Appendix A – Biodiversity Assessment

MAUNSELL AECOM

Biodiversity Assessment

Modification of Upgrade to Hume Highway Sturt Highway to Tarcutta

Road Traffic Authority of NSW

15 August 2007

Biodiversity Assessment

Prepared for

Road Traffic Authority of NSW

Prepared by

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Executive Summary

The NSW Roads and Traffic Authority (RTA) propose to upgrade a section of the Hume Highway between the Sturt Highway intersection and Tarcutta. This report relates Section 1: Sturt Highway to Tarcutta. An environmental assessment was conducted for this section. The alignment of the upgrade has since been modified.

This report provides the results of an investigation into the biodiversity associated with this section. It identifies species, communities and populations of local, regional, state and national conservation significance, and their habitats, which are known or considered likely to occur in the study area and assesses the potential impacts of the modified proposal on the identified species and communities of conservation significance. Significance assessments were conducted for the alignment considered in the original environmental assessment.

The report is based extensively on the ecological impact assessment conducted for the original alignment. The results of additional ecological investigations have been used to update the ecological assessment with respect to the modified alignment.

The methodology used for field surveys, detailed results of surveys and mapping of vegetation and fauna habitat can be found in the original ecological assessment (SKM 2006).

Changes to the impact on terrestrial ecology as a result of the modification are expected to be minimal. Greater impact is expected however on the aquatic environment of Dellateroy Creek. Additional mitigation measures are thus required for the protection of aquatic biodiversity.

1.0 Key Findings

1.1 Flora and Vegetation

Vegetation communities containing White Box, Yellow Box, Blakely's Red Gum, River Red Gum, Mugga Ironbark and Red Stringybark generally occur throughout the study area as a fragmented mosaic of small woodland remnants predominantly preserved in roadside remnants and Travelling Stock Routes (TSR's).The White Box – Yellow Box – Blakely's Red Gum Woodland (Box-Gum Woodland) is present. This community is scheduled as an Endangered Ecological Community in NSW under the *Threatened Species Conservation Act* (TSC Act), and depending on its condition, a Critically Endangered Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act). The distribution and condition of remnants of this community are identified in **Figure 1**. No threatened flora species scheduled under Commonwealth or NSW legislation were recorded however several species may potentially occur.

The conservation value of the vegetation was assessed in preliminary investigations of the Hume Highway study areas (ERM 2006). This was considered in the design of the road upgrade such that the proposal footprint was located to minimise the removal of remnant woodland in existing linear roadside reserves and TSRs wherever possible. The condition assessment for this study identified three classes of Box-Gum Woodland; high, moderate and low quality on the basis of the floristic and structural diversity, disturbance regimes, patch size and regeneration potential.

All patches of woodland present across the area are of moderate and low quality. Therefore the proposal has minimal impact on high quality Box-Gum Woodland. An estimate of the direct impacts on vegetation, and its legislative status, is given below. This is based on the design footprint and additional impacts may result during construction and from long-term edge effects.

Table 1 – Hectares of vegetation communities to be removed.

Vegetation Community	Condition	Hectares of EEC* to be Removed		
		CEEC**)	EEC	Total
White Box – Yellow Box – Blakely's Red Gum Woodland	Low	-	2.15	2.15
White Box – Yellow Box – Blakely's Red Gum Woodland	Moderate	0.30	0.98	0.98
Mugga Ironbark – Red Stringybark Woodland	Low			2.61
Total		0.30	3.13	5.74

*EEC- endangered ecological community listed under the NSW *Threatened Species Conservation Act 1995*
**CEEC - endangered ecological community listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Given that all remnants of Box-Gum woodland are of conservation value, a strategy to mitigate these losses is required through a commitment to identify offset opportunities for the enhancement or restoration of degraded woodland in the project area.

Assessments of significance conducted under both commonwealth and NSW requirements conclude that none of these species or communities would be significantly affected by the proposal.

1.2 Terrestrial Fauna and Habitat

Five broad fauna habitat types occur including woodland, riparian habitats, derived grasslands, rocky hillslopes, and freshwater habitats (dams, creeks and wet depressions).

Four threatened fauna species were recorded in the study area; the Speckled Warbler *Pyrrholaemus sagittatus*, Brown Treecreeper *Climacteris picumnus*, Diamond Firetail *Stagonopleura guttata* and Striped Legless Lizard *Delma impar*.

These species are listed as vulnerable species under the NSW *Threatened Species Conservation Act 1995* (TSC Act. The Striped Legless Lizard is also listed nationally as a vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act).

Of particular significance to the life-cycles of all identified threatened fauna is the ability to move between fragmented habitat patches to access food resources and maintain the genetic health of populations. A component of the project involves strategically located revegetation programs to increase the total area of habitat in the study area and restore links to isolated fragments.

Given that these species and their habitat were recorded across the broader landscape, they were considered indicators of habitat health. Accordingly the distribution and condition of habitat suited for these species was identified. The project is considered to have minimal impact on the presence and distribution of the Brown Treecreeper, Diamond Firetail and Speckled Warbler. These species are relatively widespread and locally common in the locality of the study area. Measures to protect restore and enhance Box-Gum woodland as discussed previously would ensure the preservation of habitat and continual presence of populations of these species and several other threatened woodland birds addressed in the study.

Potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard *Aprasia parapulchella* is restricted to the rocky hillslopes at the northern end of the study area and populations of these species are likely to be localised. The proposal would have indirect impact on potential habitat for these species through increased habitat fragmentation though the existing Hume Highway alignment at this location historically divides potential habitat.

Assessments of significance conducted under both Commonwealth and NSW requirements conclude that none of these species or their habitat would be significantly affected by the proposal.

1.3 Fish and Aquatic Habitat

Dellateroy Creek and its tributaries have the potential to be directly and indirectly impacted by the proposal and as such an assessment of the condition of this waterway and its potential to provide habitat for threatened aquatic species was conducted.

A number of threatened fish species and endangered fish populations have been recorded within the Murray-Darling basin. However, most of these species are unlikely to be impacted by the proposal. Species with the most potential to be impacted are Purple Spotted Gudgeon *Mogurnda adspersa* (western population) and Southern Pygmy Perch *Nannoperca australis*. An assessment of the likely impacts of the proposal on these species and their habitat has been prepared although there is a low probability of these species occurring.

Dellateroy Creek flows into Tarcutta Creek a short distance downstream. Tarcutta Creek contains known populations of Murray Cod and is being targeted for restoration in attempts to attract Trout Cod from the Murrumbidgee River into the waterway. Both species are listed under the Commonwealth EPBC Act and the NSW *Fisheries Management Act* (FM Act). Utmost care is required along this section, specifically in regard to sedimentation and water quality, to prevent impacts on these populations.

All waterways form part of the region covered by the endangered *Aquatic ecological community in the natural drainage basin of the lower Murray River catchment*. This community is listed as Endangered under the NSW *Fisheries Management Act 1994*.

Assessments of significance conducted under both Commonwealth and NSW requirements conclude that none of these species, populations or communities would be significantly affected by the proposal.

2.0 Impact Assessment

2.1 NSW Threatened Species Impact Assessment

2.1.1 Flora

Impacts on vegetation were quantified by overlaying the proposed duplication footprint onto the vegetation community and condition maps produced for the Tarcutta study area. The proportion of each community and condition to be directly cleared by the proposal is detailed below. The total area of disturbance (~5.74ha) is based on the road footprint and an additional 5 m buffer. Supplementary surveys would be conducted during the detailed design and construction stage to identify appropriate locations for the placement of stockpile and construction areas that avoid further impacts on vegetation and habitat.

Table 2 – Proportional impact on vegetation communities.

Vegetation Community	Condition	Total area vegetation identified (ha)	Vegetation to be impacted (ha)	Proportion of identified vegetation to be impacted (%)	Ecological Community Impact (ha)	
					TSC Act	EPBC Act
White Box – Yellow Box – Blakely's Red Gum Woodland	Low	41.4	2.15	5.2	2.15	0
White Box – Yellow Box – Blakely's Red Gum Woodland	Moderate	28.18	0.98	3.5	0.98	0.30
White Box – Yellow Box – Blakely's Red Gum Woodland	High	26.58	0	0	0	0
Sub-total		96.16	3.13	3.3	3.13	0.30
Mugga Ironbark – Red Stringybark Woodland	Low	79.89	2.61	3.3	0	0
Mugga Ironbark – Red Stringybark Woodland	Moderate	1.19	0	0	0	0
Mugga Ironbark – Red Stringybark Woodland	High	2.33	0	0	0	0
Sub-total		83.41	2.61	3.1		
Total		**179.57**	**5.74**	**3.2**		

The conservation value of the vegetation was identified from preliminary investigations (ERM 2006) and hence considered in the design of the road upgrade such that the proposal footprint was located to minimise removal of remnant woodland and existing linear road reserves wherever possible. As such the project does not directly impact on high quality Box-Gum Woodland. However up to 2.15 ha of low quality Box-Gum Woodland and 0.98 ha of moderate quality Box- Gum woodland would be disturbed (see Figure 3-4). A total area of 96.16 ha of Box-Gum Woodland was identified in the field surveys, of which 43% is of low condition, 29% is of moderate condition and 28% is of high condition.

2.1.2 Fauna Habitat and Corridors

Habitat areas for fauna are generally small and fragmented throughout the Tarcutta study area as a result of past clearing. High quality woodland remnants are restricted to narrow linear road reserves along the eastern side of the Highway and the Lower Tarcutta Road. Although small in size and fragmented, these areas provide high structural diversity, ground cover and an abundance of mature hollow-bearing trees and were considered high quality for common and threatened woodland birds, bats and the Squirrel Glider, despite the absence of the latter species from the findings. The proposed footprint through the Tarcutta study area mostly avoids areas identified as high quality fauna habitat and potential habitat of these species. Similarly potential wildlife corridors are associated with lineal road reserves along the eastern side of the Hume Highway south of the Dellateroy Creek and also along the Lower Tarcutta Road, neither area would be impacted by the current design.

Potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard occurs within the rocky hillslope areas identified on the opposite eastern and western sides of the highway (refer **Figure 4**). The design would not result in the direct loss of the potential habitat identified on the eastern side of the road though further fragmentation of habitat of these species would result. Opportunities to alter the design to avoid the direct impact of habitat are recommended.

There is no data available on important regional corridors in the Tarcutta study area. The proposal will impact linear vegetation fragments within the existing road reserves which provide connectivity for local fauna populations. The total length of corridor to be impacted by the proposal comprises approximately 1.72 km, however in most areas impacts are restricted to the edge of these corridors and therefore connectivity is maintained. The proposal is unlikely to significantly affect fauna movement in the local area.

2.1.2.1 Edge Effects

A review of edge effects associated with roads (Bali 2005) summarised data from several sources in identifying the potential impacts on adjacent terrestrial and aquatic habitats. The following effects were documented.

- Increased mortality during construction;
- Increased mortality from collisions with vehicles;
- Modifying animal behaviour;
- Altering the physical environment;
- Altering the chemical environment;
- Spreading exotic species; and
- Increasing the alteration and use of habitats by humans.

It is evident that remnant vegetation preserved within the road reserves of the study area is already edge affected as a result of past clearing and the degree of fragmentation resulting in a high edge to area ratio. Bali (2005) suggests that while there may be edge effects associated with old edges and road widening, as is the case with the current project, these are difficult to quantify based on current knowledge.

As the proposed duplication and widening will not create a new edge through unfragmented woodland, all impacts will be on current edge affected vegetation. Edge effects would be reduced through general mitigation and rehabilitation measures associated with the construction and operational stages of the road development (Bali 2005).

2.1.2.2 Waterways

Extension of the already culverted section of Dellateroy Creek would be required for the proposal and therefore would impact on the channel and riparian zone of the creek at this location. The riparian zone of Dellateroy Creek was degraded, dominated by exotic pasture grasses and supporting scattered Willows along the banks. In stream habitats of Dellateroy Creek included a rocky area and abundant Bulrush.

2.1.2.3 Riparian Vegetation Clearance

Vegetation clearance within the riparian zone of Dellateroy Creek is required for the proposal as a result of the minor realignment of some bends of the creek. However, the riparian zone in this area is comprised of exotic pasture with Willows scattered along the banks in some parts. Therefore it is considered unlikely that the proposed works would have significant detrimental impacts on the already highly modified riparian zone. Furthermore, areas directly adjacent to the proposed construction area will be revegetated following construction to increase bank stability and provide a buffer to act as an additional filter for runoff from the adjacent road surface.

2.1.2.4 Hydrological Changes

Given that the proposal would result in creek realignment, and includes the extension to the culverted area over Dellateroy Creek, some changes to hydrological regimes are anticipated. The proposal also includes the extension of the current impervious area for the Hume Highway. Impervious surfaces and changes to natural hydrological processes can have a number of potential effects including:

- alter the ecology of an area including the vegetation composition and loss of fauna habitat;
- changes in soil moisture content; and
- may create conditions conducive to invasion by exotic species.

Currently the riparian zone along Dellateroy Creek is highly degraded and it is likely that the hydrology of the site has already been altered as a consequence of the original Hume Highway and associated culvert construction. Anticipated changes to hydrology as a consequence of the proposal are likely to be due primarily to the additional vegetation removal and may include increased flows from runoff and water logging of areas adjacent to the road.

2.1.2.5 Erosion, Runoff and Sedimentation

Potential impacts on Dellateroy Creek are likely during construction from runoff, erosion and sedimentation if management measures are not implemented. There is also the potential for post-construction impacts.

There is the potential for nutrients, pollutants and seeds of exotic species to be transported from the development area downstream. Increased nutrient levels may create conditions more suitable for exotic species and therefore exacerbate the current weed invasion problems in the area. Given that the proposed construction area supports exotic species there is the potential for seeds of these species to spread as a consequence of the soil disturbance during construction works.

There is also the potential for indirect impacts on the watercourse if management measures are not implemented. Sedimentation can prevent growth of many aquatic flora species as high turbidity and fine sediments smothering leaf surfaces can prevent leaf photosynthesis and can have adverse impacts on stream flow. Sedimentation can also obstruct natural stream flow and can reduce habitat

availability (e.g. decreasing pool depths). Therefore management measures to trap or filter runoff before it enters the watercourse should be implemented.

Finally, there is the potential for increase in erosion within the study area due to increased stormwater and runoff flows. The banks of Dellateroy Creek have a high erosion potential and extensive scouring was evident during this study. Such erosion would not only destabilise the creek banks, and degrade further the riparian habitats, it would also increase sediment loads in the creek.

Provided appropriate stormwater, erosion and sediment detention systems are installed and runoff is managed to prevent uncontrolled high flows entering the watercourse, the potential for the proposal to have adverse impacts on Dellateroy Creek would be reduced. Furthermore, 'best practice' stormwater treatment measures would be implemented to maximise:

- Onsite pollutant retention and removal; and
- Infiltration and sub-surface discharge of stormwater (NPWS 1998).

2.1.2.6 Fish Passage

The maintenance of fish passage along waterways is critical to the survival of Australian fish. Fish traverse waters for a variety of reasons including food, shelter, avoidance of predators, breeding and juvenile recruitment to habitat. Dellateroy Creek is the only creek to be impacted within the study area and currently supports a culvert to enable fish to pass beneath the Hume Highway. The current culvert would need to be extended by approximately 40 metres for the widening of the highway footprint at this location. Culverts have the potential to block fish passage through factors such as excessive flow velocities within the culvert, inadequate flow depth, excessive length (i.e. lack of 'rest' areas) and debris blockage (Fairfull and Witheridge 2003). Dellateroy Creek is a Class 2 stream and therefore in accordance with Fairfull and Witheridge (2003), either a bridge, arch structure, ford or culvert is considered is required to facilitate fish passage.

Given that the proposed extension would be undertaken in accordance with the requirements outlined in Fairfull and Witheridge (2003), it is unlikely that fish passage throughout Dellateroy Creek would be impeded as a consequence of the proposal.

2.1.2.7 Key Threatening Processes

The following key threatening processes are considered relevant to the proposal:

- In-stream structures and other mechanisms that alter natural flow regimes (FM Act).
- Degradation of native riparian vegetation along NSW watercourses (FM Act).
- Alteration to natural flow regimes of rivers, streams, floodplains and wetlands (TSC Act).
- Clearing of native vegetation (TSC Act).
- Bush rock removal (TSC Act).
- Invasion of native plant communities by exotic perennial grasses (TSC Act).
- Removal of dead wood and dead trees (TSC Act).

The proposed culvert extension at Dellateroy Creek has the potential to result in alterations to natural flow regimes in Dellateroy Creek. However, given that culverts would be designed in accordance with Fairfull and Witheridge (2003) it is expected that the contribution of the proposal to key threatening processes would be minimal. Other measures should also be considered to prevent adverse impacts from the culvert extensions/modifications and associated changes to flow including planting of macrophytes along the stream banks to filter flow and enhance bank stability.

It is recommended that the guidelines in *A Rehabilitation Manual for Australian Streams* (Rutherford et al. 1999).are considered when implementing mitigation measures such as these.

Within the SWS bioregion, vegetation communities containing White Box, Yellow Box, Blakely's Red Gum, as well as Grey Box, Poplar Box, White Cypress Pine, or River Red Gum generally occur over an area that is less than 10% of their predicted distribution prior to clearing (NPWS 2001). These communities are heavily depleted and all remaining areas exist as fragmented mosaics of remnant vegetation. The clearing associated with the proposal will contribute to the cumulative loss of woodland vegetation in the bioregion and therefore appropriate mitigation would include the provision of compensatory vegetation or a commitment to the enhancement of vegetation retained in existing road reserves.

Management prescriptions described in the report are aimed at ameliorating the long-term impacts from the identified key threatening processes.

2.1.3 Significant Impact Assessment

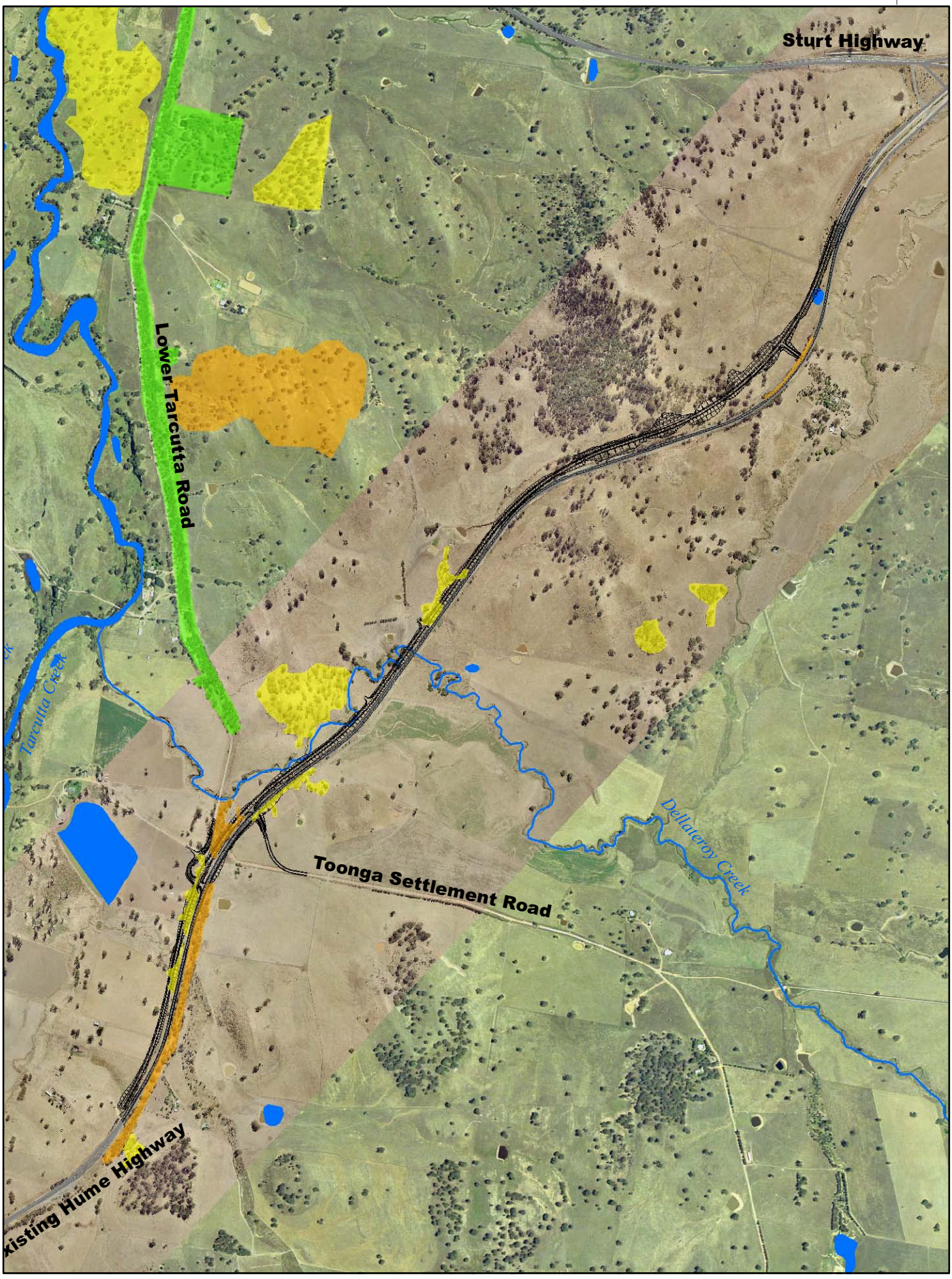
An assessment of the impacts of this proposal on species, populations and ecological communities listed Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5A of the FM Act has been undertaken. The proposal is to be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft Guidelines for Threatened Species Assessment (DEC 2005a).

2.1.3.1 Terrestrial Endangered Ecological Communities

2.1.3.1.1 Box Gum Woodland

This assessment relates to the direct and indirect impacts on the EEC Box-Gum Woodland. The area of vegetation potentially impacted comprises 2.15 ha of low condition vegetation and 0.98 of moderate vegetation condition. Total vegetation disturbance is ~3.13 ha of EEC.

Native plant species richness was relatively high within the larger remnants within roadside reserves. These areas generally have a moderate condition, with the understorey comprising a mix of both native and exotic flora. Heavily grazed areas of remnant vegetation have a low vegetation condition due to the low diversity of native species and the dominance of exotic flora.



Modified Alignment
Roads
Waterways

Vegetation Condition
High
Moderate
Low

N

0 0.1 0.2 0.4 0.6 0.8 1
km

STURT HIGHWAY TO TARCUTTA
-EA MODIFICATION REPORT

EXTENT AND CONDITION OF BOX GUM WOODLAND

Source: MapData 2006, RTA 2007, SKM 2007

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

Box-Gum Woodland is not a threatened species.

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

Box-Gum Woodland is not a threatened species or population.

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

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

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

The proposal would result in approximately 3.13 ha of Box-Gum Woodland being cleared. In addition to direct impacts from clearing the proposal has the potential to indirectly affect areas beyond the proposal footprint. The most relevant potential indirect impact would be an increased presence of weed infestations as result of altered hydrology and edge effects. The overall extant of Box-Gum Woodland in NSW is approximately 250,729 ha and approximately 10,865 ha in the ACT (DEH 2006d). Locally, the total extant of Box-Gum Woodland in the Wagga Wagga Shire is approximately 10,460 ha (Priday and Mulvaney 2005). The removal of Box-Gum Woodland for the proposal represents approximately 0.02% of the total extent of this community in the Wagga Wagga LGA. When considering the wider distribution of this community in NSW the proposed vegetation removal represents a very small proportion of the total area of this community. The total area of Box-Gum Woodland identified in the study area comprised approximately 96.16 ha with various condition ratings of which approximately 3.3 % will be required to be removed for the proposal.

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

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

The proposal would result in approximately 3.13 ha of Box-Gum Woodland being cleared.

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

The majority of the Box-Gum Woodland in the study area occurs as patches of isolated vegetation fragmented by agricultural activities and road development. Although some linear remnants are present within the road reserves, these are generally isolated from other areas of remnant vegetation outside the road reserve. Considering this community is currently fragmented by the existing highway, the proposal would further fragment vegetation on either side of the highway through widening of the road. The linear shape of remnants along the highway makes these areas vulnerable to fragmentation and degradation.

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

Most of the Box-Gum Woodland to be removed is of low condition due to weed invasion and the local extinction of native groundcover and understorey species. Most of these patches are very small with a high edge to area ration and hence have little potential for natural regeneration. Genetic connectivity between these patches and adjacent areas of the community via pollen transfer is likely to occur only for the eucalypt species.

A larger patch occurs on the western side of the southern section of highway. This patch has higher value to the community in the local context due to the greater diversity and abundance of native understorey and groundcover species which occur there. This patch is a potential source of propagative material for assisted regeneration of degraded patches of the community in the locality. Less than 0.3 ha of this patch will require removal.

The removal of vegetation required for the proposal would not have a significant impact on the survival of the endangered community in the locality.

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

No critical habitat has been identified for this community within the study area.

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

No threat abatement plans or recovery plans have been prepared for Box Gum Woodland.

The following strategies have been identified as applicable to the recovery of this community:

- Undertake control of rabbits, hares, foxes, pigs and goats (using methods that do not disturb the native plants and animals of the remnant).
- Do not harvest firewood from remnants (this includes living or standing dead trees and fallen material).
- Leave fallen timber on the ground.
- Manage stock to reduce grazing pressure in high quality remnants (i.e. those with high flora diversity or fauna habitat).
- Encourage regeneration by fencing remnants, controlling stock grazing and undertaking supplementary planting, if necessary.
- Erect on-site markers to alert maintenance staff to the presence of a high quality remnant or population of a threatened species.
- Undertake weed control (taking care to spray or dig out only target species).
- Protect all sites from further clearing and disturbance.
- Ensure remnants remain connected or linked to each other; in cases where remnants have lost connective links, re-establish them by revegetating sites to act as stepping stones for fauna, and flora (pollen and seed dispersal).
- Mark remnants onto maps (of the farm, shire, region, etc) and use to plan activities (e.g. remnant protection, rehabilitation or road, rail and infrastructure maintenance work). On-site markers can alert maintenance staff to the presence of a threatened species.

These recommendations were considered in the design of mitigation measures for the proposal.

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

Threatening processes which affect the endangered community in the study area include:

- Clearing of native vegetation
- Removal of dead wood and dead trees
- Competition and grazing by the feral European rabbit
- Predation by feral cats
- Predation by the European Red Fox
- Invasion of native plant communities by exotic perennial grasses

The proposal is unlikely to affect grazing by rabbits or predation by feral cats and foxes. Some removal of native vegetation and dead wood and trees would occur, thus adding to the effect of these processes in the locality. Measures to mitigate these impacts include translocation of dead wood and revegetation within the road corridor as described in section 3.

Although the proposal would result in the removal of approximately 3.13 ha of Box-Gum Woodland, it would not contribute to the further degradation to vegetation in adjoining lands provided adequate safeguards are implemented during the construction and operation of the road.

Mitigation measures would be implemented to ensure invasive species are not spread into areas of retained remnant vegetation. Weed management would also be implemented post-construction in vegetation retained within the road reserves to improve the vegetation condition.

Summary

In line with the findings of the Part 3A assessment under the EP&A Act and based on the relevant assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on an EEC listed under the TSC Act. Measures to protect and enhance preserved remnants outside of the construction footprint as required. These are discussed in Section 3.0.

2.1.3.2 Threatened Flora

No threatened flora species were identified in the study area despite targeted searches. The potential habitat for threatened species in the study area that would be removed could be up to 5.74 ha depending on the species preferred habitat conditions. The species with greatest potential to be impacted by the proposal due to the removal and/or potential disturbance of suitable habitat are listed in **Table 3.**

Table 3 – Habitat removal for threatened flora species.

Species	Habitat	Potential impact / habitat removal (ha)
Ammobium craspedioides	Box-Gum Woodland	3.13
Amphibromus fluitans	Riparian / Wetland Habitats	0.02
Brachycome papillosa	Ironbark Woodland	2.61
Caladenia arenaria	Ironbark Woodland	2.61
Caladenia concolor	Box-Gum and Ironbark Woodland	5.74
Caladenia rosella	Ironbark Woodland	2.61
Diuris tricolor	Ironbark Woodland	2.61
Goodenia macabarronii	Ironbark Woodland	2.61

Species	Habitat	Potential impact / habitat removal (ha)
Pilularia novae-hollandiae	Riparian / Wetland Habitats	0.02
Rutidosis leptorrhynchoides	Box-Gum Woodland	3.13
Swainsona murrayana	Box-Gum Woodland	3.13
Swainsona recta	Box-Gum Woodland	3.13
Senecio garlandii	Box-Gum Woodland	3.13

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

Proposed habitat clearance for threatened flora species is detailed in **Table 3.** The proposed removal of suitable habitat for threatened flora species that may potentially be present within the study area is unlikely to disrupt the breeding cycle of these species considering that ecological processes such as pollination and seed dispersal operating in the study area are already reduced in function or have ceased. The relatively small area of habitat to be impacted is degraded and of a low to moderate condition and hence the impact on the life cycle of these species is unlikely to be significant.

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

Proposed habitat clearance for threatened flora species is detailed in **Table 3**. The Ironbark Woodland habitats in the study area contain low quality understorey habitat attributes due to heavy grazing. The likelihood of threatened species occurring in these areas is relatively low, and if threatened species are present they are unlikely to constitute a viable population considering the disturbed and highly fragmented nature of the habitat. However species such as *Goodenia macabarronii* and *Rutidosis leptorrhynchoides* have been found to occur in grazed/disturbed areas (DEC 2005c) and therefore may occur. The small area of impact from the proposal to suitable areas of habitat is unlikely to affect the life cycle of a significant population of these species.

The Box-Gum Woodland habitats in the study area contain low to moderate quality understorey strata due to heavy grazing, weed invasions and other edge effects. The likelihood of threatened species occurring in these areas is relatively low, and if threatened species are present they are unlikely to constitute a viable population considering the disturbed and highly fragmented nature of these habitats.

Riparian habitats of Dellateroy Creek adjacent to the existing highway would be directly and indirectly impacted from the proposal. Although no threatened aquatic flora were recorded during targeted surveys, they may not have been detected due to these species being cryptic during times of drought, occurring only as underground storage organs and/or seeds. The small area of impact from the proposal to suitable areas of habitat for aquatic species is unlikely to affect the life cycle of a significant population of these species.

Provided the retained vegetation is protected during construction and appropriately managed post-construction, it is unlikely that the proposal would significantly impact on potential habitat for threatened flora species. Potential indirect impacts to areas beyond the development footprint would be minimised through the implementation of adequate safeguards and mitigation measures.

Of the 96.16 ha of Box-Gum habitats and the 83.4 ha of Mugga Ironbark-Red Stringybark habitats identified in the study area, approximately 3.3 and 3.1% respectively will require removal for the proposed development.

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

Although targeted, no threatened species were recorded in the study area. However parts of the study area provide potential habitat for threatened flora species which if present would be at the limit or near the limit of their distribution, such as the Yass Daisy *Ammobium craspedioides*.

How is the proposal likely to affect current disturbance regimes?

All areas of potential threatened species habitat in the study area are of a low to moderate condition as a result of the long-term impacts from clearing and grazing and edge effects. The proposal has potential to exacerbate these current disturbance regimes. Mitigation measures would need to be implemented to ensure invasive species are not spread into areas of remnant vegetation. Weed management would also be implemented post-construction in vegetation retained within the road reserves to improve the vegetation condition.

How is the proposal likely to affect habitat connectivity?

No threatened species were recorded in the study area and areas of potential habitat for threatened species are highly degraded with only a small portion of isolated woodland containing higher quality potential habitat. Areas of potential habitat are currently fragmented from agricultural activities and past road development and although the proposal would further fragment isolated sections of potential threatened species habitat, it is unlikely that the proposal would significantly impact ecological processes of threatened species potentially present such as pollination and seed dispersal given that the works would occur along the edge of remnants and will not traverse unfragmented woodland.

How is the proposal likely to affect critical habitat?

No critical habitat has been identified for any threatened species or populations considered to have the potential to occur within the study area.

Summary

In line with the findings of the Part 3A assessment under the EP&A Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a threatened flora species listed under the TSC Act. Measures to protect and enhance potential habitat outside of the construction footprint are required. These are discussed in Section 3.0.

2.1.3.3 Threatened Fauna

The results of the fauna survey for the Tarcutta study area recorded four threatened fauna species, the Striped Legless Lizard, Brown Treecreeper, Speckled Warbler and Diamond Firetail. The location of these records is provided in **Figure 2** and **Figure 4**. Each of these species is scheduled as Vulnerable in NSW under the TSC Act.

No other threatened fauna were recorded within the study area however a number of regionally recorded threatened species could potentially occur. This list of species is detailed in **Table 4.** Resident threatened fauna considered to potentially occupy the habitats present include woodland birds, reptiles and the Squirrel Glider. The species with greatest potential to be impacted by the proposed Tarcutta duplication include:

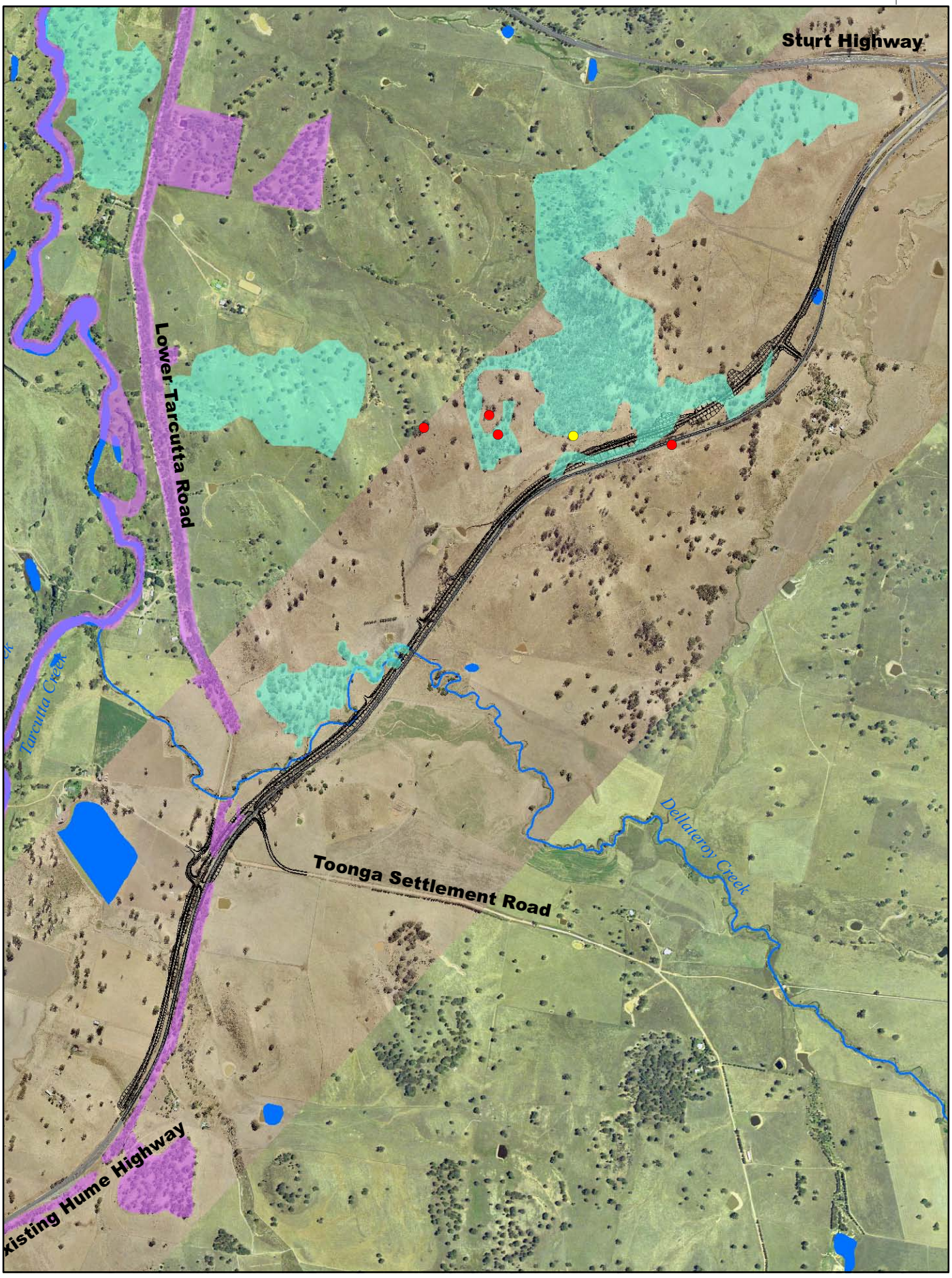
- Brown Treecreeper
- Diamond Firetail
- Black-chinned Honeyeater
- Hooded Robin
- Speckled Warbler

- Turquoise Parrot
- Squirrel Glider
- Pink-tailed Worm Lizard
- Striped Legless Lizard

Small areas of potential habitat, albeit degraded and very marginal, exist for several other threatened fauna that have been historically recorded in the region. However there are no confirmed recent records and no evidence of a viable population for these species. This includes the Southern Bell Frog, Spotted-tailed Quoll, Booroolong Frog, Gang-Gang Cockatoo, Koala, Fishing Bat and Greater Long-eared Bat. On this basis that the proposal would have little or no impact on local populations of these species, further assessment has not been conducted. Similarly, the Square-tailed Kite and Grey Falcon are wide-ranging species recorded throughout a diversity of habitat types and exhibit a broad but patchy distribution encompassing much of mainland Australia. Vagrant individuals may occasionally move through the locality although no nest sites were identified during the survey and neither species is expected to be impacted by the proposal. Assessment of the potential impacts on the Swift Parrot and Regent Honeyeater are addressed in **Section 2**.

Table 4 - Regionally recorded threatened fauna with habitat potential in the study area.

Threatened Species / Populations / Ecological Communities	EPBC Act Status	TSC Act / FM Act Status	Likelihood of Occurrence
Barking Owl (*Ninox connivens*)	-	V	Possible
Black-chinned Honeyeater (eastern subsp) (*Melithreptus gularis gularis*)	-	V	Possible
Brown Treecreeper (*Climacteris picumnus*)	-	V	Present
Bush Stone Curlew (*Burhinus grallarius*)	-	V	Potential
Diamond Firetail (*Stagonopleurata guttata*)	-	V	Present
Grey-crowned Babbler (eastern subsp) (*Pomatostomus temporalis temporalis*)	-	V	Possible
Hooded Robin (*Melanodryas cucullata*)	-	V	Possible
Painted Honeyeater (*Grantiella picta*)	-	V	Possible
Pink-tailed Worm-lizard (*Aprasia parapulchella*)	V	V	Possible
Regent Honeyeater (*Xanthomyza phrygia*)	E, M	E	Possible
Speckled Warbler (*Pyrrholaemus sagittatus)*	-	V	Present
Squirrel Glider (*Petaurus norfolcensis*)	-	V	Possible
Striped Legless-Lizard (*Delma impar*)	V	V	Present
Superb Parrot (*Polytelis swainsonii*)	V	V	Possible
Swift Parrot (*Lathamus discolor*)	E, M	E	Possible
Turquoise Parrot (*Neophema pulchella*)	-	V	Possible
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	-	V	Possible



High Quality Woodland Bird Habitat

- High Quality Habitat
- Moderate Quality Habitat

Threatened Fauna Survay

- <all other values>
- Brown Treecreeper
- Diamond Firetail

- Modified Alignment
- Roads
- Waterways

N

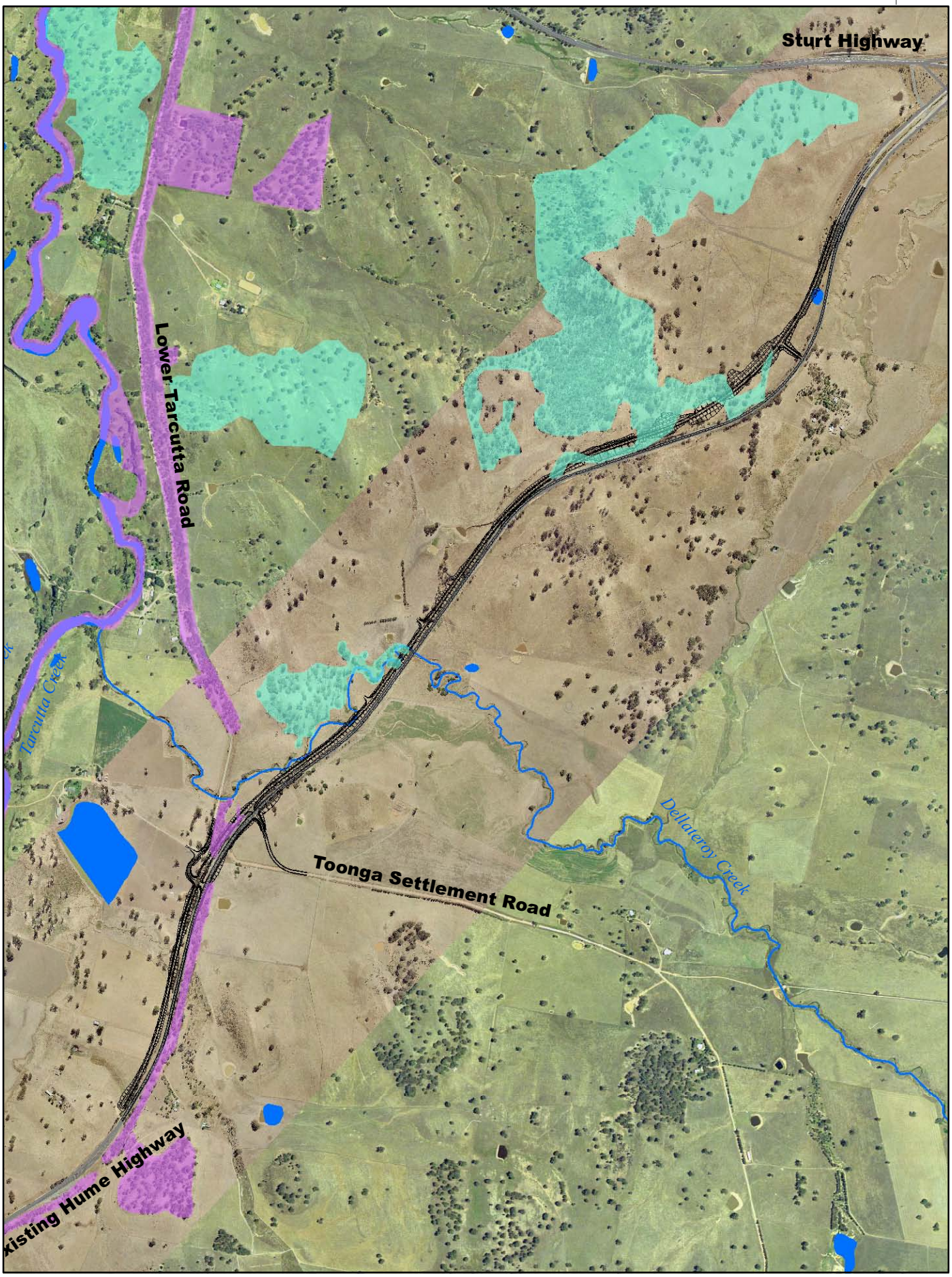
0 0.1 0.2 0.4 0.6 0.8 1

km

STURT HIGHWAY TO TARCUTTA
-EA MODIFICATION REPORT

EXTENT AND QUALITY OF WOODLAND BIRD HABITAT AND SPECIES RECORDS

Source: MapData 2006, RTA 2007, SKM 2007



High Quality Squirrel Glider Habitat

- High Quality Habitat
- Moderate Quality Habitat
- Modified Alignment
- Roads
- Waterways

N

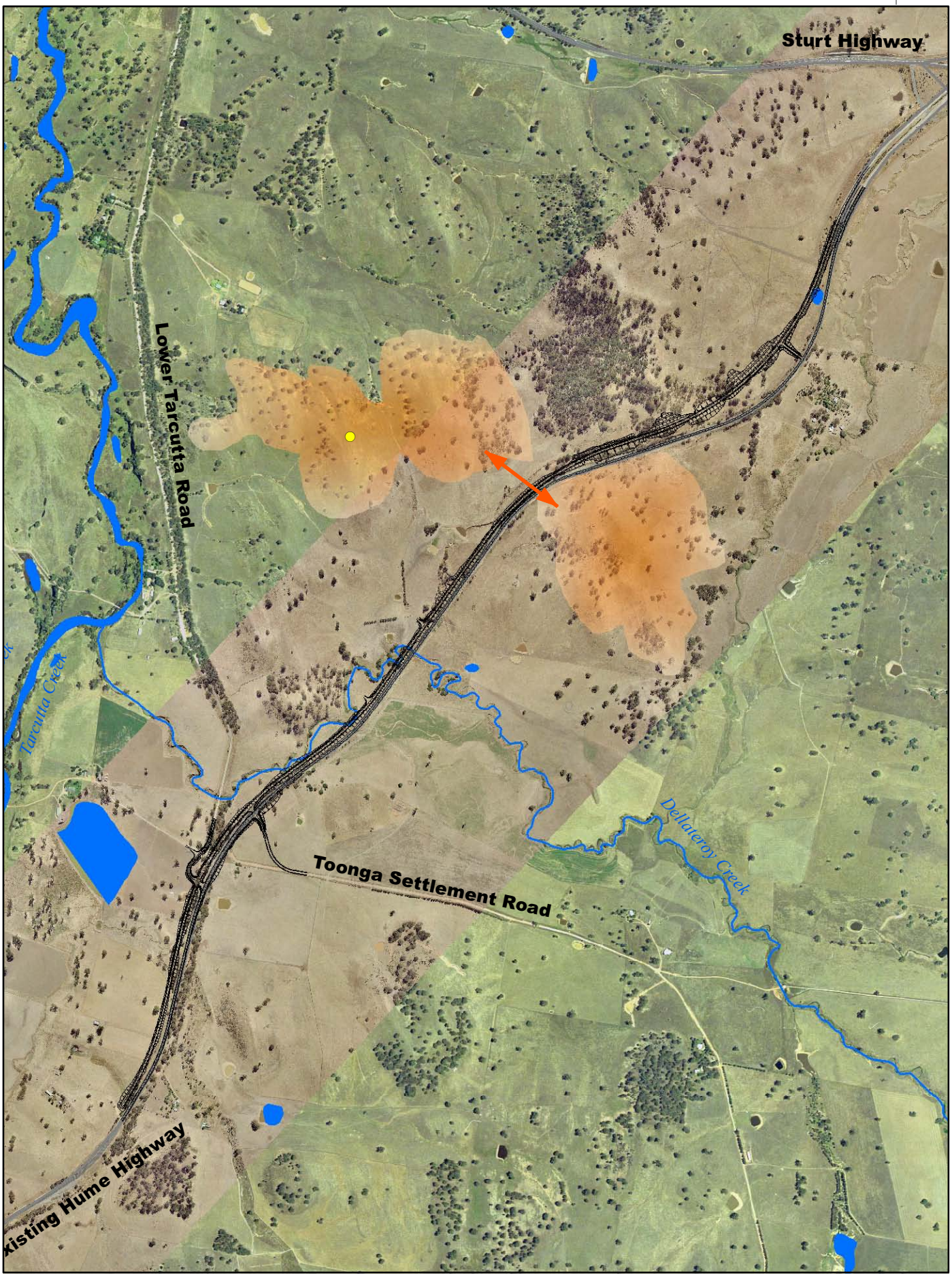
0 0.1 0.2 0.4 0.6 0.8 1

km

STURT HIGHWAY TO TARCUTTA
-EA MODIFICATION REPORT

EXTENT AND QUALITY OF SQUIRREL GLIDER HABITAT

Source: MapData 2006, RTA 2007, SKM 2007



ReptileHabitat
StripedLeglessLizard
Potential Link
Modified Alignment
Roads
Waterways

N

0 0.1 0.2 0.4 0.6 0.8 1
km

STURT HIGHWAY TO TARCUTTA
-EA MODIFICATION REPORT

HIGH QUALITY THREATENED REPTILE HABITAT

Source: MapData 2006, RTA 2007, SKM 2007

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

Potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard occurs within the rocky hillslope areas identified on **Figure 4**. The modified proposal would not have a direct impact on areas identified as suitable foraging and breeding habitat. Indirect impacts on habitat could result from construction and operation activities and edge effects. The current highway alignment historically divides potential habitat.

The total area of impact would equate to approximately 5.74 ha of woodland habitat. This constitutes only a small percentage of the habitat present within the Tarcutta study area and region. The highest quality habitats for threatened fauna species were identified in woodland and riparian vegetation within proximity to the Lower Tarcutta Road and the hillsides at the north-western end of the corridor. Neither of these locations would be impacted by the proposal.

The remaining threatened fauna mentioned above occupy large home ranges and the proposal would have minimal direct impact on the extent of habitat available in the locality. Of particular significance to the life-cycles of these threatened fauna is the ability to move between fragmented habitat patches to access food resources and maintain the genetic health of populations. There would be no severance to existing movement corridors as a result of the proposal and while there would be some minor losses of habitat this would not result in significant increases in the fragmentation of habitat. A component of the project is to involve strategically located revegetation programs to increase the total area of habitat in the study area and link isolated fragments.

Hollow-bearing trees were noted to occur in most remnants particularly in roadside reserves and riparian strips and were well replicated outside the impact areas throughout the wider landscape. The results of the habitat assessment surveys indicate that the duplication would involve minimal loss of tree hollows on a local scale and would not significantly disrupt the breeding or roosting cycles of obligate hollow roosting species.

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

The proposal would result in the removal of 5.74 ha of woodland habitat. In addition to the direct clearing, the proposal would potentially result in further degradation to adjoining habitat through edge effects (weed invasion, dust impacts, rubbish, and increased wind exposure). The loss would remove a small percentage of potential habitat resources for roosting, foraging and breeding habitat for the assessed species. However, the results of the habitat assessment indicate that the areas to be disturbed are of low value for the assessed species as a result of existing disturbance regimes and their small size and fragmented nature. A small percentage of hollow-bearing trees may be removed depending on the final design. These provide a portion of the potential nest and roost sites present in the locality.

The area of disturbance would contribute to the cumulative loss of habitat in the locality; however these losses are distributed across several very small disturbance areas, which individually are considered too small to provide sufficient habitat resources for a significant proportion of any existing local populations of the assessed fauna. Furthermore, high quality habitat for threatened fauna species was identified in woodland and riparian vegetation within proximity to the Lower Tarcutta Road and the hillsides at the north-western end of the corridor. Neither of these locations would be impacted by the proposal.

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

The Striped Legless Lizard would be at its distributional limit in the study area.

The Pink-tailed Worm Lizard is at its distributional limit in the study area, apart from a disjunct record from the 1980's at Buddigower NR near West Wyalong (Steve Sass pers. com.) The Hume Highway is considered the western limit for this species.

None of the other threatened fauna considered to potentially occur in the Tarcutta section of the project are at the limit of their distribution.

How is the proposal likely to affect current disturbance regimes?

The proposal would result in the additional clearance of vegetation in an already fragmented landscape and contribute to the cumulative loss of habitat for threatened fauna, particularly woodland birds and mammals. However current disturbance regimes including weed invasion are pronounced. Weed management is required to reduce the detrimental impacts from weed invasion.

How is the proposal likely to affect habitat connectivity?

The current study area is heavily fragmented and corridors for connectivity and movement by Squirrel Gliders across the landscape are largely retained along road reserves which would be retained in the landscape.

The majority of those threatened fauna species potentially occurring in the study area are birds or highly mobile species able to traverse areas of open space. Although the proposal would further fragment areas of potentially suitable habitat, it is not considered that it would significantly affect the woodland dependent birds from accessing areas of suitable habitat.

The current highway alignment presently divides potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard. This division would be widened even further by the new duplication. Given that the existing highway would prevent movements between potential habitats present on either side of the road, it is therefore not considered that that the proposal would significantly effect existing connectivity for these species

How is the proposal likely to affect critical habitat?

No critical habitat has been identified for any threatened species or populations considered to have the potential to occur within the study area. There will be minimal removal of key habitat features as discussed. Measures to reduce the effects of weed invasion within road reserves would need to be effectively managed.

Summary

In line with the findings of the Part 3A assessment under the EP&A Act and based on the relevant assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a threatened fauna species listed under the TSC Act. Measures to protect and enhance known and potential habitat including connectivity outside of the construction footprint are required. These are discussed in Section 3.0.

2.1.3.4 Aquatic Endangered Ecological Communities and Threatened Fish

The entire study area supported a number of watercourses and many may provide potential habitat for threatened species and populations. However, the only creek considered likely to be impacted by the current proposal footprint in the Tarcutta section is Dellateroy Creek. A number of threatened fish species, an endangered fish population and an endangered ecological community occur with the Murray-Darling basin.

2.1.3.4.1 Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment

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

N/A

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

N/A

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

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

The EEC in the locality includes the entire length of Dellateroy Creek (>7km in length) and part of Tarcutta Creek. A section of Tarcutta Creek, in excess of 5 km in length exists within a few kilometres of the proposal. The total length of the EEC in the locality is thus in excess of 12 km and would likely average at least three metres in width. Thus the extent of the community is approximately 3.5 ha. The total area of this EEC to be lost as a result of the proposal would be approximately 0.03 hectares. This would comprise 0.86 % of the local extent of the EEC. The loss of such a small a proportion of the habitat for the EEC is unlikely to place its local occurrence at risk of extinction. Furthermore, habitat for the EEC will be recreated in reconstructed sections of the creek.

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

The definition of the EEC does not include any criteria with respect to minimum species composition. Thus any natural waterway which contains any species of native fish or aquatic invertebrates within the specified range is included in the EEC. The EEC of the area affected by the proposal contains at least two native fish species (River Blackfish and Mountain Galaxias) and three species of native invertebrate (shrimp, yabby and aquatic snail). A variety of insect larvae also inhabit the creek.

Due to the small extent of habitat to be affected and the proposed construction methodology, it is considered unlikely that any of these species would be lost from the local occurrence of the EEC. The local occurrence of the EEC is hence unlikely to be placed at risk of extinction as a result of modifications to its composition as a result of the proposal.

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

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

The total area of this EEC to be lost as a result of the development would be in the range 0.001 to 0.002 hectares. This would comprise 0.0002 to 0.005 % of the local extent of the EEC. The loss of such a small a proportion of the EEC is unlikely to place its local occurrence at risk of extinction.

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

No streams or tributaries would become disconnected as a consequence of the proposal. However, the extension of the current culvert may increase the potential for barriers to fish passage. Therefore it is recommended that the proposed extension be undertaken in accordance with the requirements of

Fairfull and Witheridge (2003) to reduce the likelihood of the proposal having detrimental impacts on any current fish passage.

As the proposed action would involve re-alignment and revegetation of affected areas and the installation of fish-friendly culverts, minimal fragmentation or isolation of the remaining sections of the creek would occur.

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

The habitat to be removed includes open pools, thickly vegetated sections and a small area of riffles and pools over a rock outcrop. The riffles created here would help to oxygenate the water downstream, which may be important to the quality of the habitat for some species. The areas with rocky substrate here also form habitat for mountain galaxias and yabbies which were recorded there.

Similar rocky habitat, capable of oxygenating waters downstream and supporting aquatic species, would be recreated during the re-alignment of the creek.

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

No critical habitat has been listed for the EEC.

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

No recovery plan has been prepared for the EEC. There are no finalised threat abatement plans to date. The *draft threat abatement plan for the removal of large woody debris from NSW rivers and streams* however is relevant to the EEC.

No large woody debris exists within the area which would be affected by the proposal.

The final design of the creek realignment may include the installation of large woody debris to improve the quality of the habitat for aquatic fauna.

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

Key threatening process listed under the FM Act which are relevant to the EEC include the following:

- Removal of large woody debris from NSW rivers and streams
- Degradation of native riparian vegetation along NSW water courses
- Instream structures and other mechanisms that alter natural flows
- Introduction of fish to fresh waters within a river catchment outside their natural range

Removal of large woody debris would not occur as a result of the proposal. The final design of the creek realignment may include the installation of large woody debris to improve the quality of the habitat for aquatic fauna.

Native riparian vegetation is virtually non-existent in the area of Dellateroy Creek which would be affected by the proposal. Previous and current land use of the area for grazing has reduced riparian vegetation here to exotic pasture with occasional willows and native sedges such as *Carex apressa*. Further degradation of native riparian vegetation would not occur as result of the proposal. Revegetation of affected areas with native riparian vegetation would result in an increase in native riparian vegetation in the locality.

Alteration to natural flows would have occurred as a result of the construction of the existing Hume Highway. An existing culvert connects Dellateroy Creek where it crosses the highway. This culvert would be extended for the current proposal. Sections of the creek would also be re-aligned. Hydraulic modelling has shown that the proposed creek realignment and culvert installation is unlikely to significantly alter the existing flow of the creek.

The introduced fish *Gambusia holbrooki* was detected in part of the section of the creek which would be affected by the proposal. It is not known whether this species exists throughout Dellateroy Creek, but it is considered likely that it does. There is some potential for construction to spread this species through the translocation of mud on machinery. Mitigation measures during construction would prevent the spread of this species to nearby waterways through construction activities.

Summary

Based on the findings of the assessment of the criteria listed in section 220 of the the FM Act, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on the *Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment*. Measures to protect and enhance potential habitat are required. These are discussed in Section 3.0.

2.1.3.4.2 Threatened Fish

Most threatened fish species occurring in the region and their habitats are unlikely to be impacted by the proposal. Whilst threatened aquatic species are considered unlikely to occur, species with the most potential are listed below and an assessment of the significance of potential impacts of the proposal on these species or their habitat has been made according to the criteria listed in section 220 of the FM Act.

- Purple Spotted Gudgeon (western population); and
- Southern Pygmy Perch.
- Trout Cod

Dellateroy Creek would also from part of the endangered aquatic ecological community in the natural drainage system of the lower Murray River catchment and therefore potential impacts on this community have been addressed.

Trout Cod are listed as endangered under the TSC Act and FM Act. This species is known to inhabit the Murrumbidgee River and attempts to attract the species into Tarcutta Creek have been made through restoration works. This species would be susceptible to potential indirect impacts of the proposal on downstream areas and in particular from impacts such as sedimentation. Therefore an assessment of the likely impacts of the proposal on this species and its habitat has also been conducted as a precautionary measure.

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

The Purple Spotted Gudgeon was once widespread throughout the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling. However, predation by introduced fish, habitat degradation and fluctuations in water levels as a result of river regulation has contributed to the western population of this species becoming extremely rare. Habitat requirements of the Purple Spotted Gudgeon include slow-moving or still waters of rivers, creeks and billabongs where there are snags, rocks and weeds (NSW Fisheries 2002a).

Sections of Dellateroy Creek supported rocky areas and large woody debris and both emergent and floating macrophytes were present. Large sections of Bulrush were present through much of the channel and woody debris was prevalent. Therefore it is considered possible that the Purple Spotted Gudgeon could inhabit the waters of Dellateroy Creek. Although modifications to the channel adjacent to the Hume Highway are proposed for the culvert extension, potential habitat for this species was present and would remain downstream of the culvert. Therefore provided management measures are

implemented to limit potential construction impacts on Dellateroy Creek and the culvert extension designed to ensure fish passage is maintained, it is considered unlikely that the proposal would significantly affect the lifecycle or habitat of the Purple Spotted Gudgeon should it occur within Dellateroy Creek.

The Southern Pygmy Perch is found in vegetated areas of small streams, lakes, billabongs and other types of wetlands. A variety of factors have contributed to the decline of this species including habitat degradation, alienation of floodplain habitats by flood mitigation works, modification of natural river flows and temperatures and predation by and competition with introduced fish species (NSW Fisheries 2002d). Given that Dellateroy Creek supported abundant Bulrush and also floating macrophytes, it is considered possible that this species could inhabit the creek. Therefore provided management measures are implemented to protect the stream from indirect impacts (see Section 3.0) and that fish passage is not blocked by the culvert, it is considered unlikely that the proposal is likely to affect the lifecycle or habitat of the Southern Pygmy Perch as large areas of potential habitat would remain.

Trout Cod are known to inhabit the waters of Murrumbidgee River. Given their small home ranges and that they are often found close to cover and in relatively fast currents, especially in fairly deep water close to the bank, and often congregate around snags, it is considered unlikely that this species would occur in Dellateroy Creek (NSW Fisheries 2002e). However, this species may be impacted by indirect impacts on downstream water quality within Tarcutta Creek where current restoration works are attempting to attract this species to the stream. Given that sediment control measures would be implemented during the construction and operational phases of the proposal and that any water discharged into Dellateroy Creek would meet ANZECC water quality guidelines (2000), it is considered unlikely that the proposal would affect the lifecycle of this species.

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

Modifications/upgrading of the culvert across Dellateroy Creek would be required for the proposal. This habitat would be considered part of the endangered aquatic ecological community in the natural drainage system of the lower Murray River catchment. The proposal would alter surface water drainage patterns through the extension of culverted areas. Parts of the channel and associated riparian zone would also need to be concreted to extend the culvert. Based on the guidelines outlined in *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterways Crossings* (Fairfull and Witheridge 2003), culverts are considered the minimum crossing type for the Dellateroy Creek. Furthermore, the maintenance of a culvert crossing across Dellateroy Creek is proposed to minimise impacts and potential barriers to fish passage. Although a small amount of the endangered ecological community would be impacted by the proposal, potential habitat for fish and macroinvertebrates would remain and it is considered unlikely that it would significantly impair the function of the community as fish passage would be maintained.

Furthermore, management measures would be implemented to manage the potential for changes to flows due to the culvert modifications.

A small area of potential habitat for both the Purple Spotted Gudgeon and Southern Pygmy Perch would be removed for the proposed culvert extension and creek realignment. However, potential habitat for these species would remain within Dellateroy Creek. Removal of habitat is unlikely to significantly impact on these species provided fish passage remains. To minimise the potential for barriers to fish passage it is recommended that the culvert extension is designed in accordance with Fairfull and Witheridge (2003). Furthermore, stringent management measures would be implemented to prevent indirect impacts on Dellateroy Creek. The riparian zone of Dellateroy Creek is already highly modified and as such impacts from the proposal in this respect would be limited. Revegetation works will be conducted adjacent to the proposed construction area to enhance the riparian zone, increase the stability of the highly erodible banks and act as an additional filter for runoff from the road surface.

Direct impacts on potential habitat for the Trout Cod are not anticipated as a consequence of the proposal as it is considered unlikely that Dellateroy Creek would provide suitable habitat for this

species. However, there is the potential for indirect impacts on areas of potential habitat for this species through impacts on water quality and sedimentation. Given that sediment control measures would be implemented during the construction and operational phases of the proposal and that any water discharged into Dellateroy Creek would meet the ANZECC water quality guidelines (2000), it is considered unlikely that potential habitat for the Trout Cod would be impacted by the proposal.

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

The western Purple Spotted Gudgeon population is now rare in inland NSW but its known distribution occurs throughout the Murray, Murrumbidgee and Lachlan river systems and tributaries of the Darling (NSW Fisheries 2002a). Therefore this species is not at the limits of its known distribution at Tarcutta.

The Southern Pygmy Perch was once widely distributed throughout the Murrumbidgee and Murray River systems but there have been large-scale reductions in their range since European settlement (NSW Fisheries 2002d). The population now appears to be restricted to one small area in the Lachlan, and several small creeks and billabongs near Albury and Holbrook (DEC 2006b). Therefore this species would be close to the limit of its distribution if it were to occur within Dellateroy Creek.

Although Trout Cod were once known from throughout the Murray-Darling River System including the Murrumbidgee and Murray River Systems, there has been a dramatic decline in this species throughout its range. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal (NSW Fisheries 2002e). Therefore this species is likely to be close to the limits of it current known distribution if it occurs in Tarcutta Creek.

How is the proposal likely to affect current disturbance regimes?

The aquatic habitat within the study area is currently affected by riparian vegetation clearance, erosion and sedimentation, alterations to flow and bank instability due to stock access and vegetation removal. The proposal would result in additional clearance of vegetation along Dellateroy Creek. However, the riparian zone of Dellateroy Creek was already highly modified comprising primarily of exotic pasture. Nonetheless, it is recommended that adjacent to the proposed construction area revegetation works are undertaken to enhance the riparian zone, increase the stability of the highly erodible banks and act as an additional filter for runoff from the road surface.

The extension of the current culvert may increase the potential for barriers to fish passage. The installation of a culvert in accordance with Fairfull and Witheridge (2003) would ensure that fish passage along Dellateroy Creek is maintained.

There is the potential for impacts on hydrology and water quality as a consequence of the proposal if mitigation measures are not implemented. Potential impacts from the proposal include:

- increases in the volume and intensity of stormwater runoff due to vegetation clearance and impervious surfaces
- increases in erosion associated with increased flows;
- changes to the water table and soil moisture content; and
- may create conditions more conducive to invasion by exotic species.

Management measures would be implemented to prevent hydrological changes where possible or mitigate these impacts.

How is the proposal likely to affect habitat connectivity?

No streams or tributaries would become disconnected as a consequence of the proposal. However, the extension of the current culvert may increase the potential for barriers to fish passage. Therefore it is recommended that the proposed extension be undertaken in accordance with the requirements of

Fairfull and Witheridge (2003) to reduce the likelihood of the proposal having detrimental impacts on any current fish passage.

How is the proposal likely to affect critical habitat?

No critical habitat has been identified for any threatened species or populations considered to have the potential to occur within the study area.

Summary

In line with the findings of the Part 3A assessment under the EP&A Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a threatened fish species listed under the FM Act. Measures to protect and enhance potential habitat including outside of the construction footprint as required. These are discussed in Section 3.0.

2.2 Commonwealth Threatened Species and Communities Assessment

The RTA has a statutory responsibility to comply with the requirements and intent of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (EPBC Act) in relation to the protection and management of endangered ecological communities and threatened species. This assessment deals specifically with the significance of impacts from the proposed duplication of the Hume highway through the Little Billabong study area on nationally endangered ecological communities, threatened and migratory species.

Table 4 - Matters of National Environmental Significance: assessment of presence in the study area.

Matter of National Significance	Status	Likely presence in the study area
Endangered Ecological Community		
White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grasslands	CEEC	Presence confirmed in the study area
Fauna		
Swift Parrot (*Lathamus discolor*)	E, M	Expected to provide winter foraging resources for a portion of the population
Regent Honeyeater (Xanthomyza phrygia)	E, M	Winter food resources present, individuals may occur in the study area during favourable flowering seasons
Superb Parrot (*Polytelis swainsonii*)	V	Records in the region, a wide-ranging species which is expected to occur
Painted Snipe (*Rostratula benghalensis)*	V, M	No suitable habitat present in the study area, not expected.
Southern Bell Frog (*Litoria raniformis*)	V	No suitable habitat present in the study area, not expected.
Pink-tailed Worm-lizard (*Aprasia parapulchella*)	V	Suitable habitat for this species was identified as part of this study and has been previously recorded within the study area. This species considered to have a high potential of occurring.
Striped Legless-Lizard (Delma impar)	V	Presence confirmed in the study area

Matter of National Significance	Status	Likely presence in the study area
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	Suitable habitat for this species identified, potential to occur
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	Few records in the region, a wide-ranging species which could potentially occur.
Flora		
Phantom Wattle (*Acacia phasmoides*)	V	No suitable habitat present in the study area, not expected.
Yass Daisy (*Ammobium craspedioides)*	V	Suitable habitat for this species identified, potential to occur
River Swamp Wallaby Grass (*Amphibromus fluitans*)	V	Suitable habitat for this species identified, potential to occur
Claypan Daisy (*Brachycome muelleroides*)	V	Suitable habitat for this species identified, potential to occur
Mossigiel Daisy (*Brachycome papillosa*)	V	Suitable habitat for this species identified, potential to occur
Crimson Spider Orchid (*Caladenia concolor*)	E	Suitable habitat for this species identified, potential to occur
Caladenia rosella	V	Suitable habitat for this species identified, potential to occur
Small Scurf-pea (*Cullen parvum*)	E	Suitable habitat for this species identified, potential to occur
Tricolour Diuris (*Diuris tricolour*)	V	Suitable habitat for this species identified, potential to occur.
Goodenia macabarronii	V	Suitable habitat for this species identified, potential to occur
Button Wrinklewort (*Rutidosis leptorrhynchoides*)	V	Suitable habitat for this species identified, potential to occur
Woolly Ragwort (*Senecio garlandii*)	V	Suitable habitat for this species identified, potential to occur
Slender Darling-pea (*Swainsona murrayana*)	V	Suitable habitat for this species identified, potential to occur
Small Purple-pea (*Swainsona recta*)	V	Suitable habitat for this species identified, potential to occur
Austral Toadflax (*Thesium australe*)	V	No suitable habitat present in the study area, not expected.
Fish		
Murray Cod (*Maccullochella peelii peelii*)	V	No suitable habitat present in the study area, not expected.
Macquarie Perch (*Macquaria australasica*)	V	No suitable habitat present in the study area, not expected.
Migratory terrestrial species		
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	M	No suitable habitat present in the study area, not expected.
White-throated Needletail	M	Suitable habitat for this species identified,

Matter of National Significance	Status	Likely presence in the study area
(*Hirundapus caudacutus*)		potential to occur
Satin Flycatcher (*Myiagra cyanoleuca*)	M	Suitable habitat for this species identified, potential to occur
Regent Honeyeater (Xanthomyza phrygia)	E, M	Suitable habitat for this species identified, potential to occur
Swift Parrot (*Lathamus discolor*)	E, M	Suitable habitat for this species identified, potential to occur
Migratory wetland species		
Latham's snipe (*Gallinago hardwickii*)	M	No suitable habitat present in the study area, not expected.
Painted Snipe (*Rostratula benghalensis)*	V, M	No suitable habitat present in the study area, not expected.

2.2.1 Critically Endangered Ecological Communities

This assessment deals specifically with the significance of impacts from the proposed Hume Highway duplication through the study area. Box-Gum Woodland was identified in several locations throughout this section as discussed above.

Will the action reduce the extent of an ecological community?

The conservation value of the vegetation was identified from preliminary investigations (ERM 2006) and hence considered in the design of the road upgrade such that the proposal footprint was located to minimise removal of remnant Box-Gum Woodland and existing linear road reserves wherever possible. As such the project does no directly impact on high quality Box-Gum Woodland. However up to 0.33 ha of moderate quality Box-Gum woodland which fits the criteria for listing under the EPBC Act would be directly impacted.

The national extent of the Box-Gum Woodland and Derived Grassland ecological community occurs in an arc along the western slopes and tablelands of the Great Dividing Range from southern Queensland through NSW to Central Victoria (Beadle 1981). It occurs in the Brigalow Belt south, Nandewar, New England Tableland, south eastern Queensland, Sydney Basin, south Eastern Highlands, South East Corner, NSW South Western Slopes, Victorian Midlands and Riverina Bioregions (Thackway and Cresswell 1995). The estimated total area is approximately 404,778 ha; however this includes poor condition remnants that are not included in the listed ecological community.

Locally, the total extant of Box-Gum Woodland in the Wagga Wagga Shire is approximately 10,460 ha (Priday and Mulvaney 2005). This extant includes vegetation with varying condition. The overall extant of Box-Gum Woodland in NSW is approximately 250729 ha and approximately 10865 ha in the ACT (DEH 2006d). Approximately 0.30 ha of moderate quality Box-Gum woodland would be disturbed represents approximately 0.003% of the extant of this community in the Wagga Wagga LGA. When considering the wider distribution of this community nationally and regionally the proposed vegetation removal represents a very small proportion of the total area of this community.

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

Considering this community is currently fragmented by the existing highway, the proposal would result in a small increase in the current fragmentation between vegetation on either side of the highway through widening of the footprint. The linear shape of remnants along the highway makes these areas vulnerable to fragmentation and degradation.

This further fragmentation of Box-Gum Woodland as result of the highway widening is unlikely to significantly disrupt ecological processes important for the continuity of the community. Such ecological processes include floral pollination by flying insects and wind, seed dispersal of native flora and dispersal of fungi, mycorrhiza and lichens.

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

The proposal would reduce the area of Box-Gum Woodland of up to 0.30 ha representing approximately 0.003% of the total extent of this community in the Wagga Wagga LGA. The stands of Box-Gum Woodland affected by the proposal are in low or moderate quality condition as a result of previous agricultural activities and road development. It is not considered that these stands affected by the proposal are critical to the survival of the Box-Gum Woodland in the study area.

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?

Although the proposal would alter the abiotic factors of the study area in close proximity to the highway footprint, it is not expected to substantially alter the current condition of Box-Gum Woodland in the study area as all areas are substantially edge affected and occur as isolated patches.

With the implementation of mitigation measures during construction and adequate design of the highway, alteration to abiotic factors such as surface water drainage would be minimised.

Will the action cause a substantial change in 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?

Although the proposal would result in the removal of approximately 0.30 ha of Box-Gum Woodland which fits the criteria for listing under the EPBC Act, the proposal would not contribute to the further degradation of vegetation in adjoining lands provided adequate safeguards are implemented during construction works. Mitigation measures would be implemented to ensure invasive species are not spread into areas of retained remnant vegetation. The proposal is unlikely to cause a decline or loss of a functionally important species from the community, considering that the current disturbance regimes such as fire and grazing would not be significantly altered from the proposal.

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; 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?**

Considering that the vegetation proposed for removal is currently modified supporting numerous exotic species, and the existing vegetation currently occurs adjacent to the Hume Highway, the project is not expected to significantly reduce the quality or integrity of these remnants. All areas are currently substantially edge affected.

A weed management plan would be developed and implemented during the construction of the proposal, to identify protocols for various activities such as the cleaning of machinery working in weed infested areas, disposal of weed propagules and stockpiling of soils. Sedimentation basins would be utilised during the operation stage of the proposal to capture urban runoff from the proposal, limiting the amount of pollution entering the community.

A restoration plan would be implemented to ensure that local native flora species characteristic of Box-Gum Woodland are utilised in the landscaping activities, and the condition of the retained remnants is improved through weed management and supplementary planting of native species. There is opportunity to expand and enhance retained remnants within the road reserve to improve connectivity and offset any loss of habitat for this community. Restoration activities should include ongoing weed management and monitoring, and maintenance of plantings.

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

The action would not interfere with the recovery of the community on a regional basis. Indeed there is opportunity to expand and enhance remnants outside the construction corridor to offset any loss of habitat for this community, including ongoing weed management and supplementary plantings.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (critically endangered ecological community) if the mitigation measures outlined in Section 3.0 are implemented.

2.2.2 Threatened Flora

Significant impact criteria – Vulnerable Species

The species with greatest potential to be impacted by the proposed Tarcutta duplication due to the removal and/or potential disturbance of suitable habitat are listed below in **Table 5**.

Table 5 - Habitat removal for nationally listed Vulnerable flora species.

Species	Habitat	Potential impact / habitat removal (ha)
Ammobium craspedioides	Box-Gum Woodland	3.13
Amphibromus fluitans	Riparian / Wetland Habitats	0.02
Brachycome papillosa	Ironbark Woodland	2.61
Caladenia rosella	Ironbark Woodland	2.61
Diuris tricolor	Ironbark Woodland	2.61
Goodenia macabarronii	Ironbark Woodland	2.61
Swainsona murrayana	Box-Gum Woodland	3.13
Senecio garlandii	Box-Gum Woodland	3.13

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it would:

Lead to a long-term decrease in the size of a population;

The proposed suitable habitat clearance for nationally threatened vulnerable flora species is detailed in Table 5 along with the proposed area of impact. No populations of threatened flora species were identified in the study area during the targeted threatened species surveys. The proposal is unlikely to result in the long-term reduction in the size of a population of threatened flora species, considering the small area of potential habitat that would be removed for the proposal and areas of suitable habitat would be retained within the study area in the existing road reserves. Provided the retained vegetation is protected during construction and weed management is implemented post-construction there would be areas of suitable habitat for recruitment of threatened species that are potentially present in the local area.

Reduce the area of occupancy of an important population;

Several threatened flora species are potentially present and have areas of suitable habitat in the Tarcutta study area. Some of these species (refer **Table 4** and **Table 5**) would be at or near there limit of their distribution, such as the Yass Daisy *Ammobium craspedioides* and the Slender Darling Pea *Swainsona murrayana* and would therefore constitute an important population. Any removal of threatened flora species would reduce the occupancy of the population; however it is unlikely that threatened species are present within the proposed impact areas considering the level of degradation observed in all remnants from grazing and invasion of exotic ground cover species and the lack of records as a result of the field surveys. Provided the retained vegetation is protected during construction and appropriately managed and enhanced post-construction areas of suitable habitat for recruitment of threatened species that are potentially present in the local area would remain.

Fragment an existing population into two or more populations;

No existing populations of threatened flora have been identified in the study area. The proposal would result in a small increase in the current fragmentation between vegetation on either side of the highway through widening of the existing footprint. Considering that no populations of threatened species have been identified in the study area and the widening of the existing highway would not create a barrier to ecological processes such as pollination and seed dispersal the proposal is unlikely to fragment any threatened species populations.

Adversely affect habitat critical to the survival of a species;

No areas of critical habitat for threatened flora were identified in the study area. The potential habitat areas identified are only marginal at best and these will be retained in roadside reserves.

Disrupt the breeding cycle of an important population;

The proposed removal of a small area of potential habitat for threatened flora species occur is unlikely to disrupt the breeding cycle of a population. Considering that many flora species are wind and insect pollinated the breeding cycle of these species is unlikely to be significantly impeded by the proposal and would continue post-construction.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The potential habitat areas identified are only marginal at best and these will be retained in roadside reserves. A small area of potential habitat for threatened flora species would be removed for the proposal however areas of suitable habitat would be retained within the study area in the existing road side remnants. Provided the retained vegetation is protected during construction and appropriately managed post-construction, including weed management, it is unlikely that the proposal would modify, destroy, remove, isolate or decrease the availability or quality of habitat for threatened species potentially present in the study area.

Of the 96.16 ha of Box-Gum habitats and the 83.4 ha of Mugga Ironbark-Red Stringybark habitats identified in the study area, approximately 2.36 and 3.14% respectively will require removal for the proposed development.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

All areas of potential threatened species habitat in the study area are of a low to moderate condition as a result of the long-term impacts from clearing and grazing. The proposal is unlikely to exacerbate these disturbance regimes provided the retained vegetation is protected during construction and weed management is implemented post-construction. A weed management plan would be implemented to ensure invasive species are not spread into areas of remnant vegetation during construction. Weed

management would also be implemented post-construction in vegetation retained within the road reserves to improve the vegetation condition.

Introduce disease that may cause the species to decline; or

It is considered unlikely that the proposal would introduce any diseases.

Interfere with the recovery of the species.

Provided that management measures are implemented to protect and enhance potential habitat it is unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required

Significant impact criteria – Endangered Species

The species with greatest potential to be impacted by the proposed Tarcutta duplication due to the removal and/or potential disturbance of suitable habitat are listed below in **Table 6**.

Table 6 - Habitat removal for nationally listed Endangered flora species.

Species	Habitat	Potential impact / habitat removal (ha)
Caladenia concolor	Box-Gum and Ironbark Woodland	5.74
Rutidosis leptorrhynchoides	Box-Gum Woodland	3.13
Swainsona recta	Box-Gum Woodland	3.13

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it would:

Lead to a long-term decrease in the size of a population;

The proposed suitable habitat clearance for nationally threatened endangered flora species is detailed in Table 6 along with the proposed area of impact. No populations of threatened flora species were identified in the study area during the targeted threatened species surveys. The proposal is unlikely to result in the long-term reduction in the size of a population of threatened flora species, considering the small area of potential habitat that would be removed for the proposal and areas of suitable habitat would be retained within the study area in the existing road reserves. Provided the retained vegetation is protected during construction and weed management is implemented post-construction there would be areas of suitable habitat for recruitment of threatened species that are potentially present in the local area.

Reduce the area of occupancy of the species;

Several threatened flora species are potentially present and have areas of suitable habitat in the Tarcutta study area. Some of these species would be at or near there limit of their distributional limit, such as the Crimson Spider Orchid *Caladenia concolor*. Any removal of threatened flora species would reduce the occupancy of the species; however it is unlikely that threatened species are present within the proposed impact areas considering the level of degradation observed in all remnants from grazing and invasion of exotic ground cover species. Provided the retained vegetation is protected

during construction and weed management is implemented post-construction there would be areas of suitable habitat for recruitment of threatened species that are potentially present in the local area.

Fragment an existing population into two or more populations;

No existing populations of threatened flora have been identified in the study area. The proposal would result in a small increase in the current fragmentation between vegetation on either side of the highway through widening of the existing footprint. Considering that no populations of threatened species have been identified in the study area and the widening of the existing highway would not create a significant barrier to ecological processes such as pollination and seed dispersal the proposal is unlikely to fragment any threatened species populations.

Adversely affect habitat critical to the survival of a species;

A small area of potential habitat for threatened flora species would be removed for the proposal; however areas of suitable habitat would be retained within the study area in the existing road side remnants. Provided the retained vegetation is protected during construction and weed management is implemented post-construction there would be areas of suitable habitat for recruitment of threatened species potentially present in the study area, and therefore it is unlikely that the proposal would adversely affect critical habitat.

Disrupt the breeding cycle of a population;

The proposed removal of a small area of potential habitat for threatened flora species which potentially occur in the study area is unlikely to disrupt the breeding cycle of a population. Considering that many flora species are wind and insect pollinated these processes are most likely to be not significantly impeded by the proposal. Seed dispersal through wind, water and animal vectors is also not expected to be significantly altered by the proposal.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

All areas of potential threatened species habitat in the study area are of a low to moderate condition as a result of the long-term impacts from clearing and grazing. The proposed highway upgrade is unlikely to exacerbate these disturbance regimes provided the retained vegetation is protected during construction and weed management is implemented post-construction. A weed management plan would be implemented to ensure invasive species are not spread into areas of remnant vegetation during construction. Weed management would also be implemented post-construction in vegetation retained within the road reserves to improve the vegetation condition.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

All areas of potential threatened species habitat in the study area are of a low to moderate condition as a result of the long-term impacts from clearing and grazing. The proposed highway upgrade is unlikely to exacerbate these disturbance regimes provided the retained vegetation is protected during construction and weed management is implemented post-construction. A weed management plan should be implemented to ensure invasive species are not spread into areas of remnant vegetation during construction. Weed management would also be implemented post-construction in vegetation retained within the road reserves to improve the vegetation condition.

Introduce disease that may cause the species to decline; or

It is considered unlikely that the proposal would introduce any diseases.

Interfere with the recovery of the species

Provided that management measures are implemented to protect and enhance potential habitat it is unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required

2.2.3 Threatened and Migratory Fauna

Significant impact criteria – Endangered Species

Species assessed include the Swift Parrot and Regent Honeyeater.

Lead to a long-term decrease in the size of a population;

Both species are occasional visitors to the region during peak flowering events of the dominant trees. There are no breeding records in the study area and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation. The proposal would not reduce populations of either species.

Reduce the area of occupancy of the species;

Both species are occasional visitors to the region and there are no known permanent populations.

Fragment an existing population into two or more populations;

Both species are occasional visitors to the region and there are no known permanent populations.

Adversely affect habitat critical to the survival of a species;

Any use of the site habitats by these migratory and nomadic birds is likely to be sporadic and during peak flowering events of the dominant mature trees. The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population.

Disrupt the breeding cycle of a population;

There are no breeding records of Swift Parrot and Regent Honeyeater in the study area.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for these wide-ranging species. There are no permanent populations in the region.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

The existing habitat conditions are degraded, small and fragmented with a high proportion of exotic flora in the understorey.

Introduce disease that may cause the species to decline; or

It is considered unlikely that the proposal would introduce any diseases.

Interfere with the recovery of the species.

Provided that management measures are implemented to protect potential habitat as identified within the report, it is unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required.

Significant impact criteria – Vulnerable Species

The species with a low potential to be impacted by the proposal due to the removal and/or potential disturbance of suitable habitat include the:

- Superb Parrot
- Southern Bell Frog
- Pink-tailed Worm Lizard
- Striped Legless Lizard
- Greater Long-eared Bat
- Spotted-tailed Quoll

Lead to a long-term decrease in the size of an important population;

Vegetation to be removed was identified as moderate to low quality for the assessed species. The current condition of the vegetation has been reduced significantly by threatening processes such as clearing, weed invasion, grazing, loss of topsoil and erosion resulting in a simplified structural and floristic diversity, particularly with reduced ground cover vegetation and young trees. The resulting habitat comprises sparse mature tree cover and open understorey dominated by exotic plant species. The most significant feature retained in the landscape is an abundance of tree hollows which provide significant habitat for hollow-dependent fauna such as the Superb Parrot and Greater Long-eared Bat. The extent of high quality habitat for hollow-dependent species has been identified in **Figure 2** and **Figure 3** which indicates that the vast majority of areas would be retained within the Tarcutta study area.

Hollow-bearing trees were noted to occur in most remnants in this section particularly the linear Box-Gum Woodlands along the Hume Highway and Lower Tarcutta Road. The results of the habitat assessment surveys indicate that the proposal would involve minimal loss of tree hollows.

Potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard occurs within the rocky hillslopes identified on **Figure 4**. The current design would not directly impact on potential habitat identified for these two species. However, the current highway alignment has historically reduced this habitat and effectively divided the area of potential habitat east and west of the alignment.

There is no significant potential habitat for the Southern Bell Frog in the study area.

Given the existing degraded condition of the habitats in the study area and the degree of fragmentation, such extant vegetation is considered to only provide low to moderate value for the assessed threatened fauna. Any use of the site habitats by woodland birds is likely to be sporadic and

during peak flowering events of the dominant mature trees. The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for the assessed nationally threatened species.

Reduce the area of occupancy of an important population;

The current design would not directly impact on the potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard. The proposal would reduce the area of habitat currently available for fauna by approximately 5.74 ha. Vegetation to be removed was identified as moderate to low quality for the assessed species. The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for the assessed nationally threatened species.

Fragment an existing important population into two or more populations;

The current design would not directly impact on the potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard. The current highway alignment has historically reduced this habitat and effectively divided the area of potential habitat east and west of the alignment. There are no identified populations of the remaining threatened fauna in the study area.

Adversely affect habitat critical to the survival of a species;

Critical habitat includes breeding, sheltering and movement habitats. Although potential habitat for Striped Legless Lizard and Pink-tailed Worm Lizard may be indirectly impacted on by the proposal extensive areas of potential habitat for these two species would remain post-construction. Provided the remaining habitat is protected through the implementation of stringent management measures, it is considered unlikely that habitat critical to the survival of this species would adversely affected as a consequence of the proposal.

The remaining threatened species are wide-ranging any use of the site habitats is likely to be transient. The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for the assessed nationally threatened species and therefore impacts on critical habitat will be avoided.

Disrupt the breeding cycle of an important population;

There are no breeding records of spotted-tailed Quoll or Southern Bell Frog in the study area. The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for the assessed nationally threatened species and therefore impacts on breeding cycles will be avoided.

There is some potential for Superb Parrots to nest in the study area given the abundance of tree hollows. The proposal would not significantly reduce these features from the landscape and the current potential is considered to remain.

Any extant populations of Striped Legless Lizard and Pink-tailed Worm Lizard within the Tarcutta study area are currently divided by the existing highway. The indirect impact on potential habitat is unlikely to disrupt breeding life-cycle events.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The assessment concludes that the site habitats to be disturbed are considered too small and degraded to sustain an ecologically significant proportion of the population for the assessed nationally threatened species.

Although a small area of potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard may be indirectly impacted, extensive areas of potential habitat for these two species would remain post-construction. Provided the remaining habitat is protected through the implementation of

stringent management measures, it is considered unlikely that habitat critical to the survival of this species would adversely affected as a consequence of the proposal. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; It is considered unlikely that the proposal would increase the potential for exotic species to become established. The existing habitat conditions are degraded, small and fragmented Introduce disease that may cause the species to decline; or It is considered unlikely that the proposal would introduce any diseases.

Interfere with the recovery of the species.

Provided that management measures are implemented to protect potential habitat it is unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the relevant assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented.

Significant impact criteria – Migratory Species

The species with greatest potential to be impacted by the proposal due to the removal and/or potential disturbance of suitable habitat include the:

- White-throated Needletail
- Satin Flycatcher
- Rainbow Bee-eater

Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

The habitats in the study area are unlikely to constitute an 'important' area of habitat on the basis that significant population densities are not known from the region, the habitat is widespread throughout the south west slopes, and there are no critical or unique habitats or features present that are required by these species for particular life-cycle events.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or

As discussed above, the habitats in the study area are unlikely to constitute an 'important' area of habitat for these migratory species. Harmful invasive species may include feral cats, for which no evidence of their presence was noted in the studies and populations are not expected to be significantly increased by the proposal. On the basis that significant population densities are not known from the region, the habitat is widespread throughout the south west slopes, and there are no critical or unique habitats or features present that are required by these species for particular life-cycle events.

Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

The study area is expected to provide some resources for a small proportion of the entire populations of these migratory birds. Such resources are very widespread and there is nothing that distinguishes the habitat from the remainder of the bioregion or indeed the habitat throughout the distributional range of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required

Threatened Fish

The Matters of National Environmental Significance – Significant Impact Guidelines (DEH 2006b) criteria have been addressed with respect to Murray Cod and Trout Cod, both of which are listed under the EPBC Act. Murray Cod is known to exist in the lower Tarcutta Creek catchment. The population of Murray Cod within the Tarcutta Catchment would be considered an 'important population' in accordance with the Significance Guidelines (DEH 2006b) as this population would be a key source population for breeding or dispersal within the Murray-Darling Basin and would contribute to maintaining genetic diversity.

Recent rehabilitation of the lower catchment has been undertaken to attract Murrumbidgee River populations of conservation stocked Trout Cod into the catchment (Luke Pearce, NSW Fisheries; pers.comm). Both species are unlikely to populate Dellateroy Creek given the degraded nature of the stream and its size. However, as a precautionary measure an assessment of the potential indirect impacts of the proposal on these species and their habitat has been made.

Significant impact criteria

Endangered Species Criteria – Trout Cod

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of a population;

Direct impacts on potential habitat for the Trout Cod are not anticipated as a consequence of the proposal as it is considered unlikely to occur in Dellateroy Creek. However, there is the potential for indirect impacts through impacts on water quality and sedimentation. Given that sediment control measures would be implemented during the construction and operational phases of the proposal and that any water discharged into Dellateroy Creek would meet ANZECC water quality guidelines (2000), it is unlikely that the proposal would impact on this species such that it would lead to a long-term decrease in the size of a population.

Reduce the area of occupancy of the species;

Sediment control measures would be implemented during the construction and operational phases of the proposal and any water discharged into Dellateroy Creek would meet the ANZECC water quality guidelines (2000). Therefore it is unlikely that proposal would result in a reduction of the area of occupancy of Trout Cod through indirect impacts.

Fragment an existing population into two or more populations;

The extension of the culvert over Dellateroy Creek is proposed to ensure fish passage remains. Where possible this would be designed in accordance with (Fairfull and Witheridge 2003). Therefore no populations are considered likely to be fragmented as a consequence of the proposal.

Adversely affect habitat critical to the survival of a species;

Direct impacts on habitat critical to the survival of Trout Cod are not anticipated. Furthermore, sediment control measures would be implemented during the construction and operational phases of the proposal and any water discharged into Dellateroy Creek would meet the ANZECC water quality

guidelines (2000). Therefore it is considered unlikely that proposal would have any adverse impacts on critical habitat for this species.

Disrupt the breeding cycle of a population;

No potential barriers to fish passage are anticipated due to the culvert extension. Therefore it is not anticipated that the proposal would disrupt the breeding cycle of this species. Furthermore, management measures would be implemented to preserve water quality within Dellateroy Creek and downstream.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Direct impacts on potential habitat for Trout Cod are not anticipated as a consequence of the proposal as it is considered unlikely that Dellateroy Creek would provide suitable habitat for this species. Sediment control measures would be implemented during the construction and operational phases of the proposal to minimise the likelihood of the proposal reducing water quality within Dellateroy Creek and downstream. Any water discharged into Dellateroy Creek would meet ANZECC water quality guidelines (2000). Therefore, it is considered unlikely that the proposal would impact on this species such that it would reduce the availability or quality of habitat for this species to the extent that the species would be likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

It is unlikely that the proposed culvert extension would increase the potential for exotic fish species to inhabit Dellateroy Creek and hence downstream habitats for Trout Cod. However, management measures would be implemented to protect the current condition of Dellateroy Creek and the associated water quality to reduce the likelihood of invasion/increased invasion of exotic fish species with Dellateroy Creek or creeks downstream.

Introduce disease that may cause the species to decline; or

It is unlikely that the proposal would introduce any diseases.

Interfere with the recovery of the species.

Provided that management measures are implemented to protect potential habitat within Dellateroy Creek and water quality at the site and downstream, it is unlikely that the proposal would interfere with the recovery of this species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required

Vulnerable Species Criteria – Murray Cod

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long term decrease in the size of an important population of a species;

Direct impacts on potential habitat for the Murray Cod are not anticipated as a consequence of the proposal as it is considered unlikely to occur in Dellateroy Creek. However, there is the potential for

indirect impacts through impacts on water quality and sedimentation. Given that sediment control measures would be implemented during the construction and operational phases of the proposal and that any water discharged into Dellateroy Creek would meet ANZECC water quality guidelines (2000), it is considered unlikely that the proposal would impact on this species such that it would lead to a long-term decrease in the size of an important population of this species.

Reduce the area of occupancy of an important population;

Sediment control measures would be implemented during the construction and operational phases of the proposal and any water discharged into Dellateroy Creek would meet the ANZECC water quality guidelines (2000). Therefore it is considered unlikely that proposal would result in a reduction of the area of occupancy of an important population of Murray Cod through indirect impacts.

Fragment an existing important population into two or more populations;

The extension of the culvert over Dellateroy Creek is proposed to ensure fish passage remains. Where possible this would be designed in accordance with (Fairfull and Witheridge 2003). Therefore no important populations are considered likely to be fragmented as a consequence of the proposal.

Adversely affect habitat critical to the survival of a species;

Direct impacts on habitat critical to the survival of Murray Cod are not anticipated. Furthermore, sediment control measures would be implemented during the construction and operational phases of the proposal and any water discharged into Dellateroy Creek would meet the ANZECC water quality guidelines (2000). Therefore it is considered unlikely that proposal would have any adverse impacts on critical habitat for this species

Disrupt the breeding cycle of an important population;

No potential barriers to fish passage are anticipated due to the culvert extension. Therefore it is not anticipated that the proposal would disrupt the breeding cycle of this species. Furthermore, management measures would be implemented to preserve water quality within Dellateroy Creek and downstream.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

Direct impacts on potential habitat for Murray Cod are not anticipated as a consequence of the proposal as it is considered unlikely that Dellateroy Creek would provide suitable habitat for this species. Sediment control measures would be implemented during the construction and operational phases of the proposal to minimise the likelihood of the proposal reducing water quality within Dellateroy Creek and downstream. Any water discharged into Dellateroy Creek would meet ANZECC water quality guidelines (2000). Therefore, it is considered unlikely that the proposal would impact on this species such that it would reduce the availability or quality of habitat for this species to the extent that the species would be likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

It is unlikely that the proposed culvert extension would increase the potential for exotic fish species to inhabit Dellateroy Creek and hence downstream habitats for Murray Cod. However, management measures would be implemented to protect the current condition of Dellateroy Creek and the associated water quality to reduce the likelihood of invasion/increased invasion of exotic fish species with Dellateroy Creek or creeks downstream.

Introduce disease that may cause the species to decline; or

It is unlikely that the proposal would introduce any diseases.

Interfere substantially with the recovery of the species.

Provided that management measures are implemented to protect potential habitat within Dellateroy Creek and water quality at the site and downstream, it is unlikely that the proposal would interfere with the recovery of this species.

Summary

In line with the findings of the Part 3A assessment under the EP&A Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct or indirect impact on a matter of national environmental significance (threatened species or ecological community) or their habitat if the mitigation measures outlined in Section 3.0 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required.

3.0 Recommended Mitigation Measures

3.1 Box-Gum woodland

Additional to avoidance mitigation measures, management and restoration of surrounding Box- Gum Woodlands would be implemented as part of the proposal. The use local endemic flora species that are characteristic of Box-Gum Woodland would be beneficial to the recovery of this community. The following recommendation measures are recommended:

- A weed management plan would be developed and implemented during construction to ensure exotic flora are not spread within the study area particularly areas of retained remnant vegetation;
- A restoration plan should be implemented to ensure that local native flora species characteristic of Box-Gum Woodland are utilised in landscaping activities, and the condition and size of the retained remnants is enhanced through weed management and supplementary plantings.
- Top soil should be collected from areas of Box-Gum Woodland to be cleared with a high percentage of native species in the understorey for use in any revegetation works.
- Seed collected from plants on site for future revegetation programs along the route should be undertaken. Species appropriate for a revegetation program can include those native species identified in the study and those in Stelling (1998) appropriate to the local community.
- Monitoring of weed invasions, restored and landscaped areas should be implemented post construction and appropriate management actions implemented when identified as being required.

Several sources document the results of restoration and rehabilitation techniques for grassy box woodland communities (e.g. Yates and Hobbs 1997; Prober et. al. 2002; Cole et. al. 2004; Prober and Thiele 2005; Davidson et. al 2005 and Vesk and Dorrough 2006). The literature identifies restoration as an essential component for the conservation of these endangered woodlands. It is recognised however that restoration is often difficult and relatively complicated. The literature identifies the ecological barriers to restoration, describing situations in which restoration efforts are most likely to be effective and the actions that can improve the chances of restoration projects being successful. Any restoration/rehabilitation plan developed for the proposal should be guided by the findings of these research projects.

3.2 Fauna Habitats and Corridors

- Potential habitat for the Striped Legless Lizard and the Pink-tailed Worm Lizard occurs within the rocky hillslopes identified on **Figure 4**. Care must be taken not to disrupt the area with machinery and site works.

- Pre-clearance surveys would be undertaken within areas of bushrock that are to be removed so that any fauna present can be relocated to adjacent areas not impacted by the proposed upgrades.
- Any bushrock that is to be removed would be redistributed across the site in fragments greater than ~150mm in diameter, placed on the ground preferably amongst native vegetation. In general larger 'piling' of rocks would be avoided, and several small piles are recommended.
- By coordinating the placement of these 'artificial' rock outcrops it is likely to enhance and create additional habitat.
- Any project rehabilitation should aim to conduct strategically located revegetation programs to increase total habitat, restore gaps in the landscape and thereby link isolated fragments of potential habitat for threatened fauna.
- Dead wood and tree trunks removed during construction should be relocated within and adjacent to remnant stands of Box-Gum Woodland in order to enhance existing habitat and for use within proposed revegetation areas.

3.3 Waterways and Aquatic Ecology

Management measures would be implemented to mitigate potential impacts from the proposal only where avoidance is not considered possible. Recommended management measures to mitigation potential direct and indirect impacts on watercourses within the Tarcutta section include:

- Installation of sediment detention basins or similar to trap runoff and sediment during construction works;
- Design of the culvert extension in accordance with the requirements of Fairfull and Witheridge (2003) where possible;
- Application of jute matting or similar to stabilise soil while construction is being undertaken to prevent sedimentation of creeks;
- Revegetation of the riparian zone using local native provenance following the completion of construction works to assist in filtering runoff from the impermeable road surface;
- Prevention of stock access to revegetated areas;
- Implementation of 'best practice' stormwater treatment measures to maximise on-site pollutant retention and removal; and infiltration and sub-surface discharge of stormwater (NPWS 1998).
- Planting of macrophytes along the stream banks to filter flow and enhance bank stability;
- Placement of woody debris within Dellateroy Creek. However care must be taken not to obstruct potential fish passage or adversely affect flow;
- Placement of stockpiles away from watercourses and native vegetation;
- Piling of soil that may contain seed of exotic species away from watercourses where the soil and seed could be spread during rainfall events and covering it to stop spreading during wind events; and
- Fencing of proposed development area to ensure construction works do not breach the boundaries and impact on the stream bank or riparian areas.
- Excavation of the creek diversions and revegetation of the sites will be conducted prior to filling in the current natural creek sections. DPI is to be given sufficient prior notice to undertake inspection of the constructed diversion channels once completed.
- Physical relocation of aquatic species residing in the section of the creek to be filled to the newly created section prior to diversion will be conducted if advised by the DPI Conservation Manager, South West.
- Protective measures would be implemented to exclude stock from rehabilitated areas in order to allow vegetation to establish and earthworks to stabilise. The protective measures will be discussed with DPI and detailed within the Riparian Management Plan.
- Creek rehabilitation at all sites will be to a level where cheeks can function ecologically in terms of pool and riffle sequences. Habitat will be provided so that aquatic species can move along through the rehabilitated systems as well as reside within them.

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