 2006c). It is a gregarious species usually seen in pairs and small groups of up to 12 birds (Higgins, P.J & Davies 1996). Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least five ha. Nectar is taken from flowers, and honeydew is gleaned from foliage (Higgins, P.J & Davies 1996).

This species was recorded during surveys conducted during March/ April 2009 and June 2009 (refer Figure E10).

Painted Honeyeater- *Grantiella picta*

Painted Honeyeaters occur in dry forests and woodlands. The primary food is mistletoes in the genus Amyema, although they will take some nectar and insects (Department of Environment and Conservation 2006c). The breeding distribution is dictated by the presence of mistletoes, which are largely restricted to older trees. The species is less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).

This species was not recorded during surveys.

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- # Speckled Warbler
- # Black-chinned Honeyeater
- # Varied Sittella
- # Brown Treecreeper
- # Grey-crowned Babbler
- # Diamond Firetail
- # Hooded Robin

Fauna Habitat Areas

- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils

Fauna Habitat Condition

- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E10 - Distribution of known and potential habitat of Threatened woodland birds

Grey-crowned Babbler – *Pomatostomus temporalis temporalis*

The Grey-crowned Babbler is found mainly in rural districts where it predominantly lives in roadsides and private land (Schulz 1991). Suitable habitats are usually abundant with leaf litter and debris; often dominated by eucalypts including box and ironbark species, partly-cleared woodland, acacia shrubland and adjoining farmland (Higgins, P.J 1999). Grey-crowned Babblers are unlikely to occur in regrowth forest, large patches of forest or woodland and forest with dense understorey or grassland with few trees (Schulz 1991).

An understorey of young trees and shrubs, in the 10 to 25 cm diameter at breast height range, is used for nest sites and shelter, and a relatively sparse ground layer with more litter and less ground cover is preferred by the species (Adam & Robinson 1996). Within that broad habitat category, they prefer sites with large trees, a scattered understorey of small trees or shrubs and a sparse ground layer of litter and short grass (Davidson & Robinson 1992). At the local scale, the species is common in edge habitats where there is access to both tree-cover and open ground. Historically this edge habitat would be found near larger trees in mature woodland habitat, but is now largely restricted to roadside vegetation and the edges of remnant patches (Robinson *et al.* 2001). The Grey-crowned Babbler is a prolific nest builder, building nests throughout the year for both breeding and roosting (Counsilman 1979), and defend a territory of approximately 10 ha, however territories up to 50 ha have been recorded.

This species was recorded during surveys conducted during January/ February 2009, May 2009 and September 2009 (refer Figure E10).

Speckled Warbler- *Pyrrholaemus sagittatus*

Speckled Warblers prefers eucalypt dominated vegetation that has a grassy understorey, often on rocky ridges or in gullies (NSW Scientific Committee 2001b). The bird is a sedentary species that breeds in pairs and trios, and feeds on seeds and insects on the ground and in understorey vegetation and builds domed nests on the ground in grass tussocks, dense leaf litter and fallen branches (Reid 1999). Speckled Warblers occur at low densities (0.19-0.54 per ha) and have relatively large home ranges of 6-12 ha for pairs or trios of birds (Higgins, P.J & Peter 2002).

This species was recorded during surveys conducted during January/ February 2009, March/ April 2009, May 2009, June 2009 and September 2009 (refer Figure E10).

Diamond Firetail - *Stagonopleura guttata*

Diamond Firetails are found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. They occur also in open forest, mallee, native grasslands, and in secondary grasslands derived from other communities (Trail & Duncan 2000). They feed exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). They are usually encountered in flocks of between five and 40 birds, with groups separating into small colonies to breed, between August and January (Department of Environment and Conservation 2006c). Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. The species appears to be sedentary, although some populations move locally (Higgins, P.J & Peter 2002).

This species was recorded during surveys conducted during May 2009 and June 2009 (refer Figure E10).

Varied Sittella - *Daphoenositta chrysoptera*

The Varied Sittella is sedentary and inhabits most of mainland Australia, with a nearly continuous distribution in NSW from the coast to the far west (Higgins, P.J & Peter 2002). It inhabits open eucalypt forests and woodlands (particularly rough-barked species), mallee, inland acacia woodland and coastal tea-tree scrubs (Pizzey & Knight 2007).

Varied Sittella are highly social, with groups foraging together, whereby they fly into the heads of trees and generally make their way down limbs and the trunk of the tree. They feed on arthropods, which are gleaned from dead branches, small branches in the canopy and crevices from rough or decorticating bark (NSW Scientific Committee 2009e). This species typically breeds in groups of five to seven individuals during spring and summer, with nests well camouflaged and situated in a fork, high in the living tree canopy. The same fork or tree is often used in successive years. During winter this species forms larger companies.

The threats that affect Varied Sittella include the continued decline in habitat cover and quality (Watson *et al.* 2005). Furthermore, cleared agricultural landscapes potentially act as a barrier to movement and dispersal due the sedentary nature of this species. Thus, survival and population viability is considered sensitive to processes such as reduction in patch size and isolation and simplification of habitat including the removal of canopy cover, logs, fallen branches and litter. Therefore, three Key Threatening Processes listed under the TSC Act affect this species; clearing of native vegetation, loss of hollow-bearing trees and the removal of dead wood and dead trees.

This species was recorded utilising habitat resources within the Project boundary during winter and spring field surveys (refer Figure E10).

E10.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Seven Threatened woodland species of bird including Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella, were recorded during recent field surveys. It is assumed that approximately 1,384 ha of known habitat (for seven of eight species assessed) would be affected by the Project (Figure E10). Habitat to be removed provided (known and potential) foraging, roosting and breeding resources for all eight of the abovementioned species assessed, and essentially provided 'core habitat' for those species which are considered sedentary (Brown Treecreeper, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Varied Sittella and Diamond Firetail, although the later is known to be locally nomadic when not breeding).

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. Of the Threatened species of woodland bird recorded during field surveys, the majority were associated with Grassy Woodland on Fertile Soils and Shrubby Woodlands/ Open Forest on skeletal soils fauna habitat. Such fauna habitat was associated with the fertile flats that surround the current Boggabri Coal pit and grade into the Shrubby Woodlands/ Open Forest on Skeletal Soils fauna habitat. The Shrubby Woodlands/ Open Forest on Skeletal Soils fauna habitat generally occurs on the lower to

upper slopes of the surrounding ridge line, which essentially occurred at the limit of the Project boundary.

Habitat for these Threatened species of woodland bird is likely to be 'core habitat', in that the majority require patches greater than 100 ha in order to maintain viable populations (Higgins, P.J & Peter 2002). As this 'core habitat' corresponded with vegetation communities surrounding the current mine, thus associated with the greatest level of impact, the lifecycle of the above listed species would be affected by the Project. Moreover, using an estimate of 10 ha home range/ territory (Department of Environment and Conservation 2005a) for these species, the removal of 1,384 ha of known and potential habitat would effectively displace individuals from approximately 180 territories. While these species are likely to exist (in greatly reduced numbers) in similar habitats within remaining Leard State Forest, the removal of such a large area of known and potential habitat would have a significant impact on the lifecycle and population dynamics of these species, particularly sedentary species such as the Brown Treecreeper, Hooded Robin, Speckled Warbler, Diamond Firetail and Varied Sittella.

Furthermore, habitat occurring in the Project boundary and study area could be considered 'core habitat' in terms of metapopulation dynamics, whereby large populations, occurring in larger patches provide a source population to smaller patches of habitat in the surrounding matrix (Arnold *et al.* 1993; Hanski 1999; Lindenmayer & Burgman 2005). Therefore, by reducing the size of the overall population, of these species assessed, the source for other remote populations is also reduced, potentially affecting the lifecycle of remote populations of those species assessed.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of known habitat (for seven of eight species assessed) will be affected by the Project (Figure E10). However, habitat likely to be affected provides (known and potential) foraging, roosting and breeding resources for all eight species assessed, and essentially provided 'core habitat' for those species that are considered sedentary (Brown Treecreeper, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella).

The removal of approximately 1,384 ha of remnant vegetation would reduce Leard State Forest by 19 % to approximately 6,750 ha (Leard State Forest occurring outside the Project boundary and Leard National Park). While some of these species were recorded in similar habitats outside the Project boundary (during systematic Koala and hollow-bearing tree surveys, June 2009), the Project would effectively remove 180 known and potential territories that provided necessary habitat resources for these species. Other specific habitat features likely to be affected include down timber (used for foraging) and mature trees with mistletoe that is used by Painted Honeyeater which is a specialist forager.

Habitat for these Threatened species of woodland bird is likely to be 'core habitat' when considering metapopulation dynamics and that the majority require patches greater than 100 ha in order to maintain viable populations ((Counsilman 1979) (Department of Environment and Conservation 2005a). As this 'core habitat' corresponded with vegetation communities surrounding the current mine, thus generally associated with the greatest level of associated impacts, the habitat of the above listed species would be affected by the Project.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Woodland species of bird are commonly found within eucalyptus forests throughout NSW and Victoria. Therefore, no Threatened species of woodland bird that occur or have the potential to occur within the Project boundary are at the limit of their known distribution.

However, the western boundary of the Brown Treecreeper (eastern subspecies) runs approximately from Wagga Wagga, through Dubbo to Inverell (Department of Environment and Conservation 2005a). Along this line the eastern subspecies of the Brown Treecreeper (*Climacteris picumnus victoriae*) intergrades with the arid zone subspecies of Brown Treecreeper (*Climacteris picumnus picumnus*). Therefore, the eastern subspecies of the Brown Treecreeper could be considered as occurring at the limit of its known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would significantly increase three disturbance regimes (concerning these species), including the loss of native vegetation, dead wood and hollow-bearing trees; thereby affecting breeding and foraging home ranges. The Project would also increase edge effects and would essentially introduce edge effects into new areas. Grey-crowned babblers are known to utilise edge affected areas and as such, may provide potential habitat for this species.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant vegetation would be affected by the Project, thereby reducing the overall extent of known and potential habitat, connectivity would not be impacted any more than currently occurs in the locality. Moreover, due to the relatively large home range and mobility of each of these species (through vegetated corridors), this loss of vegetation is unlikely to result in isolation of habitat for Threatened woodland birds anymore than currently occurs within the locality. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that local populations of these species would become fragmented or isolated from other areas of habitat, however it would reduce the overall

extent of known habitat and further exacerbate key threatening processes for these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species due to their listing as Vulnerable species. The Project boundary is not considered to be critical to the survival of these species, however habitat occurring in Leard State Forest is considered to represent 'core habitat', particularly for sedentary species including Brown Treecreeper, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella.

Conclusion

Seven Threatened species of woodland bird including Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella, were recorded during recent field surveys. It is assumed that approximately 1,384 ha of known habitat (for seven of eight species assessed) would be affected by the Project (Figure E10). The Project would effectively remove approximately 180 known and potential territories for these species that provided foraging, roosting and breeding resources, and essentially provided 'core habitat' for those species which are considered sedentary (Brown Treecreeper, Hooded Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella).Moreover, populations of these species occurring in the Project boundary may act as a source for other remote populations; therefore, by reducing the size of the overall population, the source for other remote populations is also reduced.

Although it is recognised that these species are likely to exist in similar habitats in remaining Leard State Forest, the removal of such a large area of known habitat that provided limiting resources for these species, and a significant reduction in potential source populations, it is considered that the Project would have a significant impact on Threatened species of woodland bird.

E11. White-browed Woodswallow (*Artamus superciliosus*)

The White-browed Woodswallow currently has a preliminary determination to be listed as a Vulnerable species under the TSC Act. This species mostly inhabits eucalypt, sheoak and acacia woodland, inland/ coastal scrubs and open area with scattered trees and shrubs, including parks (Pizzey and Knight 2007). In agricultural landscapes this species is often associated with woodland patches exhibiting low disturbance and little grazing (Higgins, P.J. *et al.* 2006).

The White-browed Woodswallow occurs mostly west of the Great Dividing Range, in eastern, northern and central Australia. This species is largely absent from Western Australia and coastal eastern Australia. This species is highly nomadic and during prolonged drought, large flocks are known to visit coastal east and south east Australia (Pizzey & Knight 2007).

This species generally forages above the canopy and feeds on arthropods, including insects that swarm above vegetation. It is also known to feed on nectar and small native fruits (NSW Scientific Committee 2009f). The White-browed Woodswallow typically breeds in open forest and woodlands from the inland slopes to the far western plains from August to December, or after rain.

The threats that affect the White-browed Woodswallow include clearing and degradation of tree and shrub layers and firewood collection. These processes have a negative effect and place limitations on food supply and foraging substrates for this species. Moreover, the index of abundance for this species is positively correlated the number of remnants greater than 10 ha, shrub diversity and patch area and the amount of native vegetation cover (NSW Scientific Committee 2009f). Therefore, two Key Threatening Processes listed under the TSC Act affect this species; clearing of native vegetation and removal of dead wood and dead trees.

This species was recorded utilising habitat resources within the Project boundary during field surveys carried out in summer, winter and spring (refer Figure E11).

E11.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

The majority of observations of this species were associated with Grassy Woodland on Fertile Soils fauna habitat. This fauna habitat was associated with the fertile flats that surround the current Boggabri Coal pit and grade into the Shrubby Woodlands/ Open Forest on skeletal soils fauna habitat. It is assumed that approximately 1,384 ha of known habitat would be affected by the Project (Figure E11). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources for this species. Although the Project would reduce Leard State Forest by 19 %, such habitat resources would remain in remnant woodland occurring outside the Project boundary. Moreover, this species is regarded as nomadic and is capable of accessing off site habitat resources in the locality. Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west,

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(January, March, June and September 2009)

\# White-browed Woodswallow

Fauna Habitat Areas

- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition

- Good
- Moderate

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E11 - Distribution of known and potential habitat for White-browed Woodswallow

providing important habitat resources for foraging, roosting and breeding, it is not likely that the Project would affect the lifecycle of this species; however, it may temporarily affect the dynamics of local populations.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of known and potential habitat for this species would be affected by the Project (Figure E11). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources. Although the Project would reduce Leard State Forest by 17 %, a large (6,750 ha) continuous patch of remnant woodland would surround the Project to the north, east and west. While the Project would add incrementally to processes that are considered to be affecting this species, such as loss of native vegetation, this species is considered to be nomadic and is capable of accessing off site habitat resources.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The White-browed Woodswallow is mostly commonly found west of the Great Dividing Range in eastern, northern and central Australia. This species is considered highly nomadic and is known to breed from the inland slopes to the far western plains (Pizzey & Knight 2007). Furthermore, during drought years this species has been known to visit coastal eastern and south-eastern Australia. Therefore, the Project does not occur at the limit of this species known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Due to this species mobility and nomadic nature, the loss of this habitat is not likely to result in isolation of habitat for this species anymore than that currently occurring in the locality. The ability to access adjacent habitat and off site habitat resources occurring outside the Project will remain. Therefore, it is not likely that local populations of these species would become fragmented or isolated from other areas of habitat anymore than

currently occurs within the Project boundary; however it would reduce the overall extent of known habitat and further exacerbate key threatening processes for these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due its listing as a Vulnerable species. However, the site is unlikely to be critical to the survival of this species.

Conclusion

The White-browed Woodswallow was recorded using habitat resources in the Project boundary during field surveys. Although approximately 1,384 ha of known and potential habitat would be affected by the Project, this species is highly nomadic and is capable of accessing off-site habitat resources. Furthermore, approximately 6,750 ha of continuous remnant woodland will remain adjacent to the Project to the north, east and west. Therefore, this species is not likely to be significantly affected by the Project however, it would add incrementally to key threatening processes that affect this species.

E12. Spotted Harrier (*Circus assimilis*)

The Spotted Harrier is listed as a Vulnerable species under Schedule 2 of the TSC Act. The Spotted Harrier is widespread throughout most of the Australian mainland but individuals disperse widely, with this species being nomadic and irruptive in response to local conditions (food abundance). The Spotted Harrier occupies grassy open woodland, inland riparian woodland and grasslands, but is most commonly associated with native grassland and agricultural environments (NSW Scientific Committee – preliminary determination). This species builds a stick nest in open or remnant woodland and generally breeds from August to December or February to April (Pizzey & Knight 2007). The diet of the Spotted Harrier generally consists of terrestrial mammals (rodents), birds (quail) and reptiles (NSW Scientific Committee 2009d).

The main threat that affects this species is the clearing and degradation of foraging and breeding habitat, particularly where it affects prey densities. Other threats include the possibility of secondary poisoning from rodenticides and pindone used to control rabbits (NSW Scientific Committee 2009d).

This species was recorded in agricultural land associated with the proposed rail corridor (refer Figure E12).

E12.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

The Spotted Harrier was recorded in agricultural land associated with the proposed rail corridor during recent field surveys. While it is assumed that approximately 1,384 ha of remnant woodland in subject site would be affected by the Project, this area is not considered to represent core habitat for this species. While the Spotted Harrier may utilise Leard State Forest as potential foraging habitat, this species is more commonly associated with native grassland and agricultural landscapes, where they hunt low over the ground searching for prey. While the Project would affect 26.5 ha of potential foraging habitat, along the proposed rail corridor, similar habitat would still remain in the area. Moreover, this linear structure would not remove vast amounts of foraging habitat. While vegetation in Leard State Forest could be potentially used as nesting/ breeding habitat, remnant vegetation would still occur within the locality and the Project boundary. Therefore, while the Project would remove foraging and potential nesting habitat, it is not likely that the lifecycle of this species would be affected, with similar environments existing in the locality.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It has been estimated that approximately 26.5 ha of known foraging habitat (grassland and agricultural crops, where this species was recorded) would be affected by the Project (Figure E12). A further 1,384 ha of remnant vegetation occurring in the Project boundary would also be affected. However, this area is not considered to represent core habitat for this species, although it is recognised

PB Threatened Species Survey
(January, March, June and September 2009)
\# Spotted Harrier

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E12 - Distribution of known and potential habitat for Spotted Harrier

that it may provide potential nesting and foraging opportunities. While the Project would remove approximately 1,384 ha of remnant vegetation, this species is likely to exist in similar habitats that would remain in the locality. Moreover, grasslands and agricultural landscapes surround Leard State Forest, with Leard State Forest essentially occurring as an island of remnant woodland. Therefore, suitable foraging habitat and nesting opportunities in remnant vegetation in the locality would remain post development. Furthermore, the Project may create new habitat for this species at the completion of mining activities when the subject site (particularly the open cut pit) is likely to be rehabilitated.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Spotted Harrier is widespread throughout most of the Australian mainland, except in densely forest or wooded habitats of the coast. While this species is widespread, individuals are sparsely distributed, with this species being nomadic and irruptive in response to local conditions. Therefore, the Project is not at the limit of this species known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant vegetation and foraging habitat (grassland and agricultural crops) would be affected by the Project, thereby reducing the overall extent of known and potential habitat, connectivity would not be affected significantly more than currently occurs in the locality.

Due to the mobility of this species and its association with agricultural landscapes, this loss of vegetation is unlikely to result in isolation of habitat for the Spotted Harrier anymore than currently occurs within the locality. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that individuals or a

local population of this species would become fragmented or isolated from other areas of habitat. However, it would reduce the overall extent of known habitat and further exacerbate key threatening processes for these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

The Spotted Harrier was recorded foraging over grassland and agricultural crops associated with the proposed rail corridor during field surveys. It has been estimated that approximately 26.5 ha of known foraging habitat (grassland and agricultural crops, where this species was recorded) would be affected by the Project, with a further 1,384 ha of remnant vegetation occurring in the Project Boundary also affected. However, this area is not considered to represent core habitat for this species. As this species is likely to exist in similar agricultural environments and remnant vegetation in the locality, it is not likely that this species would be significantly affected by the Project.

E13. Black-necked Stork (*Ephippiorhynchus asiaticus*)

The Black-necked Stork is listed as Endangered under the TSC Act. This species is widespread across coastal and sub-coastal north and eastern Australia from Port Hedland in Western Australia to the Central Coast in NSW (Pizzey & Knight 2007), although heading south from the Queensland border, this species is increasingly uncommon. This species has been recorded as far south as Victoria and inland to the Macquarie marshes, although it is only considered a vagrant in such locations (Pizzey & Knight 2007). On the southern and western limits of this species range, individual records have declined significantly, with only occasional records occurring on the south coast or west of the Great Dividing Range (NSW Scientific Committee 1998).

Black-necked Storks are generally considered sedentary (Pizzey & Knight 2007) but some individuals may travel long distances and have can be recorded outside their normal range (NSW Scientific Committee 1998).

This species inhabits permanent freshwater wetlands, swamps, shallow floodwaters and adjacent grasslands. It can also be found on tidal mudflats, mangroves, estuaries, farm dams, sewage ponds, irrigated lands and open woodland. This species feeds in shallow water on prey such as fish, frogs, eels and turtles (NSW Scientific Committee 1998).

Black-necked Stork breeds during late summer in the north of its range and early summer further south. Nests are large and made high and exposed in tall live or dead tree in proximity to a freshwater swamp (NSW Scientifc Committee 1998; NSW Scientific Committee 1998). In northern NSW this species continues to breed river valleys, although few nests occur within each valley.

Removal of remnant vegetation and individual trees is regarded as one of the major threats to this species. The scarcity of nest sites also increases competition for those available with other species of bird. Modifications to wetlands also threaten this species and while artificial water sources do provide new areas of habitat, such habitat is often sub-optimal for Black-necked Stork (NSW Scientifc Committee 1998).

This species was recorded foraging in a mine dam within the Project boundary in August and September 2009 (refer Figure E13).

E13.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

While the Project would affect a large area of remnant vegetation, it is estimated that approximately two hectares of known and potential foraging habitat for this species would be affected. Furthermore, records for this species occurring west of the Great Dividing Range are generally considered vagrants with most breeding records occurring in river valleys of northern NSW. Although breeding records occur as far south as Shoalhaven Heads, no breeding records have been recorded south of Port Stephens for a number of years (NSW Scientific Committee 1998). Moreover, with the paucity of records in the locality, it is not likely that the Project would affect the lifecycle of this species.

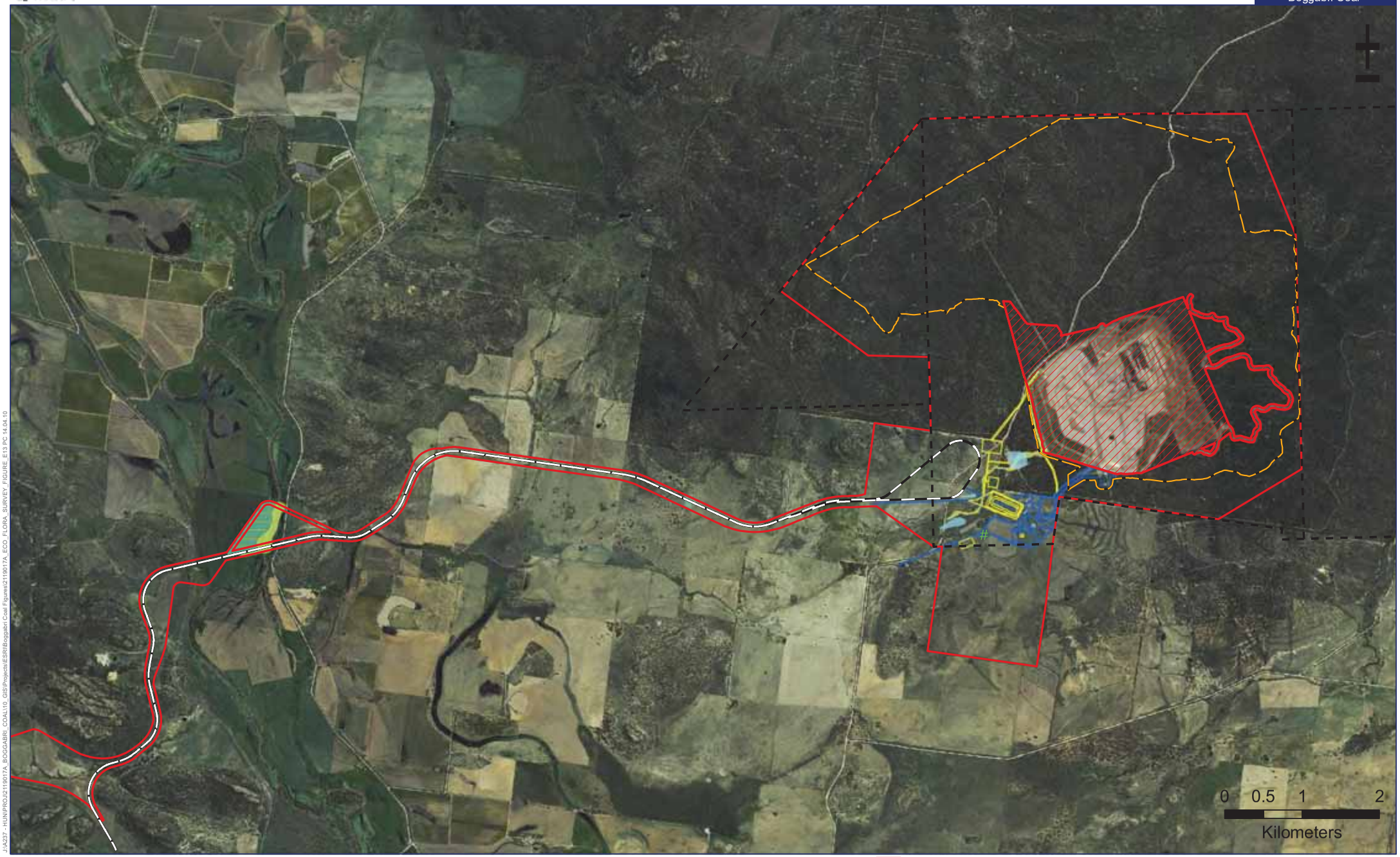
How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. While the Project would affect a large area of remnant woodland, only two hectares (approximately) of known and potential foraging habitat for this species would be affected.

The Namoi River and its' floodplain would provide potential habitat during favourable conditions for this species. A rail corridor, proposed as part of the Project, is required to cross the Namoi River which would affect approximately one hectare of potential habitat. Other habitat in the Project boundary, were this species was recorded, provided marginal habitat at best for this species. It is likely that as a result of the Project, water sources would increase; although it is recognised that such habitat would be sub-optimal for this species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Black-necked Stork occurs along coastal and sub-coastal northern and eastern Australia, with records declining significantly down the NSW coast (Pizzey & Knight 2007). Due to the paucity of records for this species west of the Great Dividing Range, the Project boundary could be considered at the limit of this species range. However, this species has been recorded as far south as Victoria and inland to Macquarie Marshes (Pizzey & Knight 2007), therefore, although records are likely to be vagrants, the Project Boundary is not considered to occur at the limit of this species range.



PB Threatened Species Survey
(January, March, June and September 2009)
\# Black-necked Stork

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbnace Limit (Boggabri Extention)
- Sediment Dam

Figure E13 - Distribution of known and potential habitat for Black-necked Stork

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would not significantly increase disturbance regimes concerning this species, however, the Project would result in the loss of a small area (two ha) of marginal habitat. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Due to this species mobility, with some individuals travelling long distances(NSW Scientific Committee 1998), the loss of two hectares of marginal habitat is not likely to result in isolation of habitat for this species anymore than that currently occurring in the locality. The ability to access adjacent habitat and off site habitat resources occurring outside the Project will remain; however it would reduce the overall extent of known habitat and further exacerbate threatening processes that affect this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

Although the Black-necked Stork was recorded in the Project boundary during field surveys, the removal of two hectares of marginal habitat is not likely to significantly affect this species. Moreover, this species is only vagrant to areas west of the Great Dividing Range, with most records occurring in coastal and sub-coastal regions.

E14. Little Lorikeet (*Glossopsitta pusilla*)

Little Lorikeet is listed as a Vulnerable species under the TSC Act (NSW Scientific Committee 2009c). This parrot is endemic to Australia and is the smallest of the Australian lorikeets (NSW Scientific Committee 2009c). This species range extends along coastal eastern Australia from Cooktown to south-east South Australia. It is inhabits forests and woodlands, with most associations occurring in dry, open eucalypt forest and woodlands. In NSW its range extends from the coast to the western slopes of the Great Dividing Range, with a western limit considered in the vicinity of Parkes, Dubbo and Narrabri (Pizzey & Knight 2007). While this species is not considered to be migratory, it is generally recognised to be nomadic (Higgins, P.J 1999), particularly concerning food availability, with irregular influxes occurring at any time. long term investigation of the breeding population on the north-western slopes indicates that breeding birds are resident from April to December, and even during their non-resident period, they may return to the nest area for short periods if there is some tree-flowering in the vicinity (Courtney J. 2006).

Little Lorikeets are gregarious, foraging in small flocks and usually with other species of lorikeet, whereby they feed primarily on nectar and pollen in the tree canopy (NSW Scientific Committee 2009c). On the Western slopes of NSW, White Box and Yellow Box are considered to be important food resources for pollen and nectar respectively (Courtney J. 2006). Most breeding records come from the western slopes of NSW (where there has been extensive loss of habitat from historic clearing), with the breeding season extending from May to September (Higgins 1999). Nest hollows are located at heights of 2 m to 15 m (Courtney J. 2006) in smooth-barked eucalypts including Blakely's Red Gum. Long-term studies of this species on the north-west slopes of NSW (Courtney J. 2006) indicate that nest hollows are used traditionally, whereby the same hollow is known to be occupied for at least 29 years, although, not necessarily by the same individuals.

Over 50 % of forest and woodlands in NSW have been cleared (Lunney 2004), coupled with the fact that most breeding records come from the western slopes, a region that has extensive habitat loss from historic clearing, the main threat that affects this species is the further loss and degradation of foraging and breeding habitat from land clearing (NSW Scientific Committee 2009c). Furthermore, nest hollows are not being recruited at a rate that compensates the loss of breeding habitat (Courtney J. 2006) and the loss of eucalypt woodland results in large reductions in food availability, particularly White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, an important habitat for Little Lorikeet, which is listed as Critically Endangered under the EPBC Act.

Little Lorikeet was recorded frequently in the Project boundary during field surveys (refer Figure E14).

PB Threatened Species Survey
(January, March, June and September 2009)
\# Little Lorikeet

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E14 - Distribution of known and potential habitat for Little Lorikeet

E14.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Approximately 1,384 ha of known breeding and foraging habitat for the Little Lorikeet would be affected by the Project (Figure E14). Most breeding records for Little Lorikeet come from the north-west slopes of the NSW (Courtney J. 2006), and as most nest hollows are traditionally used over many years, coupled with nest hollows not being recruited at a rate that exceeds their loss, such habitat could be considered to provide important resources.

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a 8,134 ha remnant stand of vegetation (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. During field surveys this species was recorded in fauna habitats including, Grassy Woodland on fertile soils and Shrubby Woodland/ Open Forests on skeletal soils.

The removal of approximately 1,384 ha of remnant vegetation would reduce Leard State Forest by 17 %. While habitat resources for these species, such as hollow-bearing trees, were recorded in greater densities within the Project Boundary (area of proposed impacts) (refer Section 3-4), such habitat resources (including breeding resources) were recorded and observed to be used in the study area occurring outside the Project Boundary (remaining Leard State Forest).

Little Lorikeet was associated with most vegetation communities surrounding the current mine operations and was observed to forage and breed in Grassy Woodland on fertile soil fauna habitat during field surveys. Hence, this species was associated in areas with the greatest level of impact. However, as Leard State Forest would only be reduced by 17 %, leaving a large continuous patch of remnant forest and Leard National Park, it is likely that this species, which is known to be nomadic, would exist in similar habitat within remaining Leard State Forest. Moreover, foraging and breeding resources were recorded and observed to be utilised in that part of the study area occurring outside the Project boundary. While the loss of 1,384 ha of known habitat would add incrementally to the loss of foraging habitat and important resources such as tree hollows, the removal of this habitat is not likely to affect the lifecycle of this species within the locality.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of known habitat would be affected by the Project (Figure E14). Vegetation to be removed provided known breeding and foraging habitat for this species, with this species being recorded frequently within the Project Boundary and in the remaining study area (Leard State Forest). The removal of approximately 1,384 ha of remnant vegetation would effectively reduce this large continuous patch of vegetation by 17 % to 6,750 ha. Important habitat resources, such as tree hollows, were recorded (marginally) in greater densities within the Project Boundary (refer section 3-4), such resources were recorded in that part of the study area occurring outside the Project boundary (remaining Leard State Forest). Although this Project would reduce Leard State Forest by 17 %, the remaining large continuous patch of remnant woodland is likely to support resources considered important for this species. While the Project is likely to affect the dynamics of a local population, it is not likely to substantially

affect habitat for this species in the locality with the Project reducing remnant vegetation cover in the locality from approximately 51 % to 48 %.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Little Lorikeet is distributed along coastal eastern Australia from Cooktown to South-east South Australia. In NSW this species range extends to the western slopes of the Great Dividing Range, with a western limit occurring in the vicinity of Parkes, Dubbo and Narrabri. Therefore, the Project could be considered to occur near the western limit of this species' range.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation and loss of hollow-bearing trees, which are known disturbances for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.**How is the Project likely to affect habitat connectivity?**

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest (including Leard National Park) essentially occurs as a large 8,134 ha (James B. Croft and Associates 1983) continuous patch of remnant woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, effectively reducing Leard State Forest by 17 %, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant woodland, comprising breeding and foraging habitat, would be affected by the Project, thereby reducing the overall extent of known habitat, connectivity would not be impacted any more than currently occurs in the locality.

Due to the mobility of this species, which is considered to be nomadic in response to feeding resources, the ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that individuals or a local population of this species would become fragmented or isolated from other areas of habitat. However, it would reduce the overall extent of known habitat and further exacerbate key threatening processes for these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-

General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

Little Lorikeet was frequently recorded foraging within the Project boundary during field surveys and was also observed breeding both within and outside the Project boundary. It is assumed that approximately 1,384 ha of known habitat would be affected by the Project, effectively reducing Leard State Forest by 17 %. Although the Project would reduce the extent of known habitat, Leard State Forest would still remain as a large (6,750 ha) continuous patch of remnant woodland. While important habitat resources, such as tree hollows, would be affected by the Project, such resources would still occur in the remaining Leard State Forest. Thus, this species is likely to exist in similar environments and remnant vegetation within the locality and as such, the Project is not likely to have a significant effect on this species.

E15. Little Eagle *(Hieraaetus morphnoides)*

The Little Eagle is listed as a Vulnerable species under Schedule 2 of the TSC Act (NSW Scientific committee 2009b). The Little Eagle is distributed throughout most of the Australian mainland, except in the most densely forested parts of the Great Dividing Range escarpment (NSW Scientific committee 2009b), with adults being sedentary (to partly migratory in autumn-winter) and young being dispersive (Pizzey & Knight 2007). The Little Eagle occupies plains, foothills, open eucalypt forest and woodland or open woodland, while acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993).This species builds a large stick nest in tall living trees within remnant patches of vegetation and generally breeds from July to October, and earlier in the south (Pizzey & Knight 2007). The diet of the Little Eagle generally consists of terrestrial mammals, birds and reptiles (NSW Scientific committee 2009b).

Over 50 % of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW Scientific committee 2009b). On the NSW tablelands and western slopes, important habitat is 53 – 84 % cleared and moderately to highly stressed (NSW Scientific committee 2009b). Loss of breeding sites may bring this species into increasing interspecific competition with the larger and more dominant Wedge-tailed Eagle.

This species was recorded soaring, on numerous occasions, over the Project boundary (refer Figure E15).

E15.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Approximately 1,384 ha of known and potential foraging and breeding habitat for Little Eagle would be affected by the Project (Figure E15), effectively reducing Leard State Forest by 17 %. Although the Project would reduce potential breeding opportunities for this species, by removing tall living trees, which is a requirement for this species to build a nest, the remaining large (6,750 ha) continuous patch of remnant woodland that would border the Project to the north, east and west, is likely to support nesting and foraging resources for this species. Moreover, given the mobility of this species and large home ranges occupied, this species would be able to occupy similar habitats in the locality. While the loss of 1,384 ha of known habitat would add incrementally to the loss of foraging and breeding habitat, it is not likely to substantially affect the lifecycle of this species in the locality.

PB Threatened Species Survey
(January, March, June and September 2009)
\# Little Eagle

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E15 - Distribution of known and potential habitat for Little Eagle

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a 8,134 ha remnant stand of vegetation (James B. Croft and Associates 1983), surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. During field surveys this species was recorded soaring over Leard State Forest. The Little Eagle is known to occupy eucalypt forest, woodland and open woodland; therefore, it is assumed that approximately 1,384 ha of known habitat would be affected by the Project (Figure E15). Vegetation to be removed provided known breeding and foraging habitat for this species. The removal of approximately 1,384 ha of remnant vegetation would effectively reduce this large continuous patch of vegetation by 17 % to 6,750 ha. However, the remaining large continuous patch of remnant woodland that would border the Project to the north, east and west, is likely to support nesting and foraging resources for this species. So, while the Project is likely to affect the dynamics of a local population, it is not likely to substantially affect habitat for this species in the locality.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Little Eagle is distributed throughout most of the Australian mainland, except in the most densely forested parts of the Great Dividing Range escarpment (NSW Scientific committee 2009b). Therefore, the Project is not at the limit of this species known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) patch of remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant vegetation, comprising nesting and foraging habitat, would be affected by the Project,

thereby reducing the overall extent of known and potential habitat, connectivity would not be affected any more than currently occurs in the locality. Due to the large home range and mobility of this species, the ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that individuals or a local population of this species would become fragmented or isolated from other areas of habitat. However, it would reduce the overall extent of known habitat and further exacerbate key threatening processes for this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

It is estimated that approximately 1,384 ha of known foraging habitat and potential breeding habitat would be affected by the Project. While this reduction would add incrementally to the loss of foraging and breeding habitat in the locality, it is not likely to significantly affect this species, as a large (6,750 ha), continuous patch of remnant woodland would occur adjacent to the Project to the north, east and west, which is likely to provide foraging and nesting opportunities.

E16. Swift Parrot (*Lathamus discolour*)

The Swift Parrot is listed as Endangered under the EPBC Act and the TSC Act. Swift Parrots migrate to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (Department of Environment and Conservation 2006c). Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens* (Higgins, P.J 1999). The parrots return to home foraging sites on a cyclic basis depending on food availability (Department of Environment and Conservation 2006c). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum *E. globulus* (Webster 1988).

On mainland Australia, the main threat affecting this species is the loss of habitat through clearing for agriculture and urban and industrial development. During the breeding season and winter migration, collisions with wire netting fences, windows and cars, threaten this species, particularly where such obstacles are in close proximity to suitable habitat (Department of Environment and Conservation 2006).

Surveys were completed during winter when Swift Parrots' arrive in their wintering grounds on mainland Australia. This species was not recorded during current surveys, however, the Project boundary provided potential habitat for this species in the form of suitable winter foraging resources (*E. albens*) (refer Figure E16).

E16.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Will the action lead to a long-term decrease in the size of a population of a species?

The Project would remove approximately 1,384 ha of potential foraging habitat for this species (Figure E16). As Swift Parrots breed in Tasmania and given the high mobility of this species, no breeding resources would be affected by the Project and off site foraging resources could be accessed by this species. Therefore, it is not likely that the Project would lead to a long-term decrease in this species.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E16 - Distribution of potential habitat for Swift Parrot

Will the action reduce the area of occupancy of the species?

The Project would remove approximately 1,384 ha of potential foraging habitat for this species. The area of occupancy for this species has declined significantly since European settlement with 70 % of Box-Ironbark habitat in NSW (principal wintering habitat of the Swift Parrot on mainland Australia) having been cleared (Environment Conservation Council 2001). Another important habitat in NSW, White Box, Yellow Box, Blakely's Red Gum has been reduced to less than four percent of its pre-European extent (Saunders & Heinsohn 2008). Therefore, the removal and incremental loss of approximately 1,384 ha of potential habitat is likely to reduce the area of occupancy for this species. However, this species would still be able to access similar condition vegetation in the locality, including within Leard State Forest.

Will the action fragment an existing population into two or more populations?

Swift Parrots are highly mobile and have a large foraging range that allows them to use similar habitat resources in the locality and region. Therefore, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the EPBC Act or the TSC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of foraging habitat for this species, which would not meet these criteria in that similar resources are available in the locality. More importantly, Lead State Forest and Leard National Park would surround the Project to the north, east and west, and effectively occur as a large (6,750 ha), continuous patch of remnant woodland. Therefore, habitat in the Project boundary is not considered critical to the survival of this species.

Will the action disrupt the breeding cycle of a population?

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Department of Environment and Conservation 2006c). While Swift Parrots are dependent on flowering resources across a wide range of habitats (woodlands and forests) in its wintering grounds in NSW, the removal of approximately 1,384 ha of potential habitat is not likely to disrupt their migratory patterns. As such it is not likely to affect their breeding cycle.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Approximately 1,384 ha of potential foraging resources for Swift Parrots would be affected by the Project. It is not likely that the Project would further isolate or decrease the availability of this habitat so that the species declines. Moreover, within the locality,

the Project would only reduce remnant vegetation cover by three percent, from 51 % to 48 %.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is not likely that invasive species (such as introduced predators) that are harmful to the Swift Parrot would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the Project.

Will the action interfere with the recovery of the species?

The *Action Plan for Australian Birds* (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Swift Parrot Recovery Plan (Swift Parrot Recovery Team 2001) include:

- Identify priority habitats and sites across the range of the swift parrot.
- Implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity.
- Reduce the incidence of collisions with man-made structures.
- Determine population trends within the breeding range.
- Quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat.
- Increase public awareness about the recovery program and to involve the community in the recovery.

Based on the potential ecological impacts of the Project on this species, as discussed above, it is not likely that the Project would interfere with the recovery of this species.

Conclusion

Although the Swift Parrot was not recorded in the Project boundary during current surveys, the Project boundary provided potential foraging resources in the form of winter flowering White Box. The Project would affect approximately 1,384 ha of remnant woodland and would essentially decrease the area of occupancy of this species on the north western slopes and plains. However, given the species high mobility and ability to access adjacent remnant woodland in the locality, it is not likely that this species would be significantly affected by the Project. However, it would further exacerbate key threatening processes that affect this species.

E16.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Department of Environment and Conservation 2006c). While Swift Parrots are dependent on flowering resources across a wide range of

habitats (woodlands and forests) in its wintering grounds in NSW, the removal of approximately 1,384 ha of potential habitat is not likely to disrupt their migratory patterns. Moreover, 6,750 ha remnant vegetation (remaining Leard State Forest and Leard National Park) would remain adjacent to the Project to the north, east and west. Therefore, the Project is not likely to affect the lifecycle of this species.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of potential foraging habitat for the Swift Parrot would be affected by the Project (Figure E16). As breeding events for this species occur in Tasmania (summer), no critical breeding resources would be affected by the Project. The Project would add incrementally to the loss of winter foraging grounds for this species with approximately 1,384 ha affected. However, given the mobility of this species, it is not considered to be significant in terms of the available (potential) habitat in the wider locality.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

During winter the Swift Parrot migrates throughout eastern Australia from Victoria to the eastern parts of South Australia and north to south-east Queensland. In NSW the Swift Parrot is found in coastal regions and along the western slopes. Therefore, the Project boundary is not at the distributional limit of the species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Whilst a large tract of remnant vegetation would be affected by the Project, thereby reducing the overall extent of potential habitat, connectivity would not be impacted any more than currently occurs in the locality. Leard State Forest essentially occurs as a large (8,134 ha) remnant patch of woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation it is not likely to fragment remaining Leard State Forest/ Leard National Park, with 6,750 ha of continuous remnant woodland bordering the Project to the north, east and west. Due to the large home range and mobility of this species, this loss of habitat is not likely to result in isolation of habitat for this species. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that local populations of these species would become fragmented or isolated from other areas of habitat anymore than currently occurs within the Project boundary. Moreover, while habitat for this species is

fragmented, the species' distribution is not severely fragmented. Swift Parrots are highly mobile and therefore the population is not fragmented (Swift Parrot Recovery Team 2001).

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, population or ecological community. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species. The Project would essentially remove 1,384 ha of potential habitat for this species, which would effectively reduce Leard State Forest by 17 %. However, this species is migratory and due its high mobility; this species is capable of accessing off site habitat resources. Moreover, Swift Parrots breed in spring/ summer in Tasmania and as such, no breeding habitat would be affected by the Project. Therefore, habitat occurring in the Project boundary is not considered critical habitat.

Conclusion

Although the Swift Parrot was not recorded in the Project boundary during current surveys, the Project boundary provided potential foraging resources in the form of winter flowering White Box. The Project would affect approximately 1,384 ha of remnant woodland and would essentially decrease the area of occupancy of this species on the north western slopes and plains. However, given the species high mobility and ability to access adjacent remnant woodland in the locality and region, it is not likely that this species would be significantly affected by the Project. However, it would further exacerbate key threatening processes that affect this species.

E17. Square-tailed Kite (*Lophoictinia isura*)

The Square-tailed Kite (Debus *et al.* 1993)is listed as a Vulnerable species under the *Threatened Species Conservation Act 1995* (NSW National Parks and Wildlife Service 1999b). This raptor is endemic to Australia and is widespread throughout the mainland, although it is sparsely distributed (Marchant and Higgins 1993). The species is recorded along coastal and sub-coastal areas, from south-western to northern Australia, Queensland, NSW and Victoria. Scattered records throughout NSW indicate that the species is a regular resident along the major west-flowing river systems. This species is also migratory throughout its range and is a summer breeding migrant to south-eastern and south-western Australia. The Square-tailed Kite inhabits open forests, woodlands with particular preference for timbered watercourses. Within NSW, the species is often associated with ridge and gully forests containing *Eucalyptus longifolia* (Woollybutt), *E. maculata* (Spotted Gum) *E. elata* (River Peppermint) and *E. smithii* (Ironbark Peppermint), as well as forests containing Angophora and Callitris and Box-Ironbark woodland.

The Square-tailed Kite occupies large home ranges, in the order of 100 square kilometres, and is specialist hunter of passerines (particularly honeyeaters) and foliage insects, with most prey taken from the outer foliage of the tree canopy (NSW National Parks and Wildlife Service 1999b). Breeding occurs from July to February with an average clutch size of three eggs. Nest sites are generally located near watercourses in a fork or large horizontal branches of eucalypts or Angophora tree species.

Except when breeding, this species tends to be a solitary bird, usually seen hunting alone high in, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland. Nests have been reported in *Eucalyptus* spp., *Angophora* spp. and native pine forests. Prey taken has included fledging birds, insects, rabbits and lizards.

Over 50 % of forest and woodlands in NSW have been cleared (Lunney 2004), thus, the main threat that affects this species is the further clearing and degradation of foraging and breeding habitat (NSW National Parks and Wildlife Service 1999b).

This species has been anecdotally recorded in Leard State Forest.

E17.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

The Square-tailed Kite has been anecdotally recorded in Leard State Forest (David Robertson 2009). Approximately 1,384 ha of potential foraging and breeding habitat for Square-tailed Kite would be affected by the Project (Figure E17), effectively reducing Leard State Forest by 17 %. Although the Project would reduce potential foraging and breeding opportunities for this species, remaining Leard State Forest/ Leard National Park would occur as a large (6,750 ha) continuous patch of remnant woodland surrounding the Project to the north, east and west. Thus, it is likely to support nesting and foraging resources for this species. Moreover, given the mobility of this species and large home ranges occupied, this species would be able to occupy similar habitats in the locality. While the loss of 1,384 ha of potential habitat would add incrementally to the loss

of foraging and breeding habitat, it is not likely to substantially affect the lifecycle of this species in the locality.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a 8,134 ha remnant stand of vegetation (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Square-tailed Kite is known to occupy territories up to 100 square kilometres in eucalypt forest, woodland, open woodland and riparian woodland (NSW National Parks and Wildlife Service 1999b); therefore, it is assumed that approximately 1,384 ha of known habitat would be affected by the Project (Figure E17). Habitat to be removed provided potential breeding and foraging resources for this species. The removal of approximately 1,384 ha of remnant vegetation would effectively reduce this large continuous patch of vegetation by 17 % to 6,750 ha. However, the remaining large continuous patch of remnant woodland (remaining Leard State Forest/ Leard National Park) that would border the Project to the north, east and west, is likely to support potential nesting and foraging resources for this species. While the Project might affect the dynamics of a local population, it is not likely to substantially affect habitat for this species in the locality.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Square-tailed Kite is widespread throughout the mainland, although it is sparsely distributed (Marchant & Higgins 1993). The species is recorded along coastal and sub-coastal areas, from south-western Australia to northern Australia, Queensland, NSW and Victoria. Scattered records throughout NSW indicate that the species is a regular resident along the major west-flowing river systems. This species is also nomadic throughout its range and is a summer breeding migrant to south-eastern and south-western Australia. Therefore, the Project is not at the distributional limit of this species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E17 - Distribution of potential habitat for Square-tailed Kite

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) patch of remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant vegetation, comprising potential breeding and foraging habitat, would be affected by the Project, connectivity would not be impacted any more than currently occurs in the locality. Due to the large home range and mobility of this species, the ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that individuals or a local population of this species would become fragmented or isolated from other areas of habitat. However, it would reduce the overall extent of known habitat and further exacerbate key threatening processes for these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

The Square-tailed Kite has been anecdotally recorded in Leard State Forest. It is estimated that approximately 1,384 ha of potential foraging habitat and breeding habitat would be affected by the Project. While this reduction would add incrementally to the loss of foraging and breeding habitat in the locality, it is not likely to significantly affect this species, as a large (6,750 ha), continuous patch of remnant woodland would surround the Project to the north, east and west, which is likely to provide foraging and nesting opportunities.

E18. Turquoise Parrot (*Neophema pulchella*)

The Turquoise Parrot is listed as Vulnerable under Schedule 2 of the TSC Act. This species was recorded during field surveys, in Grassy Woodlands on fertile soils fauna habitat (refer Figure E18).

Turquoise Parrots occur in the foothills of the Great Dividing Range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey, often in the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland (Department of Environment and Conservation 2006c). They nest in tree hollows, stumps or even fence posts, from August to December, laying four or five eggs on a nest of decayed wood dust. This species is usually seen in pairs or small, possibly family, groups and has also been reported in flocks of up to 30 individuals (Higgins, P.J 1999). The parrots spend most of the day on the ground and feed on seeds of both native and introduced grass and herb species. They forage quietly and may be quite tolerant of disturbance (Garnett & Crowley 2000).

E18.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

It is assumed that approximately 1,384 ha of known habitat for Turquoise Parrot would be affected by the Project (Figure E18). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources. Remnant woodland occurring in the Project boundary could be considered to provide a critical resource, particularly hollow trees, simply because of the extensively cleared landscape within the Southern Brigalow Belt bioregion (Resource and Conservation Assessment Council 2000).

However, Boggabri Coal currently operates on the southern edge of Leard State Forest, which occurs as an 8,134 ha remnant stand of vegetation, surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. This species is known to use tree hollows for important roosting and breeding, with most associations for this species occurring in Riverine Woodland and Grassy Woodlands on fertile soils habitat throughout the Project boundary. Although the Project would reduce Leard State Forest by 17 %, such habitat resources would remain in remnant woodland occurring outside the Project boundary (Leard State Forest). More importantly, it was observed during detailed systematic hollow-bearing tree surveys of the study area that similar densities of this important resource were recorded both inside and outside the Project boundary (refer Section 3-4 and Figure 3-10). Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west, providing similar condition habitat, it is not likely that the Project would affect the lifecycle of these species; however, it may temporarily affect the dynamics of local populations.

PB Threatened Species Survey
(January, March, June and September 2009)

\# Turquoise Parrot

Fauna Habitat Areas

- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition

- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E18 - Distribution of known and potential habitat for Turquoise Parrot

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384 ha of known foraging and potential breeding habitat (Figure E18). Individuals of this species that are known to occur within the Leard State Forest may essentially utilise this remnant habitat as their entire home range, although, Turquoise Parrot is commonly associated with disturbed areas and often favours the ecotone of forest edges and pasture or other grasslands (NSW Department of Environment and Climate Change 2009f).

Although the Project would reduce Leard State Forest by 17 %, in the locality the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1). Moreover, this species is likely to exist in similar habitats within remaining Leard State Forest, as a large (6,750 ha) patch of continuous remnant woodland would surround the Project to the north, east and west. Furthermore, tree hollows, which are important roosting and breeding resources, were recorded in similar densities outside the Project boundary (refer Section 3.4 and Figure 3-10). As this species is highly mobile, remnant habitat occurring outside the Project boundary is likely to support local populations of this species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The distribution of the Turquoise Parrot in eastern Australia extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (Department of Environment and Conservation 2007). Therefore, the Project boundary is not at the distribution limit of this species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest, however those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation and loss of dead wood and hollow-bearing trees, which are known disturbances for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest (including Leard National Park) essentially occurs as a large 8,134 ha continuous patch of remnant woodland (James B. Croft and Associates 1983), surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, effectively reducing Leard State Forest by 17 %, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant woodland, comprising breeding and foraging habitat, would be affected by the Project, thereby reducing the overall extent of habitat, connectivity would not be impacted any more than currently occurs in the locality. Furthermore, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1).

Due to the relatively large home range and mobility of this species, this loss of vegetation is unlikely to result in isolation of habitat for these species anymore than currently occurs within the locality. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is not likely that a local population of this species would become fragmented or isolated from other areas of habitat, however, it would reduce the overall extent of known habitat and further exacerbate threatening processes that affect this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due to its listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

The Turquoise Parrot was recorded regularly within that part of the Project boundary concerning Leard State Forest. Although the Project would affect a large area of known habitat for this species, 6,750 ha of similar condition woodland would surround the Project to the north, east and west. Furthermore, as important habitat resources, such as tree hollows, were recorded in similar densities outside the Project Boundary, it is not likely that the Project would have a significant effect on this species.

E19. Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*)

The Barking Owl and Masked Owl have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as result of the Project.

Barking Owl – *Ninox connivens*

The Barking Owl is listed as Vulnerable under Schedule 2 of the TSC Act. This species was recorded during field surveys at survey sites S3 and S15. Riverine Woodland and Grassy White Box Woodland on fertile soils that occur in the Project Boundary contained foraging resources and tree hollows considered suitable for breeding (refer Figure E19).

Barking Owls inhabit eucalypt woodland, open forest, swamp woodlands, and especially in inland areas, timber along watercourses (Pizzey & Knight 1997). Dense vegetation is used occasionally for roosting. During the day this species roosts along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts (Higgins, P.J 1999).

Barking Owls feed on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals, such as smaller gliders, possums, rodents and rabbits, becoming important during breeding. Estimates of Barking Owl home ranges indicated that territories range from 30 ha to 200 ha and hunt 5 km from roosts (Higgins, P.J 1999). However, surveys in the Pilliga forests of western NSW (Kavanagh, R. P. 2009) found that Barking Owl home ranges averaged approximately 2,000 ha. Regurgitated pellets also showed that prey items consisted of mostly birds, insects and some mammals.

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*), Red Box (*Eucalyptus polyanthemos*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are 2 m to 35 m above the ground with a diameter of 20 cm to 46 cm and depth of 20 cm to 300 cm. Breeding occurs during late winter and early spring (NSW National Parks and Wildlife Service 2003).

Cluster analysis of records from NSW Wildlife Atlas within 300 km diameter around the Pilliga forests (Soderquist 2009) identified seven Barking Owl populations in the region of north-west NSW. The Pilliga population spreads to the Warrumbungle ranges and to the lower slopes of Mount Kaputar. While this population is an extensive one, no obvious lines of connectivity to other populations in the region were evident. Moreover, the gaps between these populations are generally wide expanses of mostly cleared habitat and without knowledge of juvenile dispersal ability, connectivity across the landscape cannot accurately be determined (Soderquist 2009).

PB Threatened Species Survey
(January, March, June and September 2009)

Barking Owl

Masked Owl

Fauna Habitat Areas

- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition

- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E19 - Distribution of known and potential habitat for Barking Owl and Masked Owl

Masked Owl – *Tyto novaehollandiae*

The Masked Owl is listed as Vulnerable under Schedule 2 of the TSC Act. This species was recorded during targeted field surveys at survey site S18 (refer Figure E19), while also being anecdotally recorded within Leard State Forest (David Robertson 2009).

Masked Owls are distributed mainly throughout NSW from the coast where it is most abundant to the western plains (NSW Scientific Committee 2004), where they inhabit a diverse range of wooded habitats including eucalypt forests, woodlands and almost treeless inland plains. Optimal habitat includes an open understorey and a mosaic of sparse and dense ground cover. Large hollows in live or occasionally dead eucalypts are used for roosting (Department of Environment and Conservation 2006a) but are also known to roost and nest in dense foliage in gullies and caves (Garnett & Crowley 2000).

Masked Owls typically prey on terrestrial mammals including rodents and marsupials but would also take other species opportunistically. Territories range 400 ha to 1000 ha and forages by hunting from perches at ecotones within forests and at forest edges (Kavanagh, R. P. a. M. M. 1996).

Eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*Eucalyptus albens*) and Blakely's Red Gum (*Eucalyptus blakelyi*). Nest-hollow entrances are at least three metres above the ground with a diameter greater than 40 cm and depth greater than 100 cm. Breeding mostly occurs during autumn and winter (NSW National Parks and Wildlife Service 2003)

E19.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Approximately 1,384 ha of known habitat for the Barking Owl and Masked Owl would be affected by the Project (Figure E19). Habitat likely to be affected provided foraging, roosting and breeding resources for these species. Remnant woodland occurring within the Project boundary could be considered as providing critical resources for these species simply because of the extensively cleared landscape within the Southern Brigalow Belt Bioregion (Resource and Conservation Assessment Council 2000). However, within the locality the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1).

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. During field surveys Barking Owl was associated with the fertile flats surrounding the current mining operations, while Masked Owl was associated with the proposed rail corridor where it crosses the Namoi River. The Barking Owl was recorded in fauna habitats including, Riverine Woodland (S15) and Grassy White Box Woodland on fertile soils (S3), while Masked Owl was recorded in Riverine Woodland at survey site S18.

The Project would affect approximately 1,384 ha of known habitat (Figure E19), effectively reducing Leard State Forest by 17 %. Although the Project would affect habitat resources considered critical to the survival of these species, such as hollow-bearing trees, such resources would remain in remnant woodland occurring outside the Project

Boundary. More importantly, it was observed during detailed systematic hollow-bearing tree surveys of Leard State Forest that similar densities of this important resource were recorded both inside and outside the Project Boundary (refer Section 3.4 and Figure 3-10). Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west, which provided similar condition habitat, it is not likely that the Project would affect the lifecycle of these species. Moreover, these species are highly mobile and occupy large home ranges that are likely to extent well outside the Project boundary. Although, the Project would affect a large area of known habitat, it is likely that these species would exist in similar habitats occurring in the remaining Leard State Forest and locality.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of known habitat for Barking Owl and Masked Owl would be affected by the Project (Figure E19). Habitat to be affected provided (known and potential) foraging, roosting and breeding resources for these species. Barking Owl home ranges in the Pilliga forests have been estimated at approximately 2,000 ha (Kavanagh, R. P. 2009); therefore, the removal of approximately 1,384 ha of remnant vegetation, where these species have been recorded, would essentially remove an entire home range.

Although connectivity across the landscape cannot be accurately determined (Soderquist 2009), it is likely that these species would exist in similar habitats that occur within remaining Leard State Forest/ Leard National Park (approximately 6,750 ha) and the locality. Moreover, Seven Barking Owl Populations have been identified in the region of north-west NSW, with the most extensive population (Pilliga population) spreading from the Warrumbungle ranges to the lower slopes of Mount Kaputar (Soderquist 2009).

While the removal of a large area of known habitat could effectively reduce the viability of a Barking Owl/ Masked Owl population inhabiting Leard State Forest, the Project would only reduce remnant vegetation cover in the locality from 51 % to 48 %. Moreover, approximately 6,750 ha of continuous remnant woodland would surround the Project to the north, east and west, which was also observed to contain similar tree hollow densities (refer Section 3.4 and Figure 3-10).

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Barking Owl is found throughout Australia except for the central arid regions and Tasmania (Department of Environment and Conservation 2007). Furthermore, seven Barking Owl populations have been identified in the region of north-west NSW (300 km diameter around the Pilliga forests), with the largest population spreading from the Warrumbungle ranges to the lower slopes of Mount Kaputar (Soderquist 2009). Therefore, the Project boundary is not at the distributional limit of the Barking Owl.

Masked Owl is found mainly throughout NSW from the coast where it is most abundant to the western plains (NSW Scientific Committee 2004), therefore the Project does not occur at the distributional limit of this species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances

include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation and loss of dead wood and hollow-bearing trees, which are known disturbances for these species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest (including Leard National Park) essentially occurs as a large 8,134 ha continuous patch of remnant woodland (James B. Croft and Associates 1983), surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, effectively reducing Leard State Forest by 17 %, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant woodland, comprising breeding and foraging habitat, would be affected by the Project, thereby reducing the overall extent of habitat, connectivity would not be impacted any more than currently occurs in the locality. Furthermore, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1).

Due to the large home range and mobility of each of these species (through vegetated corridors), this loss of vegetation is unlikely to result in isolation of habitat for these species anymore than currently occurs within the locality. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that local populations of these species would become fragmented or isolated from other areas of habitat, however, it would reduce the overall extent of known habitat and further exacerbate threatening processes that affect these species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the TSC Act, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species due to their listing as a Vulnerable species. However, the Project boundary is not considered to be critical to the survival of this species.

Conclusion

A pair of Barking Owls was recorded during recent field surveys in the Project Boundary (Leard State Forest), while Masked Owl was recorded in Riverine Woodland occurring along the Namoi River (proposed rail corridor). While the Project would affect approximately 1,384 ha of known and potential foraging and breeding habitat, these species have large home ranges that are likely to extend into remnant habitat occurring outside the Project Boundary. As these species are highly mobile and as a large (6,750 ha) continuous patch of remnant woodland would surround the Project to the north, east and west, the Project is not likely to have a significant effect on these species.

E20. Superb Parrot (*Polytelis swainsonii*)

The Superb Parrot is listed as Vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* and *Threatened Species Conservation Act 1999.*

Superb Parrots inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. On the South-west Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box (Higgins, P.J 1999). This species nests in small colonies, often with more than one nest in a single tree, and breed between September and January (Department of Environment and Conservation 2006c). Part of the population of this species undertakes regular seasonal movements from the south-west slopes region to the eucalypt–pine woodlands of central-north and central-west NSW, with the range extending north to around Narrabri and Wee Waa (Department of Environment Water Heritage & Arts 2009)

Superb Parrots may forage up to 10 km from nesting sites, primarily in grassy box woodland. They feed in trees and understorey shrubs and on the ground; their diet consists mainly of grass seeds and herbaceous plants. The parrots also eat fruits, berries, nectar, buds, flowers, insects and grain (Higgins, P.J 1999).

Threats to this species include:

- poor regeneration of nesting trees and food resources
- removal of hollow-bearing trees
- clearing of woodland remnants
- feeding on grain spills and subsequently being struck by vehicles
- loss of hollows to feral bees and native and exotic hollow-nesting birds
- illegal trapping which can also result in the destruction of hollows (Department of Environment and Conservation 2006c).

This species was not recorded during current surveys.

E20.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The Superb Parrot is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the Act, important populations are:

- Likely to be key source populations either for breeding or dispersal.
- Likely to be necessary for maintaining genetic diversity, and/or
- At or near the limit of the species range.

A population of Superb Parrot in the Project boundary, if present, is not considered to be important, as no breeding habitat would be affected by the Project, and this species northern limit extends to Narrabri and Wee Waa, which occur north/ north-west of the Project.

Will the action lead to a long-term decrease in the size of an important population of a species?

If present, the population of Superb Parrots would not be an important population. Approximately 1,384 ha of potential foraging habitat for this species would be affected by the Project (Figure E20). This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young Department of Environment Water Heritage & Arts 2009). Therefore, no breeding habitat would be affected by the Project.

Any identified population of Superb Parrot in the area would not be restricted to habitat within the Project boundary, as similar foraging habitat could be accessed in the locality. Furthermore, the northern limit for this species extends north of the Project boundary, approximately around Narrabri and Wee Waa. Although the Project may temporarily affect the dynamics of any local population, it is not likely to result in a decline of the local population.

Will the action reduce the area of occupancy of an important population of the species?

If present, the population of Superb Parrots would not be an important population. Vegetation occurring within the Project boundary could potentially be used by individuals of those populations of this species that migrate north during winter. This species range extends north to around Wee Waa and Narrabri, from a line joining Coonabarabran and Narrabri, and extending as far west as Quambone, with occasional records further west Department of Environment Water Heritage & Arts 2009). Although Leard State Forest essentially occurs outside the normal range of where this species migrates; the removal of approximately 1,384 ha of potential foraging habitat might reduce the area of occupancy of this species. However, given that this species was not recorded in the Project boundary, that the northern range of this species effectively occurs (approximately) 50 km to the north-east of the Project boundary, and the fact that any local population of Superb Parrot would not be restricted to habitat resources in the Project boundary; it is considered that the Project would not reduce the area of occupancy of an important population of this species.

Will the action fragment an existing important population into two or more populations?

If present, the population of Superb Parrots would not be an important population. Superb Parrots are highly mobile and have a large foraging range that would allow them to use similar habitat resources in the locality. Therefore, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E20 - Distribution of potential habitat for Superb Parrot

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of potential foraging habitat for this species. However, with only part of the population of Superb Parrot regularly undertaking seasonal movements, with a northern limit extending to Narrabri and Wee Waa, this would not meet the above criteria. Furthermore, no breeding habitat would be affected by the Project. Therefore, habitat in the Project boundary is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of an important population?

If present, the population of Superb Parrots would not be an important population. This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young (Department of Environment Water Heritage & Arts 2009). At least part of the population of the Superb Parrot undertakes regular seasonal movements, vacating breeding areas at the conclusion of the breeding season and heading north to the eucalypt-pine woodlands of central-west NSW (Department of Environment Water Heritage & Arts 2009). While this species is dependent on flowering resources across a wide range of habitats (woodlands and forests) in its wintering grounds in NSW, the removal of 1,384 ha of potential habitat is not likely to disrupt their migratory pattern, which generally occurs 50 km to the west of the Project. As such, the Project is not likely to affect their breeding cycle.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Approximately 1,384 ha of potential foraging resources for Superb Parrot would be affected by the Project. While a large area of potential habitat would be affected, this species can forage over long distances, and would be able to access off site resources. Furthermore, the extent of this species range (for individuals undertaking regular seasonal movements north) extends north to Narrabri and Wee Waa and extends as far west as Quambone and no breeding habitat would be affected by the Project. Therefore, it is not likely that the Project would further isolate or decrease the availability of this habitat so that the species declines.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

It is not likely that invasive species (such as introduced predators) that are harmful to the Superb Parrot would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the Project.

Will the action interfere with the recovery of the species?

A draft national recovery plan is currently being prepared for the Superb Parrot. The *Action Plan for Australian Birds* (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of foraging and breeding habitat and identification of specific breeding requirements. Based on the potential ecological impacts of the Project on the species, as discussed above, it is not likely that the Project would interfere with the recovery of this species.

Conclusion

The population of Superb Parrot potentially occurring in the Project boundary is not considered an important population. Based on the above assessment, the Superb Parrot is not likely to be significantly affected by the Project.

E20.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young (Department of Environment and Conservation 2006b). At least part of the population of the Superb Parrot undertakes regular seasonal movements, vacating breeding areas at the conclusion of the breeding season and heading north to the eucalypt-pine woodlands of central-west NSW (Department of Environment and Conservation 2006b) (Department of Environment Water Heritage & Arts 2009). While this species is dependent on flowering resources across a wide range of habitats (woodlands and forests) in its wintering grounds in NSW, the removal of 1,384 ha of potential habitat is not likely to disrupt their migratory pattern, which generally occurs 50 km to the west of the Project. As such, the Project is not likely to affect this species lifecycle.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Approximately 1,384 ha of potential foraging habitat for this species would be affected by the Project (Figure E20). This species has a breeding range occurring in three main areas, being; the Murray and Edwards Rivers; along the Murrumbidgee River; and an area bounded by Molong, Yass and Young (Department of Environment and Conservation 2006b). Therefore, no breeding habitat would be affected by the Project.

Vegetation occurring within Leard State Forest could potentially be used by individuals of those populations of this species that migrate to the north of their range during winter. This species range extends north to around Wee Waa and Narrabri, from a line joining Coonabarabran and Narrabri, and extending as far west as Quambone, with occasional records further (Department of Environment Water Heritage & Arts 2009) (Department of Environment and Conservation 2006b). Although Leard State Forest essentially occurs outside the normal range of where this species migrates; the removal of approximately 1,384 ha of potential foraging habitat might reduce the area of occupancy of this species. However, given that this species was not recorded in the Project boundary, that the

northern range of this species effectively occurs (approximately) 50 km to the north-east of Leard State Forest, and the fact that any local population of Superb Parrot would not be restricted to habitat resources in the Project boundary; it is considered that the Project would not reduce the area of habitat for this species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Superb Parrot is found throughout all regions of eastern inland NSW. Breeding sites are known to occur in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round, and also in an area bounded by Molong, Yass and Young. (Department of Environment and Conservation 2006b). At least part of the population of the Superb Parrot undertakes regular seasonal movements, vacating breeding areas at the conclusion of the breeding season and heading north to the eucalypt-pine woodlands of central-west NSW during winter (Webster 1988). The north of this species' range (for that part of the population which migrates annually) extends to around Wee Waa and Narrabri from a line joining Coonabarabran and Narrabri, and extends as far west as Quambone, with occasional records further west (Department of Environment and Conservation 2006b). Although Leard State Forest essentially occurs outside the normal range of where this species migrates; any identified species potentially occurring within the Project boundary could be considered as occurring at the north-eastern limit of its distribution. However, with such a far ranging distributional limit in the northern wintering grounds, this species would not be at the distributional limit of its known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as large (8,134 ha) remnant patch of woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with approximately 6,750 ha of continuous remnant woodland (remaining Leard State Forest/ Leard National park) surrounding the Project to the north, east and west. Due to the large home range, mobility and nomadic nature (for at least part of the population) of this species, this potential loss of vegetation is unlikely to result in isolation of habitat anymore than currently occurs within the locality. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that any local population of Superb Parrot would become fragmented or isolated from other areas of habitat, however

it would reduce the overall extent of potential habitat and further exacerbate key threatening processes affecting this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared due to this species listing as a Vulnerable species. However, potential habitat occurring in the subject site is not considered critical to the survival of this species.

Conclusion

Although the Superb Parrot was not recorded in the Project boundary during current field surveys, the Project boundary provided potential foraging resources for that part of the population that migrates north at the conclusion of the breeding season (winter). While the Project would affect 1,384 ha of remnant woodland, it is considered that the Project would not reduce the area of occupancy of this species as the general area that this species occupies during migration, essentially occurs (approximately) 50 km to the west of Leard State Forest. While vagrant records of this species may occur within the vicinity of the Project boundary, it is not likely that this species would be significantly affected by the Project.

E21. Regent Honeyeater (*Xanthomyza phrygia*)

The Regent Honeyeater is listed as Endangered and Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* and Endangered under the *Threatened Species Conservation Act 1995*. This species currently has a preliminary listing to be upgraded to Critically Endangered under the *Threatened Species Conservation Act 1995*.

Under the *Environment Protection and Biodiversity Conservation Act 1999* important habitat for migratory species includes areas where the species is declining. Given that this species is Endangered, it can be considered to be declining within the Project boundary and the wider locality. This species is therefore assessed using the threatened species criteria of the *Principal Significance Guidelines 1.1* (Department of the Environment and Heritage 2006a).

Regent Honeyeaters inhabit dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak (Department of Environment and Conservation 2006c). The woodlands they inhabit support a significantly high abundance and species richness of bird. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes (Higgins, P.J *et al.* 2001).

The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes *Amyema miquelii, A. pendula* and *A. cambagei* are also eaten during the breeding season (Oliver 2000). When nectar is scarce, lerp and honeydew comprise a large proportion of the diet. Insects make up about 15 % of the total diet and are important components of the diet of nestlings (Higgins, P.J *et al.* 2001). A shrubby understorey is an important source of insects and nesting material (Oliver *et al.* 1998).

Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres (Higgins, P.J *et al.* 2001). However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns. To successfully manage the recovery of this species a full understanding of the habitats used in the non-breeding season is critical (Department of Environment and Conservation 2006c).

There are three known key breeding areas, two of them in NSW — Capertee Valley and Bundarra-Barraba regions (Geering & French 1998). The species breeds from May to March, but with peak breeding activity from September to November (NSW Department of Environment and Climate Change 2009e) in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River She-oak. Regent Honeyeaters usually nest in horizontal branches or forks in tall, mature eucalypts and She-oaks (Oliver 2000). An open cup-shaped nest is constructed of bark, grass, twigs and wool (Oliver *et al.* 1998).

Threats to this species include:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development, particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands.
- Continuing loss of key habitat tree species and remnant woodlands from strategic agricultural developments, timber gathering and residential developments.
- Suppression of natural regeneration of overstorey tree species and shrub species from overgrazing. Riparian gallery forests have been particularly affected by overgrazing.
- Inappropriate forestry management practices that remove large, mature resource-abundant trees. Firewood harvesting in Box-Ironbark woodlands can also remove important habitat components.
- Competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds.
- Egg and nest predation by native birds (Department of Environment and Conservation 2006c).

This species was not recorded during current surveys, but is considered likely to occur based on the suitability of habitat and proximity to Bundarra-Barraba, which is one, of the two main locations where this species is concentrated in NSW (NSW Department of Environment and Climate Change 2009e).

E21.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Will the action lead to a long-term decrease in the size of a population of a species?

Approximately 1,384 ha of potential habitat for this species, including foraging and nesting resources would be affected by the Project (Figure E21). The Project boundary is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area. While this species has not been recorded in the Project boundary during current surveys, the presence of large tracts of suitable habitat coupled with records of this species occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009e), indicate that the Project boundary might be utilised on a transient basis. However, any identified population of Regent Honeyeater in the area would not be restricted to habitat within the Project boundary, due to the species' large home range, similar foraging and nesting habitat can be accessed in the locality. Therefore, the Project is not likely to result in a decline of the local population.

Will the action reduce the area of occupancy of the species?

The Project boundary is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area(NSW Department of Environment and Climate Change 2009e). Furthermore, this species is known to disperse widely (Higgins, P.J *et al.* 2001), and with records occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009e), it is considered that this species might utilise habitat resources in the Project boundary on at least a transient basis. Although this species is highly mobile, which is likely to be in

response to spatial flowering and resources (Higgins, P.J *et al.* 2001), the removal of 1,384 ha of potential habitat would reduce the area of occupancy for the Regent Honeyeater. Furthermore, the Project would add incrementally to and exacerbate threatening processes that affect this species.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E21 - Distribution of potential habitat for Regent Honeyeater

Will the action fragment an existing population into two or more populations?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west. Moreover, Regent Honeyeaters are highly mobile and have a large foraging range that enables them to access similar habitat resources in the locality. Therefore, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

The Regent Honeyeater is known to breed in two main areas in NSW, being the Bundarra-Barraba area and Capertee Valley. Regent Honeyeater's typically occur in associations that support species which produce copious amounts of nectar, including *Eucalyptus albens*. They are also associated with woodland that support *E. blakelyi*, *E. crebra* and sometimes native Callitris (pine) woodlands mixed with eucalypts (NSW Department of Environment and Climate Change 2009e). The Project boundary supports fauna habitat that is dominated by *E. albens*, *E. crebra* and *Callitris glaucophylla* and thus, with the Project boundary occurring in proximity to a known breeding area, it potentially provides important resources for this species. However, as this species would not be restricted to habitat within the Project Boundary, this area may not be considered critical to the survival of this species.

Will the action disrupt the breeding cycle of a population?

The Project would affect approximately 1,384 ha of potential habitat for this species, including foraging and nesting resources. Furthermore, the Project boundary occurs approximately 50 km from one, of two main locations where this species is concentrated, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009e), While this species may exhibit some fidelity to nesting areas, pairs have also been recorded breeding up to 75 km from sites used in the previous breeding (Oliver 1998) (Oliver 2000) (Geering & French 1998) (Oliver *et al.* 1998). Therefore, while this species may utilise habitat resources in the Project boundary on at least a transient basis, the removal of 1,384 ha of potential habitat is not likely to disrupt the breeding cycle of a potential population of Regent Honeyeater, with 6,750 ha of remnant vegetation surrounding the Project to the north, east and west.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Regent Honeyeater is listed as Endangered and Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*, accordingly, the removal of a large tract of habitat, albeit potential, is likely to exacerbate processes that are already threatening this species. The Project boundary occurs approximately 50 km to the south-west of one, of only two main locations where this species is concentrated in NSW, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009e). Although isolation of habitat would not result from the Project, the removal of 1,384 ha of remnant vegetation would modify, destroy, remove and decrease the availability of habitat for Regent Honeyeater. The further loss of large tracts of potential habitat would add incrementally to threatening processes that affect this species, therefore, the Project could be considered as contributing to a decline in the species.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Regent Honeyeater would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

The *Action Plan for Australian Birds* (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Regent Honeyeater recovery plan (Menkhorst *et al.* 1999) include:

- maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites.
- monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions
- facilitate research on strategic questions that will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times.
- maintain and increase community awareness, understanding and involvement in the recovery effort
- maintain the captive population of Regent Honeyeaters at a size that will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90 % of the wild heterozygosity in the captive population.

Based on the potential ecological impacts of the Project, as discussed above, it is likely that the Project would interfere with the recovery of the Regent Honeyeater by removing large tracts of potential habitat, which occurs in proximity to one of only two main breeding areas in NSW.

Conclusion

Although the Regent Honeyeater was not recorded in the Project boundary during recent field surveys, the Project boundary provided potential foraging and breeding resources. The Project would affect 1,384 ha of remnant woodland that may be utilised on at least a transient basis, as records for this species extend west to the Pilliga Nature Reserve. Therefore, it is considered that the Project would reduce the area of occupancy and add incrementally to processes that threaten this species. Hence, it is likely that Regent Honeyeater would be significantly affected by the Project.

E21.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

It is assumed that approximately 1,384 ha of potential habitat for this species, including foraging, roosting and nesting resources would be affected by the Project (Figure E21). The Project boundary is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area. While this species has not been recorded in the Project boundary during current surveys, the presence of large tracts of suitable habitat coupled with records of this species occurring west to the Pilliga Nature Reserve (NSW Department of Environment and Climate Change 2009e), indicate that the Project boundary might be utilised at least on a transient basis. While this species may exhibit some fidelity to nesting areas, pairs have also been recorded breeding up to 75 km from sites used in the previous breeding season (Oliver 1998) (Oliver 2000) (Geering & French 1998) (Oliver *et al.* 1998). However, any identified population of Regent Honeyeater in the area would not be restricted to habitat within the Project boundary, due to the species' large home range, similar foraging and nesting habitat can be accessed in the local area. Although the Project may temporarily affect the dynamics of any potential local population, it is not likely to affect the lifecycle of this species, but would exacerbate key threatening processes that currently undermine this species recovery.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal currently operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha remnant stand of vegetation, surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. It is assumed that approximately 1,384 ha of potential habitat for this species, including foraging, roosting and nesting resources would be affected by the Project (Figure E21). The removal of approximately 1,384 ha of remnant vegetation would reduce Leard State Forest by 17 % to 6,750 ha.

The Project boundary is situated approximately 50 km to the south-west of one of only two main breeding locations in NSW, being the Bundarra-Barraba area (NSW Department of Environment and Climate Change 2009e). Furthermore, this species is known to disperse widely (Higgins, P.J *et al.* 2001), and with records occurring west to the Pilliga Nature Reserve, it is considered that this species might utilise habitat resources in the Project boundary on at least a transient basis. Although the Regent Honeyeater is highly mobile, which is likely to be in response to spatial flowering and resources (Higgins, P.J *et al.* 2001), the removal of 1,384 ha of potential habitat would reduce the area of occupancy for this species in an already highly fragmented landscape, which effectively contains less than 40 % of its original vegetation (Resource and Conservation Assessment Council 2000). Moreover, the Project would add incrementally to and exacerbate threatening processes that undermine this species recovery, particularly the loss of habitat.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

In eastern Australia the Regent Honeyeater is distributed from north-east Victoria to south-east Queensland. In NSW the distribution is patchy and breeding events are mainly

confined to two main breeding areas — the Capertee Valley and Bundarra-Barraba region (Geering & French 1998). This species is also regularly recorded form Warrumbungle National Park and there are scattered records west (from Leard State Forest) to the Pilliga Nature Reserve in the north-west plains (NSW Department of Environment and Climate Change 2009e). Therefore, the Project boundary is not at the distributional limit of this species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserves.

The Project would increase the clearing of native vegetation, which is a known disturbance for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant patch of woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with approximately 6,750 ha of continuous remnant woodland (remaining Leard State Forest/ Leard National park) surrounding the Project to the north, east and west.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant vegetation would be affected by the Project, thereby reducing the overall extent of potential habitat, connectivity would not be impacted any more than currently occurs in the locality. Due to the large home range and migratory nature of this species, this loss of vegetation is unlikely to result in isolation of habitat. The ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that any local population of Regent Honeyeater would become fragmented or isolated from other areas of habitat; however it would reduce the overall extent of habitat and further exacerbate key threatening processes affecting this species.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species, although known breeding sites are likely to be important. The site is not likely to be critical to the survival of the species.

Conclusion

Although the Regent Honeyeater was not recorded in the Project boundary during recent field surveys, the Project boundary provided potential foraging and breeding resources. The Project would affect 1,384 ha of remnant woodland that may be utilised on at least a transient basis, as records for this species extend west to the Pilliga Nature Reserve. It is considered that the Project would reduce the area of occupancy and add incrementally to and exacerbate threatening processes that currently undermine the recovery of this species. Therefore, it is likely that Regent Honeyeater would be significantly affected by the Project.

E22. Microchiropteran bats (hollow-dependent)

Threatened hollow-dependent species of microchiropteran bat have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as result of the Project. Hollow-dependent microchiropteran bats considered under the Heads of Consideration for the current Project include:

- Greater Long-eared Bat - south eastern form (*Nyctophilus timoriensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

Greater Long-eared Bat – south-eastern form

The Greater Long-eared Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. Although not recorded during current surveys, this species has previously been recorded in Leard State Forest (Pennay, Michael 2001), and suitable habitat exists within the Project boundary.

Greater Long-eared Bats inhabit a variety of vegetation types, including mallee and box eucalypt dominated communities, but they are distinctly more common in box/ironbark/cypress-pine vegetation, which occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. They roost in tree hollows, crevices and under loose bark. It is a slow flying, agile bat using the understorey to hunt non-flying prey — especially caterpillars and beetles — and will even hunt on the ground. Mating takes place in autumn, with one or two young born in late spring to early summer (Churchill 2008).

Eastern False Pipistrelle

The Eastern False Pipistrelle is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species was recorded via Anabat in the Project boundary during field surveys (refer Figure E22).

This species is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (Department of Environment and Climate Change 2005; Department of Environment and Conservation 2005c). Its distribution extends over the Great Dividing Range, with a preference for wet altitude forests. This species is thought to hunt beetles and moths above, or just below the canopy. The Eastern False Pipistrelle roosts in tree hollows, although it can sometimes be found in caves (Jenolan area) and buildings (Churchill 1998). This species hibernates during winter, with females pregnant in late spring-early summer (NSW Department of Environment and Climate Change 2009c).

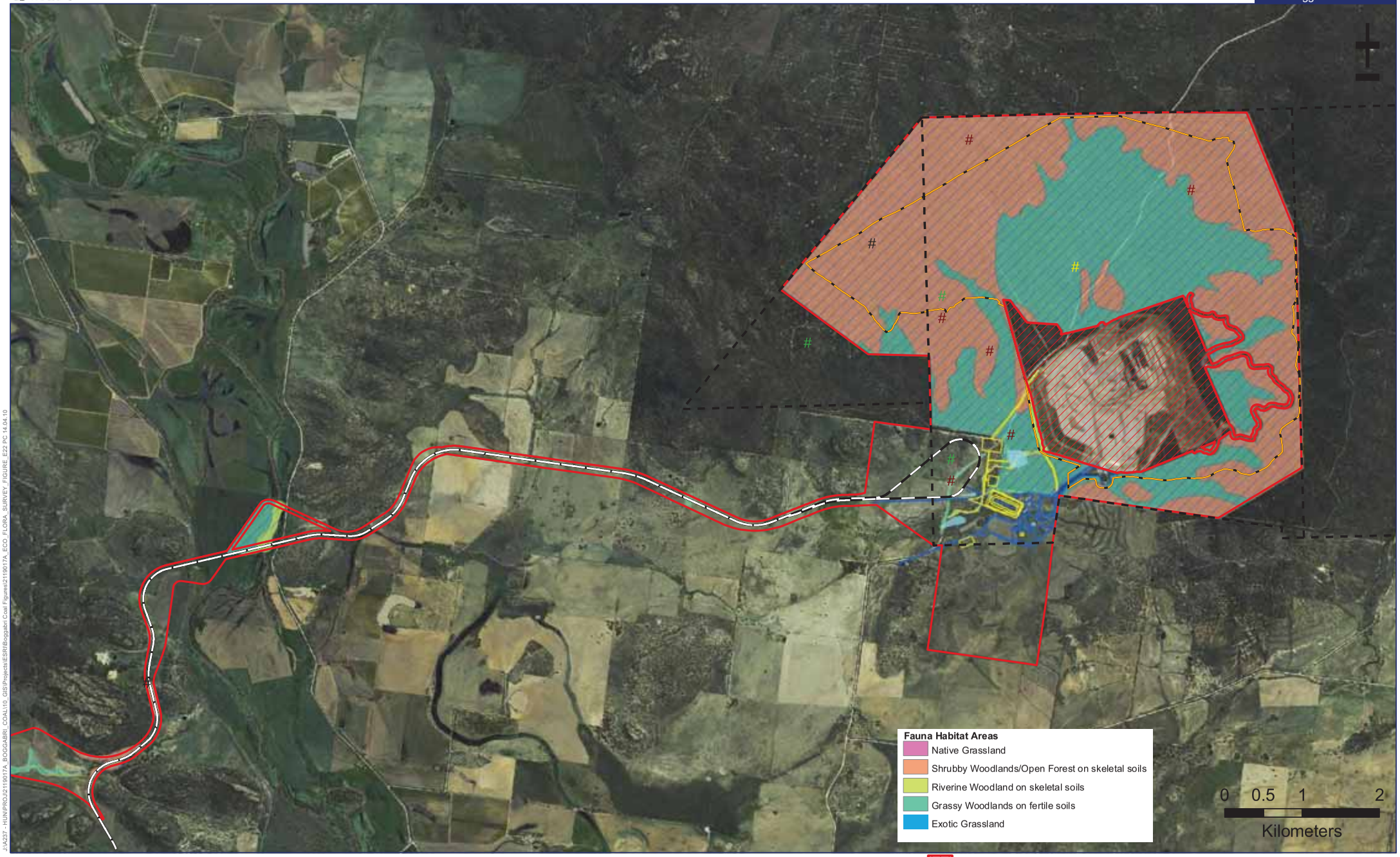
Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species was recorded via Anabat throughout the Project boundary including survey site S18 and S20 (refer Figure E22).

This species is wide ranging and found across northern and eastern Australia, encompassing the majority of NSW. Although, only scattered records exist across the New England Tablelands and north-west slopes (NSW Department of Environment and Climate Change 2009g). This species occurs in eucalypt forest where it flies high above the canopy, feeding on insects. In mallee or open country it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows and is thought to be a migratory species to southern Australia during late summer and autumn (Churchill 1998). Breeding has been recorded from December to late March in this species (NSW Department of Environment and Climate Change 2009g).

Threats (combined for all species)

- loss or modification of habitat (including feeding habitat) near roosting and maternity sites
- clearing and isolation of dry eucalypt forest and woodland, particularly about cliffs and other areas containing suitable roosting and maternity sites, mainly as a result of agricultural and residential development.
- predation by cats
- application of pesticides in or adjacent to foraging areas may reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores.
- damage to roosting and maternity sites from mining operations
- there is a strong likelihood that unrecorded populations could be unintentionally affected by land management actions.



PB Threatened Species Survey (January and March 2009)

- # Large-eared pied Bat (Potential)
- # Yellow-bellied Sheathtail Bat
- # Eastern Bent-wing Bat
- # Eastern Cave Bat
- Eastern Cave Bat Breeding Area

National Park Threatened Species Survey

- Greater Long-eared Bat
- Yellow-bellied Sheathtail-bat

Fauna Habitat Condition

- Good
- Moderate

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E22 - Distribution of known and potential habitat for Threatened microchiropteran bats

E22.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a).

Under these guidelines, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity
- at or near the limit of the species range.

The Greater Long-eared Bat population in the Project boundary, if present, is considered to be important in that the Project boundary could be considered 'core habitat' in terms of metapopulation dynamics, whereby large populations, occurring in larger patches provide a source population to smaller patches of habitat in the surrounding matrix (Arnold *et al.* 1993; Hanski 1999; Lindenmayer & Burgman 2005). Therefore, by reducing the size of the overall population, of this species, the source for other remote populations is also reduced, potentially affecting the lifecycle of remote populations.

Will the action lead to a long-term decrease in the size of an important population of a species?

The population of Greater Long-eared Bat in the Project boundary is considered to be an important population.

The Project would remove approximately 1,384 ha of habitat for this species including roosting and foraging resources, effectively reducing Leard State forest by 17 %. Although this species is highly mobile and known to forage more than three kilometres from roost sites (Churchill 2008), the removal of a large tract of remnant vegetation is likely to affect this species.

In terms of a metapopulation and given that the Brigalow Belt South bioregion retains less than 40 % of its original native vegetation (Resource and Conservation Assessment Council 2000), it is likely that the Project boundary occurs as 'core habitat' that provides a source population to smaller fragmented patches of habitat in the surrounding fragmented landscape. The reduction in the overall size of this population also reduces the source for other remote populations. Therefore, it is considered that the removal of 1,384 ha of habitat for this species would affect the dynamics of a local population and lead to a long-term decrease in the locality.

Will the action reduce the area of occupancy of an important population of the species?

The population of Greater Long-eared Bat in the Project boundary is considered to be an important population.

While a local population of Greater Long-eared Bat would not be restricted to habitat resources in the Project boundary, the removal of 1,384 ha of foraging and roosting habitat would reduce the area of occupancy for this species by 17 % in the study area. This habitat is likely to consist of 'core habitat' and as such, is likely to act a source population for other remote populations.

Hollow-bearing trees are an important habitat resource for this species; as such sites are used for both roosting and breeding purposes. Detailed systematic surveys of tree hollows were undertaken in the Project boundary and remaining study area (refer Section

3.4 and Figure 3-10). While these surveys showed that tree hollows within remaining Leard State Forest occur at similar densities to those within the Project boundary, the removal of such a great extent of potential roost and breeding sites would reduce the area of occupancy for this species.

Therefore, as the Project boundary is likely to act as a source population for remote populations and given the large extent of potential foraging, roost and breeding habitat that would be affected, it is considered that the project would reduce the area of occupancy for this species.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as large (8,134 ha) remnant woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining. Moreover, Greater Long-eared Bats are highly mobile and given potential roosting/ breeding hollows occur at similar densities outside the Project boundary, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of potential foraging, roosting and breeding habitat for this species. However, this species high mobility would allow it to access and occupy foraging and roosting/ breeding resources outside the Project boundary. Furthermore, approximately 6,750 ha of continuous remnant woodland would remain around the subject site and important habitat resources such as tree hollows had similar densities in the remaining Leard State Forest to that of the Project boundary. Therefore, habitat in the Project boundary is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of an important population?

The population of Greater Long-eared Bat in the Project boundary is considered to be an important population.

The Project would remove approximately 1,384 ha of habitat for this species including roosting and foraging resources, effectively reducing Leard State forest by 17 %. While similar densities of hollow-bearing tree resources were observed throughout the study area (refer Section 3.4 and Figure 3-10), the removal of such a vast amount of potential

foraging, roosting and breeding habitat in the Project boundary would affect the dynamics of a local population.

In terms of a metapopulation and given that the Brigalow Belt South bioregion retains less than 40 % of its original native vegetation, it is likely that the Project boundary occurs as 'core habitat' that provides a source population to smaller fragmented patches of habitat in the surrounding fragmented landscape. The reduction in the overall size of this population also reduces the source for other remote populations. Therefore, it is considered that the removal of 1,384 ha of habitat for this species would affect the dynamics of a local population and potentially disrupts the breeding cycle of an important population.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Although isolation of habitat would not result from the Project, it would remove 1,384 ha of remnant vegetation and effectively reduce Leard State Forest and decrease good condition habitat by 17 %. The further loss of large tracts of potential habitat would add incrementally to and exacerbate processes that affect this species. Therefore, the Project could be considered as contributing to a decline in the species.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

It is not likely that invasive species (such as introduced predators) that are harmful to the Greater Long-eared Bat would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. There are no known diseases that are likely to increase in the area as a result of the Project.

Will the action interfere with the recovery of the species?

The *Action Plan for Australian Bats* (Duncan *et al.* 1999) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific roosting requirements.

Based on the potential ecological impacts of the Project on the Greater Long-eared Bat, as discussed above, it is not likely that the Project would interfere with the recovery of this species.

Conclusion

Although the Greater Long-eared Bat was not recorded in the Project boundary during recent field surveys, the Project boundary provided foraging, roosting and breeding resources. Furthermore, this species has previously been recorded in the study area by NSW National Parks and wildlife Service (Pennay 2001) The Project would affect 1,384 ha of good condition remnant woodland, effectively reducing Leard State Forest by 17 %. Therefore, it is considered that the Project would reduce the area of occupancy and add incrementally to processes that threaten this species. Hence, it is likely that Greater Long-eared Bat would be significantly affected by the Project.

E22.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Two Threatened hollow-dependent species of microchiropteran bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat, were recorded in the Project boundary during recent surveys via Anabat. Greater Long-eared Bat has previously been recorded in the study area by NSW National Parks and Wildlife Service (Pennay 2001). It is assumed that approximately 1,384 ha of known habitat would be affected by the Project (Figure E22). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources for all three species.

Boggabri Coal currently operates on the southern edge of Leard State Forest, which occurs as an 8,134 ha remnant stand of vegetation, surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. Although the Project would reduce Leard State Forest by 17 %, such habitat resources would remain in remnant woodland occurring outside the Project boundary. More importantly, it was observed during detailed systematic hollow-bearing tree surveys of the study area that similar densities of this important resource were recorded throughout (refer Section 3.4 and Figure 3-10). Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west, providing important habitat resources for foraging, roosting and breeding, it is not likely that the Project would affect the lifecycle of these species; however, it may temporarily affect the dynamics of a local population.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

The Project would affect 1,384 ha of moderate to good condition habitat that provided foraging, roosting and breeding resources, and effectively reduce Leard State Forest by 17 % (Figure E22). While similar densities of hollow-bearing tree resources were observed throughout the study area (refer Section 3.4 and Figure 3-10), given that the Brigalow Belt South bioregion retains less than 40 % of its original native vegetation (Resource and Conservation Assessment Council 2000), the removal of such a vast amount of known and potential foraging, roosting and breeding habitat would significantly reduce the area of occupancy for these species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

One species of Threatened microchiropteran bat, Eastern False Pipistrelle, could be considered to occur near the limit of their distribution within the Project boundary.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20

years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserves.

The Project would increase the clearing of native vegetation, which is a known disturbance for these species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west. For these species, which utilise tree hollows for roosting/ breeding purposes, similar densities of this important resource (compared to the Project boundary) were recorded in the remaining study (remaining Leard State Forest). Therefore, it is not likely that the Project would isolate habitat of fragment an existing population.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species due to their Vulnerable species listing. However, habitat occurring in the subject site is not considered critical to the survival of these species.

Conclusion

Two Threatened hollow-dependent species of microchiropteran bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat, were recorded in the Project boundary during recent surveys via Anabat. Greater Long-eared Bat has previously been recorded in the study area by NSW National Parks and Wildlife Service (Pennay 2001). The Project would affect 1,384 ha of good condition remnant woodland, effectively reducing Leard State Forest by 17 %. Therefore, it is considered that the Project would reduce the area of occupancy and add incrementally to processes that threaten these species. Hence, it is likely that hollow-dependent species of microchiropteran bat (Greater Long-eared Bat, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat) would be significantly affected by the Project.

E23. Microchiropteran bats (cave-dependent)

Threatened cave-dependent species of microchiropteran bat have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as result of the Project. Cave-dependent microchiropteran bats considered under the Heads of Consideration for the current Project include:

- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- Little Pied Bat (*Chalinolobus picatus*).

Large-eared Pied Bat

The Large-eared Pied Bat has been recorded in scattered localities from near Rockhampton in central coastal Queensland to Bungonia in Southern NSW. It can be found in a variety of dry habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. "Isolated records from subalpine woodland above 1500 m and at the edge of rainforest and moist eucalypt forest, suggest it may tolerate a greater range of habitats than has so far been recorded" (Strahan 1995).

During the daytime, its roosts include caves, mine tunnels and the abandoned, mud-shaped nests of Fairy Martins. While roosting in the caves it often selects positions close to the entrance where individuals huddle together.

The Large-eared Pied Bat is thought to be quite manoeuvrable due to a relatively short, broad wing and a low weight per unit area of wing. It is most likely to forage for small flying insects below the forest canopy (Duncan *et al.* 1999).

A group of females and a few males assemble deep inside a roosting site during early spring. Young are born between November and December and are weaned until late January. The colony will disperse from the site during autumn. Females become reproductively mature after one year. During autumn and winter males have enlarged testes and both sexes have swollen glands on the muzzle.

This species has potentially been recorded via Anabat within the Project boundary during March/ April field surveys (refer Figure E22).

Eastern Bent-wing Bat

The Eastern Bent-wing Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species was recorded via Anabat in the Project boundary during field surveys (refer Figure E22).

This species is distributed along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria, predominantly on the eastern side of the Great Dividing Range (Churchill 2008). This species form large maternity colonies in traditional maternity roosts throughout their range during the summer months including, limestone and sandstone caves and abandoned gold mines (Strahan and Van Dyck 2008). Outside the breeding period populations disperse to other roost sites within its own territory (generally within 300 km) including caves, derelict mines, buildings, bridges, culverts and storm water tunnels (NSW Department of Environment and Climate Change 2009a). In southern part of its range, this species selects caves that are cold enough for hibernation

during winter, whereas in the northern part of their range they are generally remain active throughout the year (Strahan and Van Dyck 2008).

The Eastern Bent-wing Bat is generally associated with wet and dry sclerophyll forest, rainforest, open woodland and grasslands, where they predominantly forge on moths. Flight is very fast and in forested areas often flies above the canopy. In open areas, flight is often close to the ground. This species is known to forage long distances from roost sites, with several specimens recorded travelling 65 km in one night (Churchill 2008).

Eastern Cave Bat

The Eastern Cave Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species was trapped via a harp trap at survey site S1 (Leard State Forest), S20 and S21 (rail alignment) (refer Figure E22). A cave located within vicinity of the Project boundary along the rail alignment and existing haul route (S20) was observed to contain approximately 85 Eastern Cave Bat's, with two bat exit surveys conducted during September 2009. A harp trap was also located at the cave entrance on one of those evenings. Sixteen individuals were trapped as they exited the cave and subsequent measurements revealed an approximate ratio of 1:8 (males: females). As both male and female bats were recorded within, it is likely assumed that the site could be used as a maternity cave.

This species is distributed on both sides of the Great Dividing Range from Cape York to Kempsy, with records indicating this species presence from the New England Tablelands to the upper north coast of NSW (NSW Department of Environment and Climate Change 2009b). This species inhabits tropical mixed woodland and wet and dry sclerophyll forest on the coast and Great Dividing Range, extending into drier woodland on the western slopes and inland areas (Churchill 2008). Presumably, the western limit for this species appears to be the Warrumbungle Range (NSW Department of Environment and Climate Change 2009b).

Little is known about the biology of this species, although it is a cave roosting species that is usually found in dry woodland and open forest, particularly near cliffs and rocky overhangs. They roost near the entrance of reasonably well lit areas often in domes in the roof of caves as well as cracks and crevices. Roost fidelity is thought to be low (Churchill 2008).

Little Pied Bat

The Little Pied Bat is listed as Vulnerable under the *Threatened Species Conservation Act 1995*. This species was recorded via Anabat at survey site S20 during field surveys (refer Figure E22).

This species is endemic to Australia and is distributed from near the central Queensland coast through western NSW, extending to far eastern and far northern South Australia and Victoria respectively(NSW Department of Environment and Climate Change 2009d). This species roosts in trees, caves, rock outcrops, abandoned mines and occasionally buildings (Churchill 2008). The Little Pied Bat occurs in dry open woodland/ open forest, mulga woodlands, cypress pine forest and mallee, where they feed predominantly on moths (NSW Department of Environment and Climate Change 2009d). This species occurs in areas where water is highly ephemeral and has been recorded making nightly return trips of 14 to 34 km between a roost site and a creek bed with small stands of water (Strahan and Van Dyck 2008). This species flight is fast and highly manoeuvrable, flying close to the canopy and sometimes among vegetation, gleaning from the canopy (Churchill 2008).

Threats (combined for all species)

- loss or modification of habitat (including feeding habitat) near roosting and maternity sites
- clearing and isolation of dry eucalypt forest and woodland, particularly about cliffs and other areas containing suitable roosting and maternity sites, mainly as a result of agricultural and residential development.
- predation by cats
- application of pesticides in or adjacent to foraging areas may reduce the availability of invertebrates, or result in the accumulation of toxic residues in individuals' fat stores.
- damage to or disturbance of roosting caves, particularly during winter or breeding
- damage to roosting and maternity sites from mining operations, and recreational activities such as caving
- there is a strong likelihood that unrecorded populations could be unintentionally affected by land management actions.

E23.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The Large-eared Pied Bat is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the Act, important populations are:

- Likely to be key source populations either for breeding or dispersal.
- Likely to be necessary for maintaining genetic diversity, and/or
- At or near the limit of the species range.

A population of Large-eared Pied Bat in the Project boundary, if present, is not considered to be important, as no breeding habitat would be affected by the Project.

Will the action lead to a long-term decrease in the size of an important population of a species?

The population of Large-eared Pied Bat potentially present in the Project boundary is not considered to be an important population.

This species roosts include caves, mine tunnels and the abandoned, mud-shaped nests of Fairy Martins. As such, the Project would remove approximately 1,384 ha of potential foraging habitat only. While any identified population of Large-eared Pied Bat in the area would not be restricted to habitat within the Project boundary, similar foraging habitat can be accessed in the locality. Moreover, the Project would reduce Leard State Forest by 17 %, effectively leaving 6,750 ha of continuous remnant woodland. Although the Project may temporarily affect the dynamics of a local population, it is not likely to result in a decline of the local population.

Will the action reduce the area of occupancy of an important population of the species?

A local population of Large-eared Pied Bat would not be restricted to habitat resources in the Project boundary. While a relatively large patch (1,384 ha) of potential foraging

habitat for this species would be affected by the Project, no roosting or breeding habitat would be affected. Furthermore, it is likely that this species would use similar habitat resources within the locality and 6,750 ha of similar vegetation (Leard State Forest) would remain as a large continuous patch of remnant woodland.

The Project is not considered likely to reduce the area of occupancy of an important population of Large-eared Pied Bat.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as large (8,134 ha) remnant woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining. Moreover, Large-eared Pied Bats are highly mobile and given no suitable roosting sites, including caves and mine tunnels, would be affected, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- For activities such as foraging, breeding, roosting, or dispersal.
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators).
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of potential foraging habitat for this species. As this species is likely to access suitable foraging resources in the locality and that no roosting/ breeding habitat would be affected by the Project, this would not meet the above criteria. Moreover, Leard State Forest and Leard National Park would exist, post continuation of mining, as large continuous 6,750 ha patch (approximately) of remnant woodland. Therefore, habitat in the Project boundary is not considered critical to the survival of the species.

Will the action disrupt the breeding cycle of an important population?

No. No breeding habitat would be affected by the Project.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

No. No roosting habitat would be affected by the Project. While approximately 1,384 ha of potential foraging habitat would be removed, effectively reducing Leard State Forest by 17 %, it is likely that other foraging resources in the locality would be accessed for feeding purposes. Moreover, Leard State Forest and Leard National Park would remain

as a large (6,750 ha) continuous patch of remnant vegetation and the Project is not likely to increase the degree of fragmentation or isolation of this species.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

It is not likely that invasive species (such as introduced predators) that are harmful to the Large-eared Pied Bat would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. There are no known diseases that are likely to increase in the area as a result of the Project.

Will the action interfere with the recovery of the species?

The *Action Plan for Australian Bats* (Duncan *et al.* 1999) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific roosting requirements. Although approximately 2,535 ha of potentially suitable foraging habitat would be removed, the Project would not impact any known roosting habitat.

Based on the potential ecological impacts of the Project on the species, as discussed above, it is not likely that the Project would interfere with the recovery of this species.

Conclusion

A population of Large-eared Pied Bat potentially occurring in the Project boundary is not considered an important population. Based on the above assessment, this species is not likely to be significantly affected by the Project.

E23.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Three Threatened cave-dependent microchiropteran bat species including Eastern Bent-wing Bat, Eastern Cave Bat and Little Pied Bat have been recorded within the Project boundary via Anabat or harp trap. Large-eared Pied Bat, while not positively recorded, was potentially recorded via Anabat. It is assumed that approximately 1,384 ha of known habitat (for three of four species assessed) would be affected by the Project (Figure E22). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources for all four of the species assessed.

Boggabri Coal currently operates on the southern edge of Leard State Forest, which occurs as an 8,134 ha remnant stand of vegetation, surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The four species of cave-dependent bat that utilise caves for roosting and breeding purposes, no critical roosting or breeding habitat would be affected by the Project. However, approximately 1,384 ha of known and potential foraging resources for these species would be affected, effectively reducing Leard State Forest by 17 %. Of the cave roosting species, only the Eastern Bent-wing Bat and Eastern Cave Bat were positively recorded within that part of the Project boundary encompassing Leard State Forest. The Eastern Cave Bat and Little Pied Bat were also recorded along the proposed rail corridor at survey site S20 and S21 (Eastern Cave Bat only). As no roosting or breeding resources were observed in Leard State Forest, such habitat is not considered core

habitat for these species. Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west, it is not likely that the Project would affect the lifecycle of these species; however, it may temporarily affect the dynamics of local populations.

A colony of Eastern Cave Bat was recorded roosting in a cave occurring along the proposed rail alignment within the Project boundary. Cave exit surveys indicated approximately 85 Eastern Cave Bat's roosting within. While this species was also recorded at survey site S1, the section of Project boundary occurring in Leard State Forest is not considered core habitat for this species, as no roosting habitat (caves) was recorded therein. Habitat resources surrounding the rocky outcrop where the cave was located is likely to provide foraging habitat and other habitat resources that support this species.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

It is assumed that approximately 1,384 ha of known habitat (for three of four species assessed) would be affected by the Project (Figure E22). Habitat likely to be affected provided (known and potential) foraging, roosting and breeding resources for all four species.

For these cave-dependent species that utilise such resources for important roosting and breeding, the Project boundary (particularly that part of the Project boundary encompassing Leard State Forest) is not considered to represent 'core habitat' in that no roosting or breeding habitat was recorded therein.

Although the project would reduce Leard State Forest by 17 %, a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west. As these species are highly mobile, remnant habitat occurring outside the Project boundary is likely to support foraging opportunities for these species.

A colony of Eastern Cave Bat was recorded roosting in a cave occurring along the proposed rail alignment within the Project boundary. While this species was also recorded at survey site S1, the section of Project boundary occurring in Leard State Forest is not considered core habitat for this species, as no roosting habitat (caves) was recorded therein. Habitat resources surrounding the rocky outcrop where the cave was located is likely to provide foraging habitat and other resources that support this species. Although the Project would affect 1,384 ha of foraging habitat, this species mobility, enables it access off-site foraging resources.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Three species of Threatened cave-dependent microchiropteran bat could be considered to occur near the limit of their distribution within the Project boundary. These species include Eastern Bent-wing Bat, Eastern Cave Bat and Little Pied Bat.

The Eastern Cave Bat western limit is thought to occur around the Warrumbungle Ranges in NSW. Furthermore, due to the paucity of information regarding this species, the Project boundary could be considered to occur near the western limit of this species distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance for these species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west. No structures that these species utilise for roosting and breeding would be affected by the Project. Therefore, it is not likely that the Project would isolate habitat of fragment an existing population.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for these species due to their Vulnerable species listing. However, habitat occurring in the subject site is not considered critical to the survival of these species.

Conclusion

Three Threatened cave-dependent species of microchiropteran bat have been recorded within the Project boundary during recent field surveys. Although the Project would affect approximately 1,384 ha of known and potential foraging habitat, no critical habitat features such as maternity caves would be affected. Moreover, 6,750 ha of continuous remnant vegetation would surround the Project to the north, east and west, essentially providing necessary habitat resources for important roosting and breeding. Therefore, the Project is not considered to have a significant impact on Threatened cave-dependent species of microchiropteran bat.

E24. Spotted-tailed Quoll (*Dasyurus maculatus*)

The Spotted-tailed Quoll is listed as an Endangered species under the *Environment Protection and Biodiversity Conservation Act 1999* and Vulnerable under the *Threatened Species Conservation Act 1995*.

The Spotted-tailed Quoll is about the size of a domestic cat, from which it differs most obviously in its shorter legs and pointed face (Cronin 2000). The average weight of an adult male is about 3,500 g and an adult female about 2,000 g. It has rich-rust to dark-brown fur above, with irregular white spots on the back and tail, and a pale belly. The spots may be indistinct on juvenile animals (Edgar & Belcher 1998).

Spotted-tailed Quoll occur in a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline (Belcher 2003). Preferred habitat for Spotted-tailed Quoll includes dry and moist sclerophyll forests where they nest in hollow-bearing trees, fallen logs, burrows, small caves, rock crevices, boulder-fields and rocky-cliff faces and will feed in nearby cleared areas (Edgar & Belcher 1998). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas (Triggs 2004), although individuals require large areas of relatively intact vegetation through which to forage.

Spotted-tailed Quoll is mostly nocturnal although it will hunt during the day. On cold winter days they often bask in the sun. It spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds. This species consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, reptiles, bandicoots, rabbits and insects. It also eats carrion and takes domestic fowl (Edgar & Belcher 1998).

Females breed only once a year unless they fail to find a mate or lose their litter early, at which time they will try to breed again. Breeding occurs in early winter with females giving birth to up to six young after a gestation period of 21 days. The young leave the pouch at seven weeks and are left in the den when too large to carry on the mothers back (Gibbons & Lindenmayer 2000). They are independent at five months, with sexual maturity reached at one year of age (Kortner *et al.* 2004). Dens are shared by family groups and are aggressively defended by both males and females. Females occupy large home ranges up to about 750 ha and males up to 3,500 ha and they usually traverse their ranges along densely vegetated creeklines. This species has been recorded moving more than two kilometres overnight (Claridge *et al.* 2005).

Spotted-tailed Quoll use ‘latrine sites’, often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals. Latrine sites can be recognised by the accumulation of the sometimes characteristic ‘twisty-shaped’ faeces deposited by animals (Triggs 1996).

The Spotted-tailed Quoll is found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common (NSW National Parks and Wildlife Service 1999a).

This species was not recorded during current field surveys.

E24.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

Will the action lead to a long-term decrease in the size of a population of a species?

It is assumed that approximately 1,384 ha of potential habitat would be affected by the Project. This species has not been recorded in the Project boundary during recent surveys, however the presence of large tracts of potentially suitable habitat indicate a potential presence. However, any identified population of Spotted-tailed Quoll in the area would not be restricted to habitat within the Project boundary, due to the species' large home range and accessibility of similar foraging and nesting habitat in the remaining Leard State Forest/ Leard National Park. Furthermore, the paucity of records for this species in the area also suggests the Project would not contribute to a long-term decrease in the size of a potential local population.

Will the action reduce the area of occupancy of the species?

Approximately 1,384 ha of potential habitat for this species would be affected by the Project. While this species was not recorded in the Study during recent field surveys, this species is highly mobile and has a large foraging home range (NSW National Parks and Wildlife Service 1999a). Therefore, this species might utilise habitat resources in the Project boundary on at least a transient basis. The removal of 1,384 ha of potential habitat would reduce the area of potential occupancy for this species, however, given the species large foraging home range, the removal of this potential habitat is not considered significant. Moreover, a large (6,750 ha) remnant patch of woodland (remaining Leard State Forest/ Leard National Park) would surround the Project to the north, east and west, which is likely to provide similar habitat resources. However, the Project would add incrementally to and exacerbate threatening processes that already affect this species.

Will the action fragment an existing population into two or more populations?

Spotted-tailed Quolls are highly mobile and have a large foraging range that allows them to use similar habitat resources outside the Project boundary. Therefore, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E23 - Distribution of potential habitat for Spotted-tailed Quoll

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of potential foraging habitat and den sites for this species. However, as 6,750 ha of continuous remnant vegetation would surround the Project to the north, east and west, which is likely to contain similar habitat resources, vegetation in the Project boundary is not considered to be critical to the survival of this species.

Will the action disrupt the breeding cycle of a population?

The Project would affect approximately 1,384 ha of potential habitat for this species, including foraging resources and den sites. However, the breeding cycle of this species is not likely to be affected as a large 6,750 ha patch of continuous remnant woodland would surround the Project to the north, east and west. The Project would however, add incrementally to processes that affect this species survival.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Project would affect approximately 1,384 ha of potential habitat for this species, including foraging and breeding resources, effectively reducing Leard State Forest by 17 %. This species is listed as Endangered and accordingly, the removal of a large tract of habitat, albeit potential, is likely to add incrementally to processes that are already threatens this species. However, as Leard State Forest (occurring outside the Project boundary)/ Leard National Park would remain as a large (6,750 ha) continuous patch of remnant vegetation surrounding the Project to the north, east and west, the Project is not likely to result in the decline of this species.

Will the action result in invasive species that are harmful to an endangered species becoming established in the endangered species´ habitat?

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Spotted-tailed Quoll would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

A recovery plan for the Spotted-tailed Quoll is currently in preparation (Department of Environment and Conservation (NSW) 2009).

Conclusion

The Project would affect approximately 1,384 ha of potential foraging and breeding habitat. While this species was not recorded in the Study during recent field surveys, this species is highly mobile and has a large foraging home range, indicating that this species might utilise habitat resources in the Project boundary on at least a transient basis if present. While the Project would reduce available habitat (albeit potential) in the locality, a large (6,750 ha) continuous patch of remnant vegetation would surround the Project to the north, east and west. Thus while the Project would add incrementally to processes that threaten this species, it is not likely to have a significant impact.

E24.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (Croft & Associates 1979), surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384ha of potential habitat for this species, including foraging resources and den sites. The removal of a vast amount of potential habitat could be considered to affect the lifecycle of this species; however, given the paucity of records for this species in the area, the mobility of this species and relatively large home range, this species would be able to occupy similar habitats in the locality. Moreover, a large 6,750 ha patch of continuous remnant woodland would surround the Project to the north, east and west. Thus, the Project is not likely to affect the lifecycle of this species.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384 ha of potential habitat (Figure E23). Although the Project would reduce Leard State Forest by 17 %, this species is highly mobile and has a large foraging home range allowing it to access off site resources.

Moreover, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1) and a large 6,750 ha patch of continuous remnant woodland would surround the Project to the north, east and west, the Project is not likely to affect the lifecycle of this species.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Spotted-tailed Quoll is found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland (NSW National Parks and Wildlife Service 1999a). In NSW, the Spotted-tailed Quoll occurs on both sides of the Great Dividing Range. The

Western division of NSW has scattered but unconfirmed records of this species. As this species is known to occur within Liverpool Plains sub-region of the Namoi CMA, but only predicted to occur in the Pilliga sub-regions to the west of the Project. Moreover, following dramatic declines in range and numbers, this species is distributed over a restricted range in isolated areas that may potentially be too small to support long-term viable populations. Hence, the Project could be considered as occurring near the limit of this species distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, fallen timber and hollow-bearing trees, which are known disturbances for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest (including Leard National Park) essentially occurs as a large 8,134 ha (James B. Croft and Associates 1983) continuous patch of remnant woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, effectively reducing Leard State Forest by 17 %, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant woodland, comprising potential breeding and foraging habitat, would be affected by the Project, thereby reducing the overall extent of known habitat, connectivity would not be impacted any more than currently occurs in the locality. Furthermore, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1).

Due to the large home range and mobility of this species, this potential loss of habitat is unlikely to result in isolation of habitat and the ability to access adjacent habitat occurring outside the Project would remain. Therefore, it is unlikely that any local population of Spotted-tailed Quoll would become fragmented or isolated from other areas of habitat anymore than currently occurs within the Project boundary. However, the Project would reduce the overall extent of potential habitat and add incrementally to processes threatening this species.

How is the Project likely to affect critical habitat?

The Department of Environment, Climate Change and Water maintains a register of critical habitat. No critical habitat has been listed for this species to date and the Project boundary is not considered to represent critical habitat.

Conclusion

Although the Spotted-tailed Quoll was not recorded, the Project boundary provided potential habitat. While the Project would affect 1,384 ha of remnant woodland, effectively reducing Leard State Forest 17 %, in the locality the Project will only reduce remnant vegetation cover from 51 % to 48 %. While this species might utilise habitat resources within the Project boundary, this species would be not restricted to those resources. Therefore, it is not likely that this species would be significantly affected by the Project.

E25. Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is listed as Vulnerable under Schedule 2 of the *Threatened Species Conservation Act 1995*. This species was not recorded during targeted field surveys; however, this species may be present within Box-Gum Woodland due to the presence of habitat trees providing suitable tree hollows and foraging resources.

Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range. Suitable vegetation communities include at least one species of plant that flowers heavily in winter and one or more of the smooth-barked eucalypts (Department of Environment and Conservation 2005d).

Tree hollows greater than five centimetres diameter, in both living and dead trees as well as hollow stumps, are used as den sites for refuge and nesting (Gibbons & Lindenmayer 2000). Studies in Queensland showed that Squirrel Gliders used ironbark eucalypts and stags more than the hollows of smooth barked eucalypts and non-eucalypt tree species (Rowston 1998).

Squirrel Gliders use tree hollows for diurnal shelter either alone or in family groups of up to six individuals and offspring that occupy the same hollow simultaneously. The size and composition of groups of gliders occupying a particular hollow varies from day to day because gliders regularly swap den trees (van der Ree 2002). The nests are bowl-shaped and lined with leaves within tree hollows (Triggs 1996).

Squirrel Gliders are nocturnal and display seasonal trends in feeding behaviour that are in accordance with phenological patterns consists of trees and shrubs (Goldingay & Sharpe 1998). Their diet includes acacia gum, eucalypt sap, nectar, honeydew and manna, lichens with invertebrates and pollen providing protein (NSW National Parks and Wildlife Service 1999c).

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated at between 300 m and 500 m. Home-ranges have been estimated at between 0.65 ha and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources, with more productive forests attributed to smaller home ranges (Quin 1995).

This species was not recorded during targeted surveys within the boundary.

E25.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

The Project would affect approximately 1,384 ha of potential habitat for this species, including foraging resources and den sites (Figure E24). This species regularly swap den sites, occupies territories between 0.65 ha and 8.55 ha, and have nightly movements ranging from 300 m to 500 m. As such, the removal of 1,384 ha of potential habitat, equates to a removal of approximately 178 individual territories (using the upper limit of territory size).

The Squirrel Glider uses tree hollows for important roosting and breeding. Although the Project would reduce Leard State Forest by 17 %, such habitat resources would remain

in remnant woodland occurring outside the Project boundary. More importantly, it was observed during detailed systematic hollow-bearing tree surveys of the Project boundary and remaining Leard State Forest that similar densities of this important resource were recorded both inside and outside the Project boundary (refer Section 3.4 and Figure 3-10). Furthermore, as a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west, providing important habitat resources for foraging and breeding and given the paucity of records for this species in the locality, it is not likely that the Project would affect the lifecycle of this species; however, it may temporarily affect the dynamics of local populations.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surrounded by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384 ha of potential foraging and breeding habitat (Figure E24). Although the Project would reduce Leard State Forest by 17 %, this species is mobile with nightly movements up to 500 m recorded. As this species regularly swap den sites within their home range, it is likely that this species would be able access off-site resources.

Moreover, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1) and a large 6,750 ha patch of continuous remnant woodland would surround the Project to the north, east and west.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Squirrel Gliders are widely, though sparsely, distributed in eastern Australia, from northern Queensland to western Victoria. This species is known to occur as far inland as the Pilliga forests and Coonabarabran areas of NSW. Therefore, the Project boundary is not at the distributional limit of this species.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserves.

The Project would increase the clearing of native vegetation and hollow-bearing trees, which are known disturbances for this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E24 - Distribution of potential habitat for Squirrel Glider

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest (including Leard National Park) essentially occurs as a large 8,134 ha continuous patch of remnant woodland (James B. Croft and Associates 1983), surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, effectively reducing Leard State Forest by 17 %, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland remaining.

Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate dispersal and to maintain foraging and breeding resources (NSW National Parks and Wildlife Service 2003). Whilst a large tract of remnant woodland, comprising potential breeding and foraging habitat, would be affected by the Project, thereby reducing the overall extent of potential habitat, connectivity would not be impacted any more than currently occurs in the locality. Furthermore, within the locality, the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 5.1 and Figure 5-1).

Due to the relatively large home range and mobility of this species, this potential loss of habitat is unlikely to result in isolation of habitat anymore than currently occur within the locality. The ability to access adjacent habitat, occurring in the remaining Leard State Forest, outside the Project would remain. Therefore, it is unlikely that any local population of Squirrel Glider would become fragmented or isolated from other areas of habitat. However, the Project would reduce the overall extent of potential habitat and further exacerbate key threatening processes affecting this species.

How is the Project likely to affect critical habitat?

The Department of Environment, Climate Change and Water maintains a register of critical habitat. No habitat critical to the survival of this species has been listed to date, and habitat occurring in the Project boundary is not considered to represent habitat critical to the survival of this species.

Conclusion

Although the Squirrel Glider was not recorded during recent surveys, the Project boundary provided potential habitat. While the Project would affect 1,384 ha of remnant woodland, effectively reducing Leard State Forest by 17 %, this species would be not restricted to habitat occurring in the Project boundary, as similar habitats occurred outside the Project boundary in remaining Leard State Forest. Therefore, while the Project might disrupt the dynamics of any potential population, it is not likely that this species would be significantly affected.

E26. Koala (*Phascolarctos cinereus*)

The Koala occurs along the east coast of Australia and extends into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range (Department of Environment and Climate Change 2008a). The range of the Koala covers all such suitable areas of NSW. The diet is generally restricted to Eucalypt leaves (Department of Environment and Climate Change 2008a), although on occasion, non-Eucalypt foliage is eaten. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. melliodora* (Yellow Box), *E. albens* (White Box), *E. blakelyi* (Blakely's Red Gum) and *E. microcarpa* (Western Grey Box) are some of the preferred and secondary food tree species for Koalas occurring on the Western Slopes and Plains (Department of Environment and Climate Change, 2008 #2061). Koalas use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted or nutrient deprived. Individual home ranges range from one to two ha in high quality habitat, to around 100 ha in more arid country where territories are usually discrete (Strahan and Van Dyck 2008).

Conservation status of the Koala in western NSW is variable (Department of Environment and Climate Change 2008a). Most records for this species during detailed vertebrate fauna surveys for the Brigalow Belt South Western Regional Assessments (Pennay, M. 2002) came from the Pilliga forests. Moreover, during recent surveys of the Pilliga forests, this species was found to be widespread and common in some areas with these forests reported as supporting a large Koala population (Department of Environment and Climate Change 2008a). Furthermore, the Koala population situated around Gunnedah has also been reported as increasing (Smith 1992).

Within the Project boundary one dead Koala (cause of death uncertain) was observed during opportunistic surveys undertaken in March/ April. As a result of this observation, a systematic grid based Koala habitat survey was undertaken throughout the Project boundary and remaining Leard State Forest. One Koala was observed as a result of these surveys and five sites of 166 surveyed (3 %) indicated Koala activity through the presence of Koala scats (refer Section 3.5 and Figure 3-14).

Furthermore, only secondary food tree species were recorded in Leard State Forest. Results of the systematic Koala habitat surveys indicated a low population density centred on an area of habitat that bounds the northern and western limit of the current pit disturbance (refer Figure E25). Analysis of data also inferred *E. blakelyi* as the dominant feed tree species utilised within the Project boundary. However, seven secondary food tree species listed for the western slopes and plains Koala management area were recorded throughout the Project boundary and observed in remaining Leard State Forest occurring outside the Project boundary. Such species included *E. populnea*, *E. pilligaensis*, *E. melliodora*, *E. albens*, *E. dwyeri*, *E. dealbata* and *E. blakelyi*.

In addition a small section of Riverine Woodland occurring along the proposed rail alignment (survey site S18), was the only section in the Project boundary that contained *E. camaldulensis*, which is listed as a primary food tree species for the western slopes and plains Koala management area (Department of Environment and Climate Change 2008a). No Koalas or habitat use were observed in this area during extensive field surveys in this area.

PB Threatened Species Survey
(January, March, June and September 2009)

- Koala Scats Recorded
- # Koala Sighting
- 1% Koala Activity Contour
- 3% Koala Activity Contour

Fauna Habitat Areas

- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition

- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary

- Core distribution of *E.blakelyi*
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E25 - Distribution of known and potential habitat for Koala

E26.1 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

Data analysis and habitat modelling following systematic Koala habitat searches of the Project boundary and remaining Leard State Forest indicate an area of approximately 172 ha (at the 1 % activity level) being utilised by this species. However, approximately 1,384 ha of potential habitat that provided secondary food trees would be affected by the Project (Figure E25).

This species was considered to occur as a low density population, with only extremely low habitat utilisation observed (3 % of 166 sites surveyed). With such a low habitat utilisation rate recorded, the viability of this species remains unclear. Furthermore, if there is a breeding population present within the Project boundary, this population is not likely to be significant in light of area of habitat utilised and other more robust populations recorded in the Pilliga forests (Department of Environment and Climate Change 2008a), around Gunnedah (Smith 1992) and Riverine Woodland (containing *E. camaldulensis*) occurring along natural drainage lines, all of which occur within the Brigalow Belt South Bioregion.

While the Project is likely to affect the lifecycle of an extremely small population with questionable long term viability, these impacts are considered unlikely to be significant in light of more robust populations recorded elsewhere in the locality and region, the retention of the remaining large (6,750 ha) continuous patch of similar condition remnant woodland and given the extremely robust populations of Koalas recorded within the Pilliga forests (Department of Environment and Climate Change 2008a) and around Gunnedah (Smith 1992).

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (Croft & Associates 1979), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. Approximately 1,384 ha of potential habitat that provided secondary food trees would be affected by the Project (Figure E25).

Detailed systematic Koala habitat utilisation surveys and habitat modelling of the Project boundary and remaining Leard State Forest indicate extremely low (1-3 % activity) habitat utilisation in a small area to the south of the Leard State Forest.

Although the project would reduce Leard State Forest by 17 %, a large (6,750 ha) continuous patch of remnant woodland would still surround the Project to the north, east and west. Furthermore, secondary food tree species including *E. blakelyi*, which was the main tree species to be utilised at active sites (refer Figure 3-12 in main report), were recorded outside the Project boundary in remaining Leard State Forest.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

Koala distribution extends from the tropics to the cool-temperate regions across Queensland, NSW, Victoria and south-eastern South Australia. Although this species has a patchy record west of the Great Dividing Range in NSW, robust populations have been

recorded in the Pilliga forests to the west of the Project. Therefore, the Project does not occur at this species distributional limit.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion. However, the majority of these regimes do not appear to be significantly impacting the local Koala population within Leard State Forest, with the only living Koala and the majority of Koala activity observed within approximately 100 m from the current pit disturbance boundary.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation, which is a known disturbance, being the loss of native vegetation, thereby reducing potential breeding resources and known foraging home range. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant patch of woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west. Therefore, it is not likely that the Project would isolate habitat of fragment an existing population.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due its listing as a Vulnerable species. However, the site is not likely to be critical to the survival of the species as:

- it was considered that the population occurring within the Project boundary occurred at a low density, as extremely low habitat utilisation rates were recorded with 3 % of 166 sites surveyed indicating Koala use.
- the viability of this species remains unclear due to low habitat utilisation rates
- the population is not likely to be significant in light of habitat utilisation rates and more robust populations recorded in the Pilliga forests and around Gunnedah, both of which occur within the Brigalow Belt South bioregion.
- a large 6,750 ha continuous patch of remnant woodland would surround the Project to the north, east and west

- Leard State Forest provided only secondary food tree species, with no primary food trees recorded. (Note: *E. camaldulensis*, which is listed as a primary food tree, was recorded in a small section of the proposed rail corridor along the Namoi River).

Conclusion

A single living Koala was recorded in the Project boundary during field surveys, however detailed surveys throughout the Project boundary and Leard State Forest only identified extremely low rates of habitat utilisation (only 3 % of 166 sites surveyed indicated Koala use). These surveys also identified Leard State Forest as providing only secondary food tree species. While the Project is likely to affect the lifecycle of an extremely small population with questionable long term viability, these impacts are considered unlikely to be significant in light of more robust populations recorded elsewhere in the locality and region, the retention of the remaining large (6,750 ha) continuous patch of similar condition remnant woodland and given the extremely robust populations of Koalas recorded within the Pilliga forests (Department of Environment and Climate Change 2008a) and around Gunnedah (Smith 1992).

E27. Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*)

The Border Thick-tailed Gecko is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. This species is also listed as Vulnerable under the *Threatened Species Conservation Act 1995*; although a preliminary determination for this species to be removed from its vulnerable status is currently being considered by the NSW Scientific Committee (NSW Scientific Committee 2009a). Although not recorded during current surveys, this species has previously been recorded in the locality (Vickery State Forest) (Pennay, M. 2002) and suitable habitat exists within the Project boundary.

The Border Thick-tailed Gecko is a small lizard up to 10 cm long. This species is nocturnal and shelter by day under rock slabs and fallen timber (NSW Department of Environment 2009). This species is only found in southern Queensland and on the tablelands and slopes of northern NSW. The Border Thick-tailed Gecko has previously been recorded as far south as Tamworth and as far west as Moree (Department of Envioronment Water Heritage & Arts 2009).

The Border Thick-tailed Gecko is most common in the granite country of the New England Tablelands, and is generally associated with rocky hills in dry eucalypt woodland or open forest. This species tends to favour forest and woodland areas with rock slabs, boulders, deep leaf litter and fallen timber.

E27.1 Significance assessment – *Environment Protection and Biodiversity Conservation Act 1999*

The Border Thick-tailed Gecko is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006a). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

While the Project boundary lies in proximity to the western limit of this species range, the paucity of records in the locality, the lack of occurrence during targeted reptile searches and the fact that 6,750 ha of similar condition habitat would border the Project to the north, east and west, indicate that any potential population is not likely to be important.

Will the action lead to a long-term decrease in the size of an important population of a species?

This species would not be considered an important population if found to be utilising habitat resources in the Project boundary.

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384 ha of potential habitat for this species, effectively reducing Leard State Forest by 17 %. While the Project boundary provided potential habitat for this species, 6,750 ha of similar habitat

would surround the Project to the north, east and west. Furthermore, with the paucity of records in the locality and lack of occurrence during targeted reptile surveys, it is not likely that the Project would result in a long-term decline of an important population.

Will the action reduce the area of occupancy of an important population of the species?

Approximately 1,384 ha of potential habitat for this species would be affected by the Project (Figure E26), effectively reducing Leard State Forest by 17 %. While this species was not recorded during field surveys, suitable habitat was recorded therein, however, this species would not be restricted to habitat occurring in the Project Boundary, as similar condition habitat would be available in remaining Leard State Forest. Moreover, approximately 6,750 ha of continuous remnant vegetation would border the Project to the north, east and west and in the locality the Project would reduce the total area of remnant vegetation from 51 % to 48 % (refer Section 5.1 and Figure 5-1). Therefore, while the project would reduce the potential area of occupancy for this species, it is not likely to significantly affect this species, however, the project might add incrementally to processes that threaten this species.

Will the action fragment an existing important population into two or more populations?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as large (8,134 ha) remnant woodland, surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of potential habitat, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of remnant woodland remaining. Therefore, it is not likely that the Project would isolate habitat or fragment an existing population into two or more populations.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat is listed for this species under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006a).

The Project would remove approximately 1,384 ha of potential habitat for this species. However, as 6,750 ha of similar condition remnant vegetation would surround the Project to the north, east and west, potential habitat in the Project boundary is not considered to be critical to the survival of this species.

PB Threatened Species Survey
(January, March, June and September 2009)

Fauna Habitat Areas
- Native Grassland
- Shrubby Woodlands/Open Forest on skeletal soils
- Riverine Woodland on skeletal soils
- Grassy Woodlands on fertile soils
- Exotic Grassland

Fauna Habitat Condition
- Good
- Moderate
- Poor

- Existing Infrastructure to 2011
- Proposed New Infrastructure
- Mine Tenement
- Project Boundary
- Mine Disturbance to 2011
- Proposed Disturbance Limit (Boggabri Extention)
- Sediment Dam

Figure E26 - Distribution of potential habitat for Border Thick-tailed Gecko

Will the action disrupt the breeding cycle of an important population?

The Project would affect approximately 1,384 ha of potential habitat for this species, including foraging and breeding resources. However, the breeding cycle of this species is not likely to be affected as a large (6,750 ha) patch of similar condition remnant woodland would surround the Project to the north, east and west. The Project would however, add incrementally to processes that affect this species survival.

Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The Project would affect approximately 1,384 ha of potential habitat for the Border Thick-tailed Gecko, effectively reducing Leard State Forest by 17 %. This species is listed as Endangered and accordingly, the removal of a large tract of habitat, albeit potential, is likely to add incrementally to processes that are already threatens this species. However, as Leard State Forest (occurring outside the Project boundary)/ Leard National Park would remain as a large (6,750 ha) continuous patch of remnant vegetation surrounding the Project to the north, east and west, the Project is not likely to result in the decline of this species.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Border Thick-tailed Gecko would become further established as a result of the Project.

Will the action introduce disease that may cause the species to decline?

No. It is not likely that disease would be increased by the action.

Will the action interfere with the recovery of the species?

No recovery plan has currently been prepared for the Border Thick-tailed Gecko (Department of Envioronment Water Heritage & Arts 2009).

The *Action Plan for Australian Reptiles* (Cogger *et al.* 1993) addresses the need for further ecological research on the species to determine conservation status and ensure viable populations are maintained within reserve systems.

It is not likely that the Project would interfere with the recovery of this species as this species occurs within Mt Kaputar National Park, which occurs approximately 50 km to the north-east of the Project boundary.

E27.2 Significance assessment – *Environmental Planning and Assessment Act 1979*

How is the Project likely to affect the lifecycle of a threatened species and/or population?

The Project would affect approximately 1,384 ha of potential habitat for this species, effectively reducing Leard State Forest by 17 %. While the Project boundary provided potential habitat for this species, 6,750 ha of similar condition habitat would surround the Project to the north, east and west. Furthermore, with the paucity of records in the locality and lack of occurrence during targeted reptile surveys, it is not likely that the Project would affect the lifecycle of this species.

How is the Project likely to affect the habitat of a threatened species, population or ecological community?

Boggabri Coal operates on the southern edge of Leard State Forest, which occurs as a large 8,134 ha, continuous patch of remnant woodland (James B. Croft and Associates 1983), surround by an agricultural landscape between the Nandewar Range to the east, and the Pilliga Scrub to the west. The Project would affect approximately 1,384 ha of potential foraging and breeding habitat (Figure E26). Although the Project would reduce Leard State Forest by 17 %, in the locality the Project would only reduce remnant vegetation cover from 51 % to 48 % (refer Section 2.1 and Figure 5-1).

Moreover, a large (6,750 ha) patch of continuous remnant woodland would surround the Project to the north, east and west, and the Project would not fragment remaining Leard State Forest/ Leard National Park.

Does the Project affect any threatened species or populations that are at the limit of its known distribution?

The Border Thick-tailed Gecko only occurs on the northern slopes and tablelands of northern NSW and the adjacent Stanthorpe region in southern Queensland. This species has previously been recorded as far south as Tamworth and as far west as Moree. Therefore, the Project boundary is situated in proximity to the western limit of this species known distribution.

How is the Project likely to affect current disturbance regimes?

Leard State Forest currently exhibits disturbance regimes associated with the contemporary operation of Boggabri Coal Mine, particularly in those areas surrounding and in vicinity of the current open cut pit and coal haulage route. These disturbances include vegetation clearing and habitat removal, exploration drilling and artificial noise/ light regimes and some weed invasion.

The habitat within Leard State Forest has also previously been subject to a history of logging regimes by State Forest however, those operations ceased approximately 20 years ago. Furthermore, sections of Leard State Forest are currently managed as declared hunting reserve.

The Project would increase the clearing of native vegetation and fallen timber, both of which are known to threaten this species. The Project would also increase edge effects and would essentially introduce edge effects into new areas.

How is the Project likely to affect habitat connectivity?

Habitat connectivity would be unlikely to be affected by the Project. Leard State Forest essentially occurs as a large (8,134 ha) remnant patch of woodland surrounded by an agricultural landscape. While the Project would affect approximately 1,384 ha of remnant vegetation, it is not likely to fragment remaining Leard State Forest, with 6,750 ha of continuous remnant woodland surrounding the project to the north, east and west. Therefore, it is not likely that the Project would isolate habitat of fragment an existing population.

How is the Project likely to affect critical habitat?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations and ecological communities. Under the *Threatened Species Conservation Act 1995*, the Director-General maintains a register of critical habitat. To date, no critical habitat has been declared for this species due its listing as a

Vulnerable species. However, the site is not likely to be critical to the survival of this species

Conclusion

Although the Border Thick-tailed Gecko was not recorded in the Project boundary, the Project boundary provided potential habitat. While the Project would affect 1,384 ha of remnant woodland, effectively reducing Leard State Forest 17 %, in the locality the Project would reduce remnant vegetation cover from 51 % to 48 %. While this species might utilise habitat resources within the Project boundary, this species would be not restricted to those resources, with 6,750 ha of similar condition vegetation surrounding the Project to the north, east and west. Therefore, it is not likely that this species would be significantly affected by the Project.

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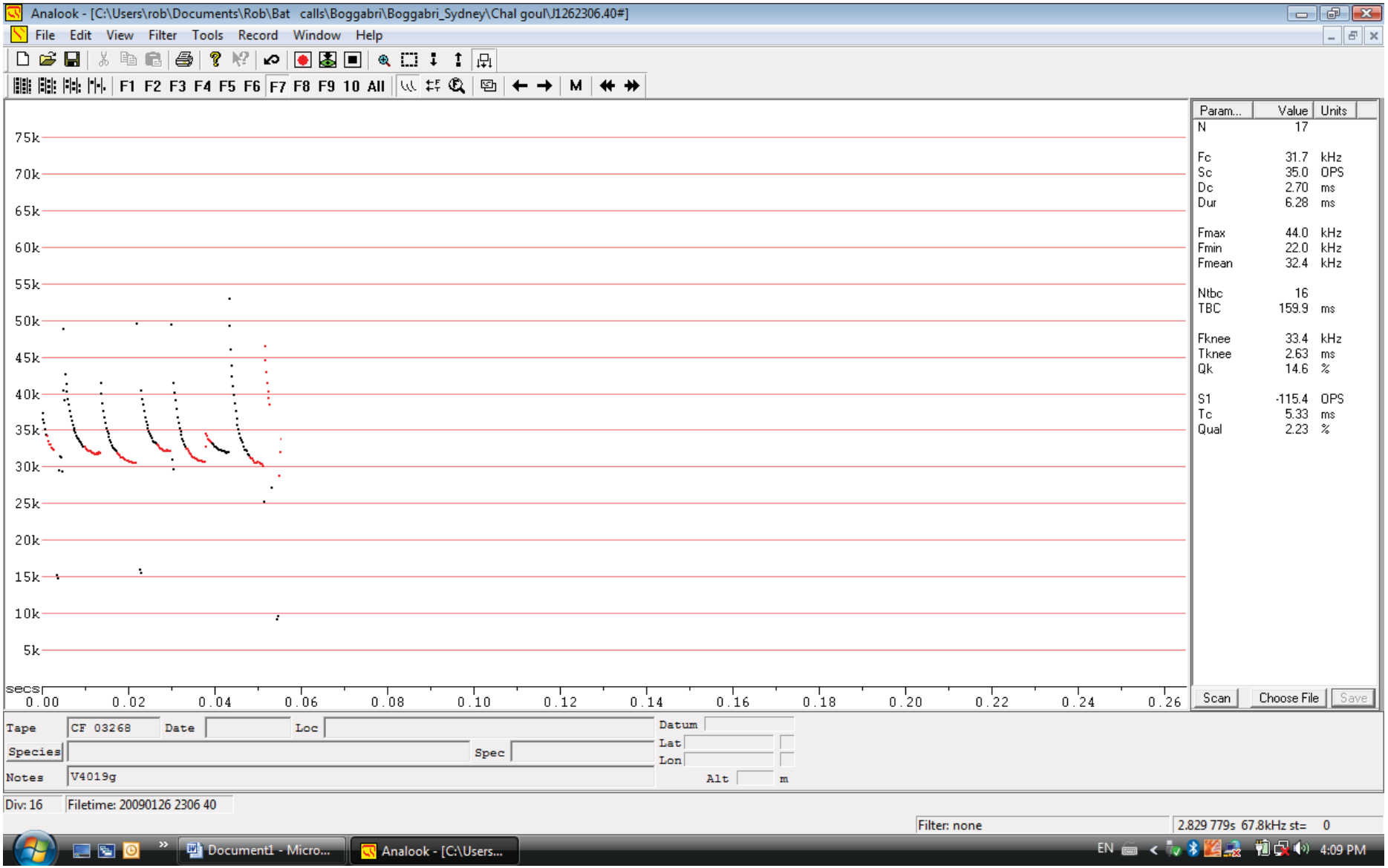
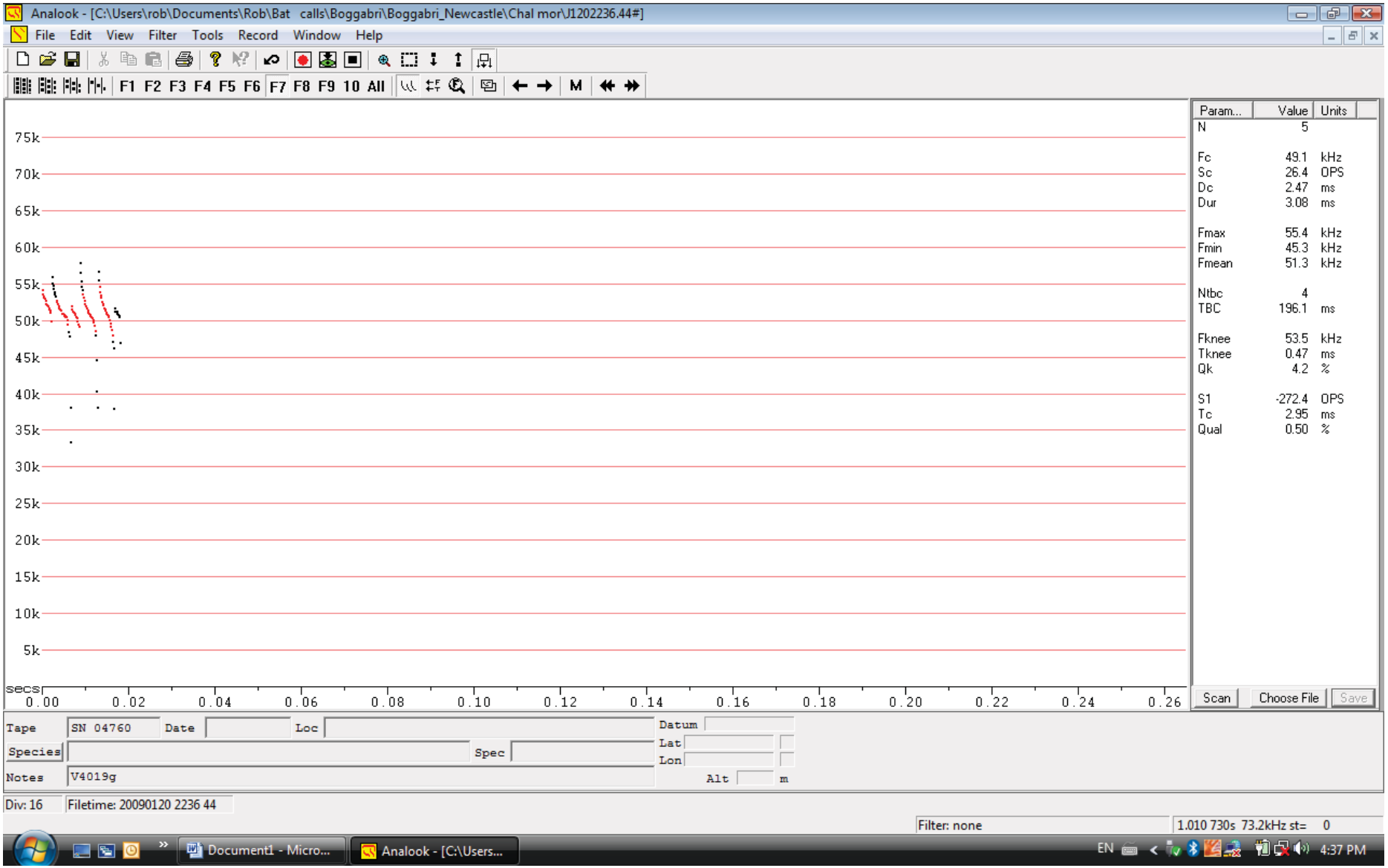
Appendix F

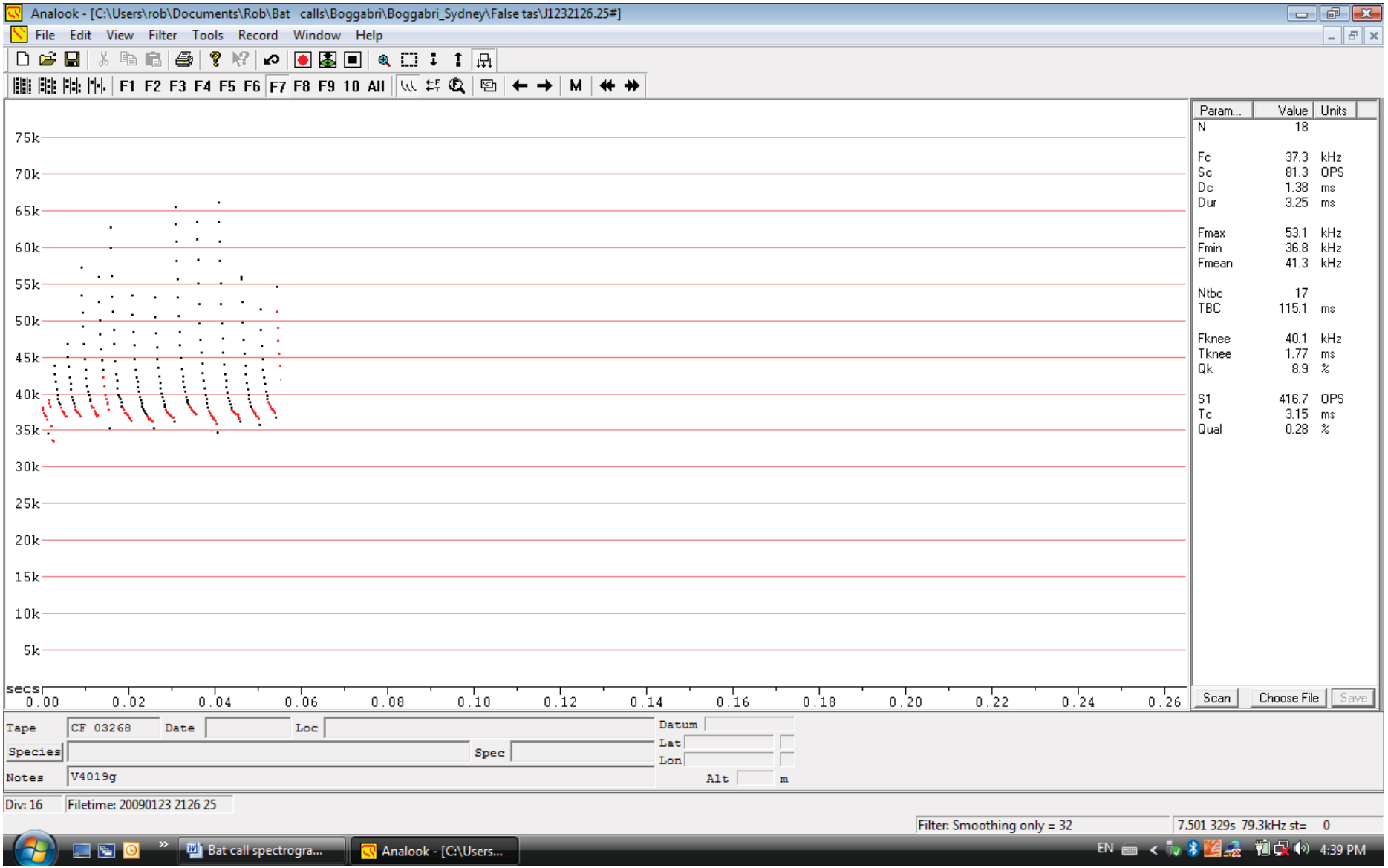
Anabat spectograms



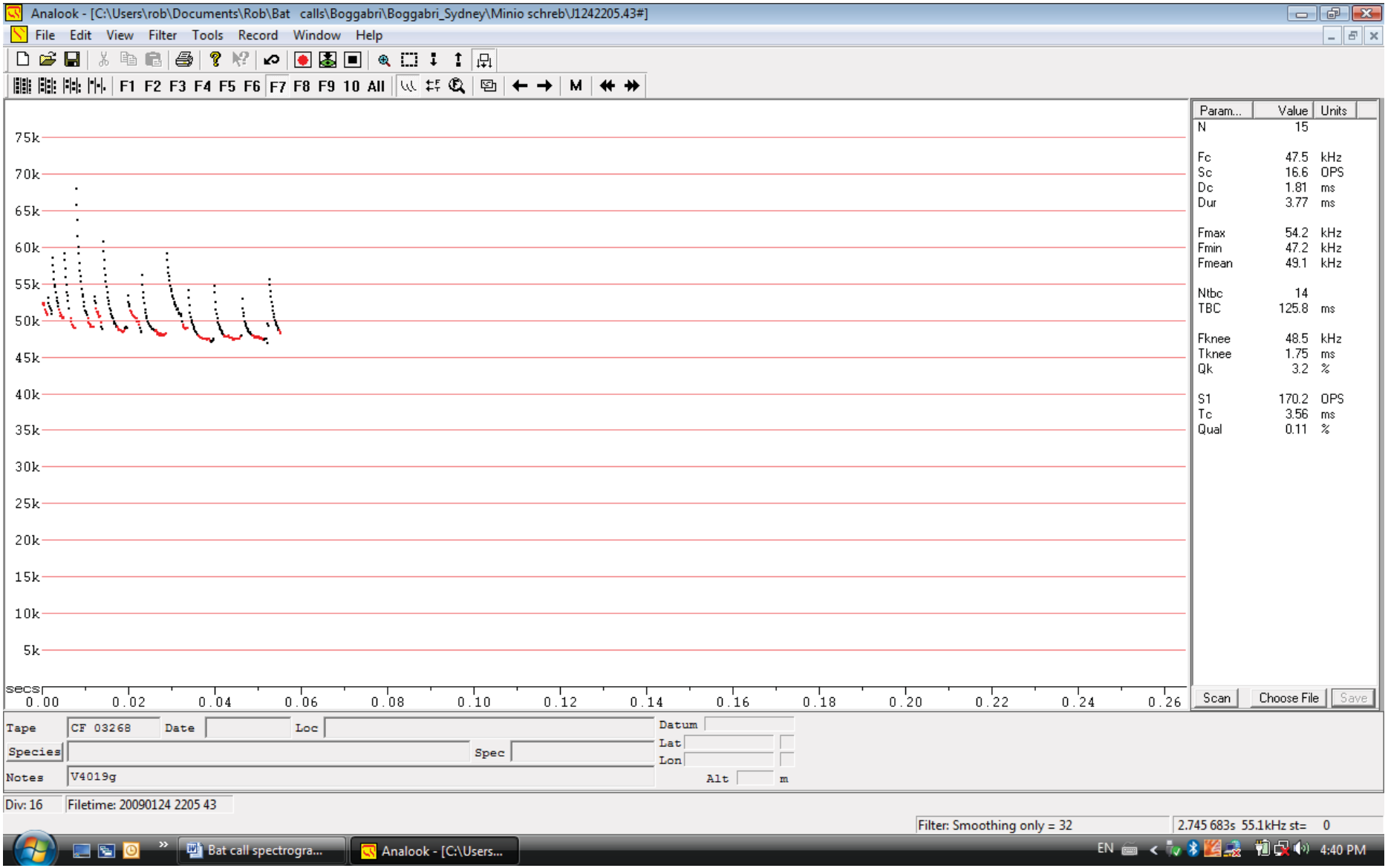
Gould's Wattled Bat



Chocolate Wattled Bat



Eastern Falsistrellus



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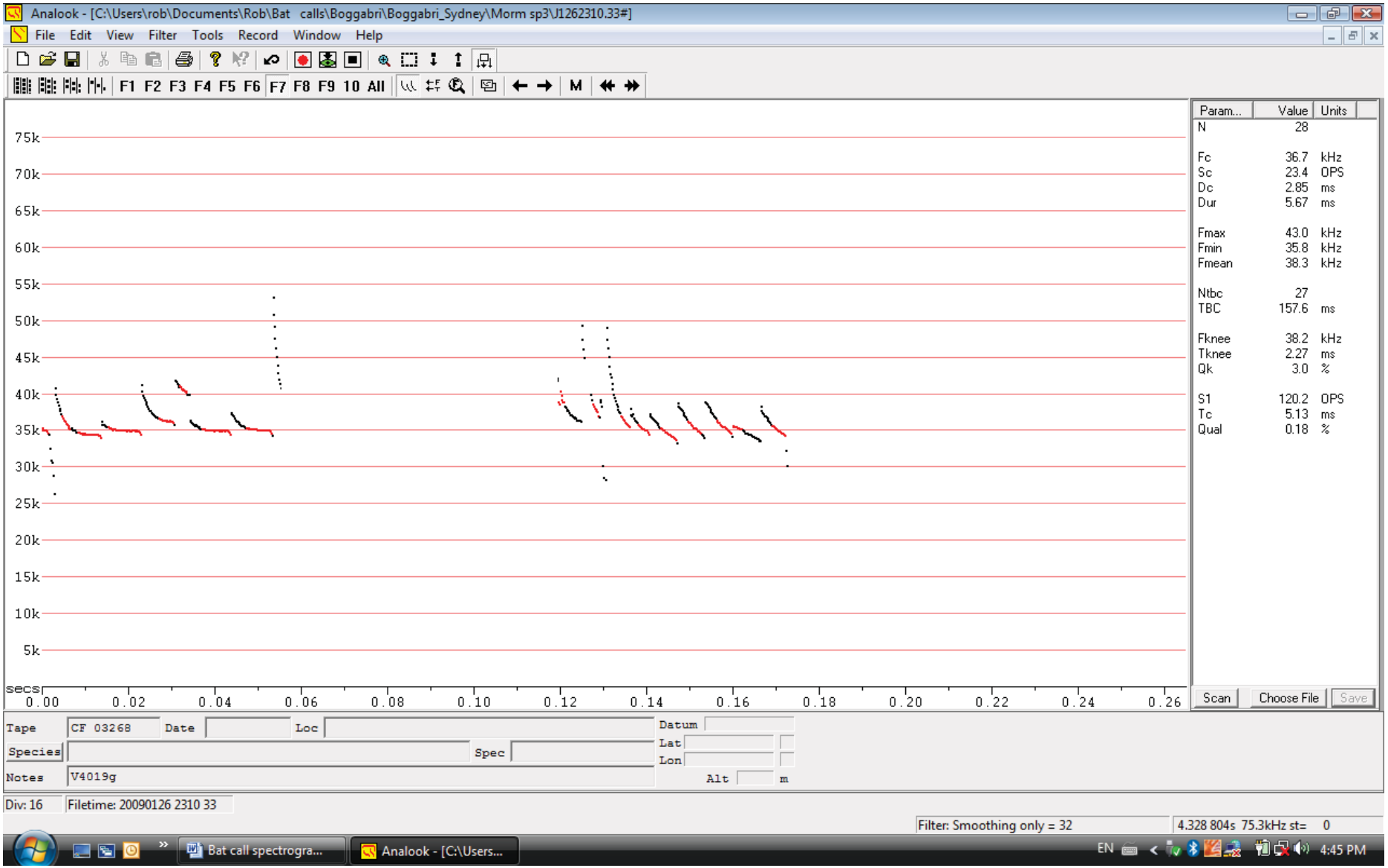
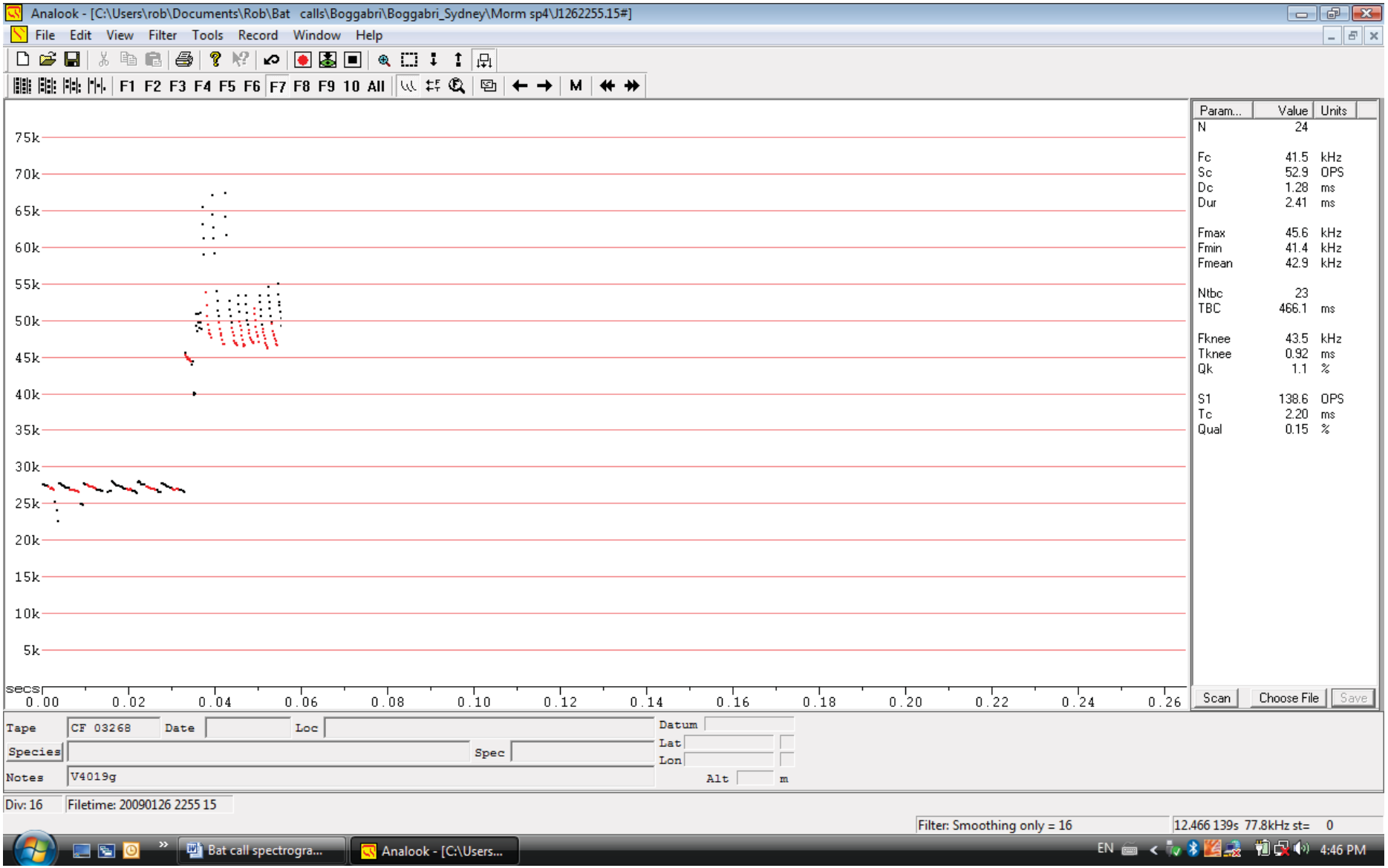
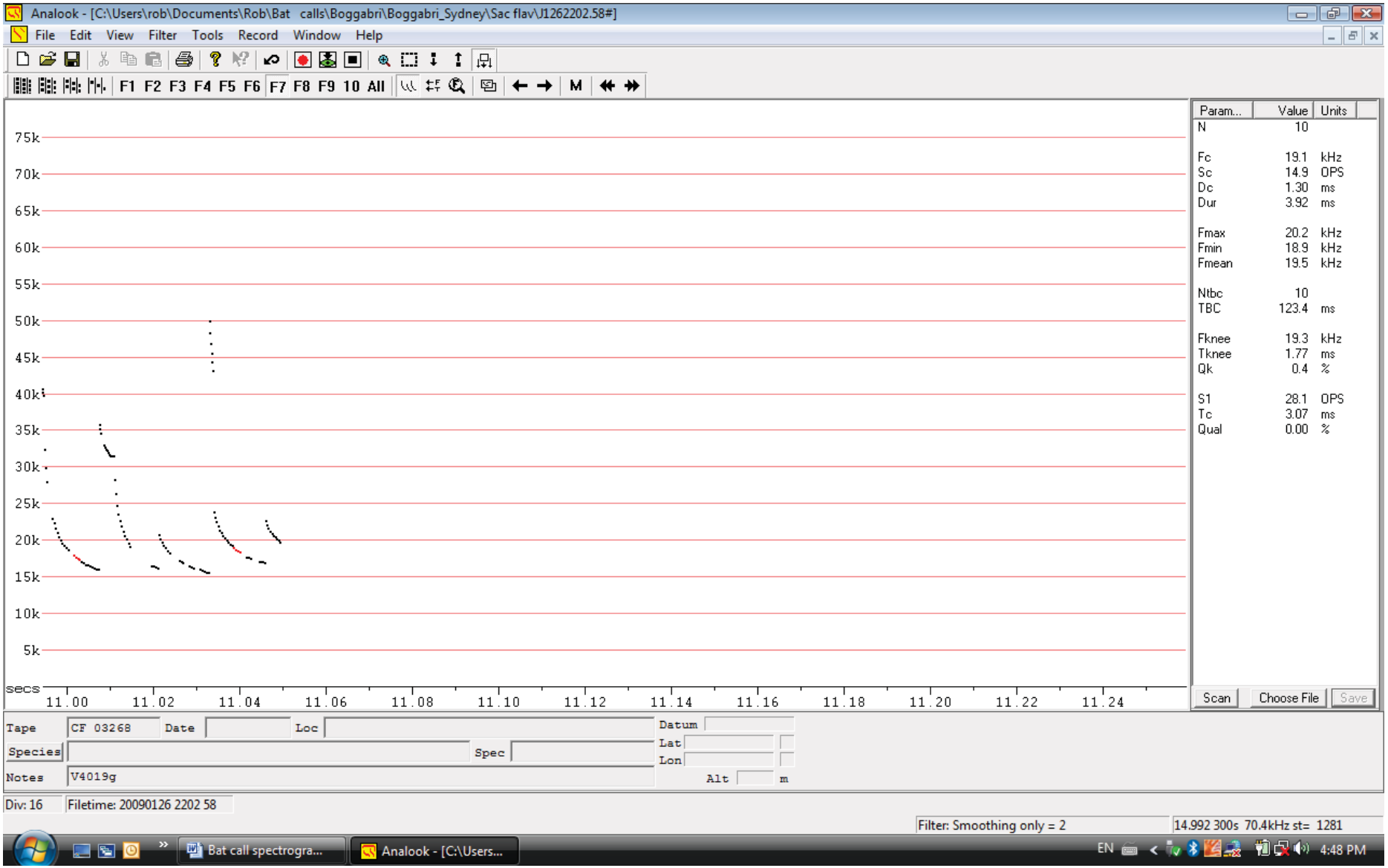


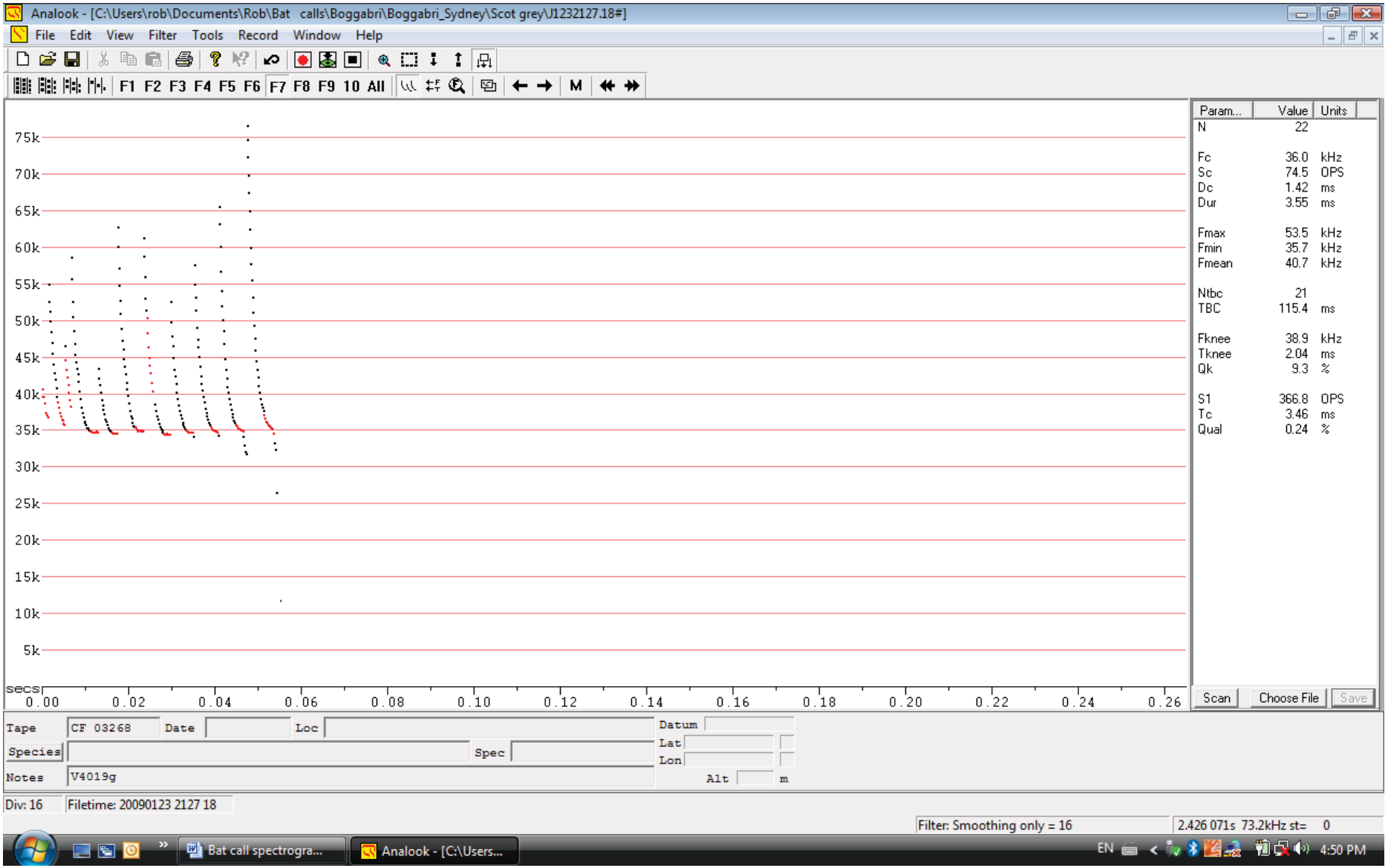
Eastern Freetail Bat



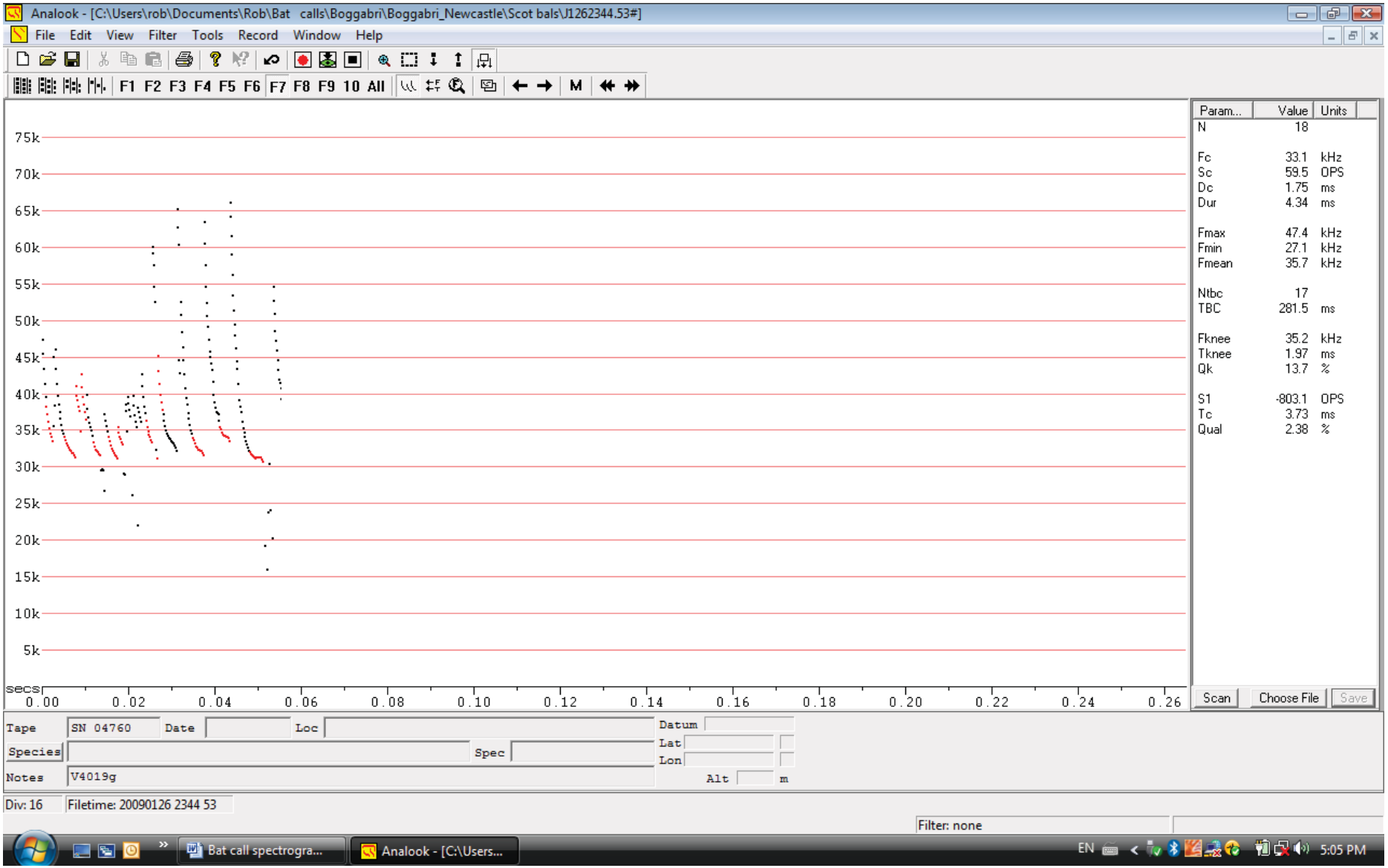
Southern Freetail Bat



Yellow-bellied Sheathtail Bat



Eastern Broad-nosed Bat



Inland Broad-nosed Bat

Appendix G

Fauna survey effort

Appendix G: Describes detailed fauna survey effort completed in December 2008, January, March/ April, June and September 2009.

Table G-1 Total fauna survey effort

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
December 2008						
09/12/08	Anabat[2]	1 night	Supplementary	Shrubby Woodland	226346	6614386
09/12/08	Anabat	1 hour	Supplementary	Shrubby Woodland	226346	6614386
10/12/08	Anabat	1 hour	S1,S2	Shrubby Woodland		
09/12/08	Call playback	30 minutes	Supplementary	Shrubby Woodland	226346	6614386
10/12/08	Call playback	30 minutes	S1,S2	Shrubby Woodland		
09/12/08	Spotlighting	1 hour	Supplementary	Shrubby Woodland	226346	6614386
10/12/08	Spotlighting	1 hour	S1,S2	Shrubby Woodland		
10/12/08	Bird Survey	20 minutes	S2	Shrubby Woodland	224030	6611053
10/12/08	Bird Survey	2*20 minutes	Supplementary	Shrubby Woodland	223717	6610562
10/12/08	Bird Survey	2*20 minutes	Supplementary	Shrubby Woodland	223883	6610410
10/12/08	Bird Survey	2*20 minutes	Supplementary	Shrubby Woodland	223987	6610138
10/12/08	Bird Survey	2*20 minutes	Supplementary	Shrubby Woodland	224176	6610242
09/12/08	Reptile survey	40 minutes	Supplementary	Shrubby Woodland	226346	6614386
10/12/08	Reptile survey	40 minutes	S1	Shrubby Woodland	224545	6611636
09/12/08	Frog survey	40 minutes	Supplementary	Shrubby Woodland	226346	6614386

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
08/12/08-12/12/08	Opportunistic recordings	4 days	Across all sites	Study area		
January 2009						
20/01/09-23/01/09	Arboreal trapping	40 trap nights	S1-S4	Leard State Forest fauna survey area		
24/01/09-27/01/09	Arboreal trapping	40 trap nights	S6-S8	Leard State Forest fauna survey area		
20/01/09-23/01/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S1-S4	Leard State Forest fauna survey area		
24/01/09-27/01/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S6-S8	Leard State Forest fauna survey area		
20/01/09-23/01/09	Cage trapping	24 trap nights	S1-S4	Leard State Forest fauna survey area		
24/01/09-27/01/09	Cage trapping	24 trap nights	S6-S8	Leard State Forest fauna survey area		
20/01/09-24/01/09	Pitfall/funnel Trapping	40 trap nights	S1,S2	Shrubby Woodland		
25/01/09-28/01/09	Funnel Trapping	32 trap nights	S6,S7	Grassy Woodland		
20/01/09	Anabat	1 hour	S1	Shrubby Woodland	224545	6611636
22/01/09	Anabat	1 hour	S2	Shrubby Woodland	224030	6611053
23/01/09	Anabat	1 hour	S3,S4	Leard State Forest fauna survey area		
24/01/09	Anabat	1 hour	S3	Grassy Woodland	226075	6610709
26/01/09	Anabat	1 hour	S6,S7	Grassy Woodland		
20/01/09-21/01/09	Harp trap	2 nights	S1,S2	Shrubby Woodland		

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
22/01/09-23/01/09	Harp trap	2 nights	S3,S4	Leard State Forest fauna survey area		
20/01/09	Call playback	30 minutes	S1	Shrubby Woodland	224545	6611636
22/01/09	Call playback	30 minutes	S2	Shrubby Woodland	224030	6611053
23/01/09	Call playback	30 minutes	S5,S4	Leard State Forest fauna survey area		
24/01/09	Call playback	30 minutes	S3	Grassy Woodland	226075	6610709
26/01/09	Call playback	30 minutes	S6	Grassy Woodland	225456	6611327
28/01/09	Call playback	30 minutes	S7	Grassy Woodland	225576	6609226
20/01/09	Spotlighting	1 hour	S1	Shrubby Woodland	224545	6611636
22/01/09	Spotlighting	1 hour	S2	Shrubby Woodland	224030	6611053
23/01/09	Spotlighting	1 hour	S4,S5	Leard State Forest fauna survey area		
24/01/09	Spotlighting	1 hour	S3	Grassy Woodland	226075	6610709
26/01/09	Spotlighting	1 hour	S6	Grassy Woodland	225456	6611327
28/01/09	Spotlighting	1 hour	S7	Grassy Woodland	225576	6609226
26/01/09	Bird Survey	2*20 minutes	S6	Grassy Woodland	225456	6611327
27/01/09	Bird Survey	20 minutes	S1	Shrubby Woodland	224545	6611636
27/01/09	Bird Survey	2*20 minutes	S7	Grassy Woodland	225576	6609226
29/01/09	Bird Survey	20 minutes	S2,S3	Leard State Forest fauna survey area		
28/01/09	Reptile survey	40 minutes	Supplementary	Shrubby Woodland	225608	6611643

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
28/01/09	Reptile survey	40 minutes	Supp9	Shrubby Woodland	225394	6611916
28/01/09	Reptile survey	40 minutes	Supp10	Shrubby Woodland	225243	6612175
28/01/09	Reptile survey	40 minutes	Supp11	Shrubby Woodland	225316	6612567
28/01/09	Reptile survey	40 minutes	Supp12	Shrubby Woodland	225472	6612692
29/01/09	Reptile survey	40 minutes	S1	Shrubby Woodland	224545	6611636
29/01/09	Reptile survey	40 minutes	Supp7	Shrubby Woodland	224044	6610454
19/01/09-30/01/09	Opportunistic recordings	12 days	Across project boundary	Leard State Forest fauna survey area		
02/04/09	General habitat assessment[3]	12 person hours	Across all sites			
March/ April 2009						
25/03/09-28/03/09	Arboreal trapping	24 trap nights	S12	Grassy Woodland	227169	6612543
26/03/09-29/03/09	Arboreal trapping	24 trap nights	S9-S11, S13-S14	Leard State Forest fauna survey area		
29/03/09-01/03/09	Arboreal trapping	24 trap nights	S15	Riverine Woodland	226479	6608870
30/03/09-02/03/09	Arboreal trapping	24 trap nights	S16-S17	Leard State Forest fauna survey area		
25/03/09-28/03/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S12	Grassy Woodland	227169	6612543
26/03/09-29/03/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S9-S11, S13-S14	Leard State Forest fauna survey area		
29/03/09-01/03/09	Terrestrial trapping	100 trap nights (Elliott A) & 40	S15	Riverine Woodland	226479	6608870

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
		trap nights (Elliott B)				
30/03/09-02/03/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S16-S17	Leard State Forest fauna survey area		
25/03/09-28/03/09	Cage trapping	24 trap nights	S12	Grassy Woodland	227169	6612543
26/03/09-29/03/09	Cage trapping	24 trap nights	S9-S11, S13-S14	Leard State Forest fauna survey area		
29/03/09-01/03/09	Cage trapping	24 trap nights	S15	Riverine Woodland	226479	6608870
30/03/09-02/03/09	Cage trapping	24 trap nights	S16-S17	Leard State Forest fauna survey area		
25/03/09-28/03/09	Funnel Trapping	24 trap nights	S12	Grassy Woodland	227169	6612543
26/03/09-29/03/09	Funnel Trapping	24 trap nights	S13,S14	Leard State Forest fauna survey area		
29/03/09-01/03/09	Funnel Trapping	24 trap nights	S15	Riverine Woodland	226479	6608870
30/03/09-02/03/09	Funnel Trapping	32 trap nights	S16	Grassy Woodland	229095	6610981
25/03/09	Anabat[2]	1 night	S12,S13	Leard State Forest fauna survey area		
25/03/09	Anabat	1 hour	S12,S13	Grassy Woodland	227169	6612543
26/03/09	Anabat[2]	1 night	S10,S14	Leard State Forest fauna survey area		
26/03/09	Anabat	1 hour	S10	Grassy Woodland	228024	6611268
27/03/09	Anabat[2]	1 night	S9,S11	Leard State Forest fauna survey area		
27/03/09	Anabat	1 hour	S11,S9	Leard State Forest fauna survey area		
28/03/09	Anabat[2]	1 night	S11,S15	Leard State Forest fauna survey area		

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
29/03/09	Anabat	1 hour	S14,S15	Leard State Forest fauna survey area		
30/03/09	Anabat[2]	1 night	S17	Leard State Forest fauna survey area	228991	6609566
30/03/09	Anabat	1 hour	S15	Riverine Woodland	226479	6608870
31/03/09	Anabat[2]	1 night	S16	Shrubby Woodland	229095	6610981
1/04/09	Anabat[2]	1 night	S18	Riverine Woodland	216791	6607900
1/04/09	Anabat	1 hour	S16,S17	Leard State Forest fauna survey area		
25/03/09-26/03/09	Harp trap	2 nights	S12	Grassy Woodland	227169	6612543
25/03/09-26/03/09	Harp trap	2 nights	S13	Grassy Woodland	227184	6611306
27/03/09-28/03/09	Harp trap	2 nights	S9	Shrubby Woodland	229193	6612746
27/03/09-28/03/09	Harp trap	2 nights	S10	Grassy Woodland	228024	6611268
29/03/09-30/03/09	Harp trap	2 nights	S14	Grassy Woodland	226366	6609117
29/03/09-30/03/09	Harp trap	2 nights	S15	Riverine Woodland	226479	6608870
1/04/09-2/04/09	Harp trap	2 nights	S18	Riverine Woodland	216791	6607900
25/03/09	Call playback	30 minutes	S12	Grassy Woodland	227169	6612543
25/03/09	Call playback	30 minutes	S13	Grassy Woodland	227184	6611306
26/03/09	Call playback	30 minutes	S10	Grassy Woodland	228024	6611268
27/03/09	Call playback	30minutes	S9	Shrubby Woodland	229193	6612746
27/03/09	Call playback	30minutes	S11	Shrubby Woodland	228677	6612321

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
29/03/09	Call playback	30 minutes	S14	Grassy Woodland	226366	6609117
30/03/09	Call playback	30 minutes	S15	Riverine Woodland	226479	6608870
31/03/09	Call playback	30 minutes	S18	Riverine Woodland	216791	6607900
01/04/09	Call playback	30minutes	S16,S17	Leard State Forest fauna survey area		
25/03/09	Spotlighting	1 hour	S12	Grassy Woodland	227169	6612543
25/03/09	Spotlighting	1 hour	S13	Grassy Woodland	227184	6611306
26/03/09	Spotlighting	1 hour	S10	Grassy Woodland	228024	6611268
27/03/09	Spotlighting	1 hour	S9	Shrubby Woodland	229193	6612746
27/03/09	Spotlighting	1 hour	S11	Shrubby Woodland	228677	6612321
29/03/09	Spotlighting	1 hour	S14	Grassy Woodland	226366	6609117
30/03/09	Spotlighting	1 hour	S15	Riverine Woodland	226479	6608870
31/03/09	Spotlighting	0.5 hours	S18	Riverine Woodland	226479	6608870
01/03/09	Spotlighting	1 hour	S16,S17	Leard State Forest fauna survey area		
24/03/09	Bird survey	20 minutes	Supplementary	Shrubby Woodland	228965	6613053
24/03/09	Bird Survey	20 minutes	S12,S10	Leard State Forest fauna survey area		
27/03/09	Bird Survey	20 minutes	S11,S12 S14	Leard State Forest fauna survey area		
28/03/09	Bird survey	20 minutes	S9	Shrubby Woodland	229193	6612746
28/03/09	Bird Survey	20 minutes	S14,S10 S11	Leard State Forest fauna survey area		

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
31/03/09	Bird Survey	20 minutes	S15	Riverine Woodland	226479	6608870
01/04/09	Bird Survey	20 minutes	S16,S17	Leard State Forest fauna survey area		
03/04/09	Bird Survey	20 min	S20	Shrubby Woodland	214592	6604741
30/03/09	Frog Survey	40 minutes	S15	Riverine Woodland	226479	6608870
31/03/09	Frog Survey	40 minutes	Supp.13	Grasslands	225629	6607890
31/03/09	Frog Survey	40 minutes	S18	Riverine Woodland	216791	6607900
28/03/09	Reptile survey	40 minutes	S9,S11	Leard State Forest fauna survey area		
29/03/09	Reptile survey	40 minutes	S12	Grassy Woodland	227169	6612543
30/03/09	Reptile survey	40 minutes	S13	Grassy Woodland	227184	6611306
01/04/09	Reptile survey	40 minutes	S10,S16 S17	Leard State Forest fauna survey area		
02/04/09	Reptile survey	40 minutes	S14,S15	Leard State Forest fauna survey area		
24/03/09-03/04/09	Opportunistic recordings	12 days	Across project boundary	Leard State Forest fauna survey area		
24/03/09-03/04/09	General habitat assessment[3]	12 person hours	Across all sites	Study area		
June 2009						
15/06/09-24/06/09	Systematic Koala habitat assessment within Lead State Forest	9 days	W1-W153	Study area (Leard State Forest)		
15/06/09-24/06/09	Systematic quantitative assessment of hollow trees within	9 days	W1-W153	Study area (Leard State Forest)		

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
	Lead State Forest					
16/06/09-23/06/09	Targeted Call playback for Masked Owl	8 consecutive nights (30 minutes per night)	S1	Shrubby Woodland	224545	6611636
16/06/09-23/06/09	Targeted Call playback for Masked Owl	8 consecutive nights (30 minutes per night)	S11	Grassy Woodland	228677	6612321
16/06/09-23/06/09	Spotlighting	4 hours	S1	Shrubby Woodland	224545	6611636
16/06/09-23/06/09	Spotlighting	4 hours	S11	Grassy Woodland	228677	6612321
15/06/09-24/06/09	Bird survey	20 minutes	W5		228769	6608362
15/06/09-24/06/09	Bird survey	20 minutes	W6		229269	6608362
15/06/09-24/06/09	Bird survey	20 minutes	W21		228769	6609362
15/06/09-24/06/09	Bird survey	20 minutes	W22		229269	6609362
15/06/09-24/06/09	Bird survey	20 minutes	W23		229769	6609362
15/06/09-24/06/09	Bird survey	20 minutes	W29		228269	6609862
15/06/09-24/06/09	Bird survey	20 minutes	W30		228769	6609862
15/06/09-24/06/09	Bird survey	20 minutes	W31		229269	6609862
15/06/09-24/06/09	Bird survey	20 minutes	W32		229769	6609862
15/06/09-24/06/09	Bird survey	20 minutes	W41		228269	6610362
15/06/09-24/06/09	Bird survey	20 minutes	W42		228769	6610362

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
15/06/09-24/06/09	Bird survey	20 minutes	W43		229269	6610362
15/06/09-24/06/09	Bird survey	20 minutes	W55		228769	6610862
15/06/09-24/06/09	Bird survey	20 minutes	W56		229269	6610862
15/06/09-24/06/09	Bird survey	20 minutes	W57		229769	6610862
15/06/09-24/06/09	Bird survey	20 minutes	W66		227769	6611362
15/06/09-24/06/09	Bird survey	20 minutes	W67		228269	6611362
15/06/09-24/06/09	Bird survey	20 minutes	W68		228769	6611362
15/06/09-24/06/09	Bird survey	20 minutes	W69		229269	6611362
15/06/09-24/06/09	Bird survey	20 minutes	W70		229769	6611362
15/06/09-24/06/09	Bird survey	20 minutes	W82		229769	6611862
15/06/09-24/06/09	Bird survey	20 minutes	W91		228769	6612362
15/06/09-24/06/09	Bird survey	20 minutes	W92		229269	6612362
20/06/09	Targeted Frog Survey (*Crinia sloanei*)	1 hour	S18	Riverine Woodland	216914 216791	6608095 6607900
21/06/09	Targeted Frog Survey (*Crinia sloanei*)	1 hour	S18	Riverine Woodland	216914 216791	6608095 6607900
22/06/09	Targeted Frog Survey (*Crinia sloanei*)	1 hour	S18	Riverine Woodland	216914 216791	6608095 6607900
15/06/09-24/06/09	Opportunistic recordings	9 days	Across study area	Study area		

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
September 2009						
17/09/09-21/09/09	Arboreal trapping	24 trap nights	S18-S20	Rail corridor fauna survey area		
18/09/09-22/09/09	Arboreal trapping	24 trap nights	S21	Shrubby Woodland	215054	6605915
17/09/09-21/09/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S18-S20	Rail corridor fauna survey area		
18/09/09-22/09/09	Terrestrial trapping	100 trap nights (Elliott A) & 40 trap nights (Elliott B)	S21	Shrubby Woodland	215054	6605915
17/09/09-21/09/09	Cage trapping	24 trap nights	S18-S20	Rail corridor fauna survey area		
18/09/09-22/09/09	Cage trapping	24 trap nights	S21	Shrubby Woodland	215054	6605915
17/09/09-21/09/09	Funnel Trapping	32 trap nights	S19	Grassy Woodland	216346	6607751
18/09/09-22/09/09	Funnel Trapping	32 trap nights	S21	Shrubby Woodland	215054	6605915
	Anabat[2]	1 night	S20	Shrubby Woodland		
	Anabat	0.5 hours	S20	Shrubby Woodland		
	Anabat	0.5 hours	S19	Grassy Woodland		
	Anabat[2]	1 night	S21	Shrubby Woodland		
17/09/09-20/09/09	Harp Trap	3 nights	S18 & S20	Rail corridor fauna survey area		
20/09/09-23/09/09	Harp Trap	3 nights	S19	Grassy Woodland	216346	6607751
21/09/09-24/09/09	Harp Trap	3 nights	S21	Shrubby Woodland	215054	6605915

Date	Survey method	Effort	Survey site	Location description[1]	Location (MGA94 Zone 56)	
					Easting	Northing
18/09/09	Call playback	30 minutes	S20	Riverine Woodland	214903	6604784
20/09/09	Call playback	30 minutes	S18	Riverine Woodland		
23/09/09	Call playback	30 minutes	S21	Shrubby Woodland	215054	6605915
18/09/09	Spotlighting	1 hour	S20	Riverine Woodland	214903	6604784
20/09/09	Spotlighting	1 hour	S18	Riverine Woodland		
21/09/09	Spotlighting	1 hour	S19	Grassy Woodland	216346	6607751
22/09/09	Spotlighting	1 hour	S21	Shrubby Woodland	215054	6605915
20/09/09	Bird survey	1 hour	S20	Riverine Woodland	214903	6604784
22/09/09	Bird survey	55 minutes	Supplementary	Leard State Forest fauna survey area	228695	6612328
24/09/09	Bird survey	1 hour	S21	Shrubby Woodland	215054	6605915
24/09/09	Bird survey	50 minutes	S19	Grassy Woodland	216346	6607751
24/09/09	Bird survey	40 minutes	Supplementary	Leard State Forest fauna survey area	227385	6612320
24/09/09	Reptile survey	40 minutes	S19	Grassy Woodland	216346	6607751
23/09/09	Reptile survey	60 minutes	S21	Shrubby Woodland	215054	6605915
23/09/09	Reptile survey	40 minutes	S20	Riverine Woodland	214903	6604784
17/09/09-25/09/09	Opportunistic recordings	9 days		Across project boundary		

Note: **1**: Grassy Woodland refers to Grassy Woodland on fertile soils fauna habitat; Shrubby Woodlands refers to Shrubby Woodland/ Open Forest on skeletal soils fauna habitat; Riverine Woodland refers to Riverine Woodland fauna habitat **2**: Anabat Bat Detector set to record throughout the night.
3: General habitat assessment includes, hollow-bearing tree assessment (20 m * 50 m) and Koala scat search (20 Koala feed trees).

Appendix H

Weather conditions

Appendix H: Describes weather conditions experienced during field surveys

Table H-1 Daily weather conditions during field surveys

Date	Day	Temperature		Rain (mm)	Wind		Moon phase
		Min (°C)	Max (°C)		Direction	Speed (kph)	
5/12/08	Fri	19.8	31.8	0	N	43	First quarter
6/12/08	Sat	22.3	32.7	0	WNW	48	First quarter
7/12/08	Sun	18.8	28.9	3.8	WNW	33	First quarter
8/12/08	Mon	17.2	31.2	0	SW	48	First quarter
9/12/08	Tue	15.9	31.9	0	N	46	First quarter
10/12/08	Wed	22.7	36.3	0	W	61	First quarter
11/12/08	Thur	18.6	36.6	0.2	SSE	48	First quarter
12/12/08	Fri	19.8	29.2	2.4	NNE	72	Full moon
16/01/09	Fri	23.6	39.7	0	WSW	46	Full moon
17/01/09	Sat	18.0	34.4	0	SE	56	Full moon
18/01/09	Sun	16.5	33.4	0	ESE	35	Last quarter
19/01/09	Mon	20.7	33.4	0	NE	44	Last quarter
20/01/09	Tue	23.7	35.1	0	N	52	Last quarter
21/01/09	Wed	25.1	30.8	0	SE	48	Last quarter
22/01/09	Thur	20.9	25.8	9.8	NE	44	Last quarter
23/01/09	Fri	20.9	32.7	5.2	NNW	33	Last quarter
24/01/09	Sat	24.6	37.0	0	S	46	Last quarter
25/01/09	Sun	21.8	37.6	3.8	N	48	Last quarter
26/01/09	Mon	21.6	36.7	0	SSE	35	New Moon
27/01/09	Tue	20.9	35.6	0	S	33	New Moon
28/01/09	Wed	20.9	36.3	0	SSW	0	New Moon
29/01/09	Thur	20.3	36.5	0	N	33	New Moon
30/01/09	Fri	21.9	36.1	0	NNE	44	New Moon
20/03/09	Fri	15.5	32.7	0	ESE	41	Last quarter

Date	Day	Temperature		Rain (mm)	Wind		Moon phase
		Min (°C)	Max (°C)		Direction	Speed (kph)	
21/03/09	Sat	14.4	31.7	0	S	31	Last quarter
22/03/09	Sun	12.9	31.8	0	ESE	28	Last quarter
23/03/09	Mon	13.9	32.8	0	SSE	26	Last quarter
24/03/09	Tue	16.2	34.8	0	N	30	Last quarter
25/03/09	Wed	20.2	32.7	0	N	44	Last quarter
26/03/09	Thur	17.9	33.2	0	NW	31	New Moon
27/03/09	Fri	19.4	32.5	0.2	WSW	50	New Moon
28/03/09	Sat	14.3	30.1	0.4	SE	33	New Moon
29/03/09	Sun	11.7	30.8	0	SSE	35	New Moon
30/03/09	Mon	16.4	30.7	0	SSE	50	New Moon
31/03/09	Tue	17.0	22.8	0.6	SSE	57	New Moon
1/04/09	Wed	17.2	31.1	5.2	SSE	37	New Moon
2/04/09	Thur	18.7	30.5	14.6	E	50	First Quarter
3/04/09	Fri	18.1	30.1	1.6	SSE	28	First Quarter
12/06/09	Fri	-2.3	17.2	0	E	19	Full moon
13/06/09	Sat	2.7	19.3	0	NNW	44	Full moon
14/06/09	Sun	2.1	20.5	0	N	41	Full moon
15/06/09	Mon	8.3	19.9	0.6	N	39	Last quarter
16/06/09	Tue	5.6	19.0	0	SE	28	Last quarter
17/06/09	Wed	5.2	19.5	0	SSE	39	Last quarter
18/06/09	Thur	8.5	18.5	0	SE	43	Last quarter
19/06/09	Fri	7.9	19.7	0	SE	41	Last quarter
20/06/09	Sat	9.2	22.2	0	SSE	33	Last quarter
21/06/09	Sun	12.2	21.1	0.8	NNE	37	Last quarter
22/06/09	Mon	9.8	21.0	7.8	E	26	New moon

Date	Day	Temperature		Rain (mm)	Wind		Moon phase
		Min (°C)	Max (°C)		Direction	Speed (kph)	
23/06/09	Tue	6.7	22.0	0	ENE	22	New moon
24/06/09	Wed	4.9	20.7	0	NNW	39	New moon
14/09/09	Mon	14.7	29.6	0	N	44	Last quarter
15/09/09	Tue	8.9	29.7	0	N	43	Last quarter
16/09/09	Wed	13.3	30.6	0	N	44	Last quarter
17/09/09	Thur	17.7	29.6	0	N	67	Last quarter
18/09/09	Fri	16.4	28.9	0	W	43	New moon
19/09/09	Sat	7.5	28.2	0	W	33	New moon
20/09/09	Sun	9.5	30.8	0	SE	30	New moon
21/09/09	Mon	13.1	28.4	0	NW	43	New moon
22/09/09	Tue	15.6	26	6.0	N	70	New moon
23/09/09	Wed	14.0	19.1	2.0	WNW	74	New moon
24/09/09	Thur	6.5	23.1	0	WNW	39	New moon

Notes: Data from Narrabri (Bureau of Meteorology 2008). Shaded rows are the period of survey.