

9. Assessment of key issues

This chapter assesses issues identified as key issues in the Director-General's Requirements (DGRs) (see Appendix B and below), which may be associated with the project, including flora and fauna, Aboriginal heritage, surface water and groundwater, noise and vibration, social and economic, and traffic and transport impacts.

DGRs	Where addressed
An assessment of the key issues , with the following aspects addressed for each key issue (where relevant):	Chapter 9 Technical Papers (Volume 2)
- Describe the existing environment. - Assess the potential impacts of the project (direct, indirect and cumulative) at both construction and operation stages, in accordance with relevant policies and guidelines. - Identify how relevant planning, land use and development matters (including relevant strategic and statutory matters) have been considered in the impact assessment and/or in developing management/mitigation measures. - Describe measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the project and the residual impacts.	

During the preparation of the environmental assessment, there has been limited access to private properties located within the assessment area. To ensure all likely impacts have been adequately addressed, a precautionary approach has been taken in the assessment. Where necessary, the RTA has committed to carry out supplementary studies to confirm the extent of impacts as described in the environmental assessment prior to the commencement of any construction works.

9.1 Flora and fauna

A flora and fauna assessment was undertaken as presented below. This assessment is supported by *Technical Paper 1 — Flora and Fauna* (Volume 2).

DGRs	Where addressed
Flora and fauna (including but not limited to):	
Threatened terrestrial and aquatic species, populations, ecological communities and/or critical habitat, consistent with the <i>Threatened Species Assessment Guidelines</i> (DECC 2007a), including details on the existing site conditions and quantity and likelihood of disturbance.	Sections 9.1.2, 9.1.3 Technical Paper 1
Targeted surveys of threatened flora and fauna species including White Box, Yellow Box, Blakely's Red Gum Woodland, Hooded Robin, Brown Treecreeper and Squirrel Glider.	Sections 9.1.1, 9.1.2 Technical Paper 1
Native vegetation loss, weed infestation; habitat fragmentation; impacts to wildlife corridors including riparian corridors; and impacts to groundwater dependent communities, riparian and aquatic habitat.	Section 9.1.3 Technical Paper 1

9.1.1 *Assessment approach*

Due to property access restrictions, targeted flora and fauna surveys were not undertaken as part of the environmental assessment. This flora and fauna assessment is, therefore, based on a review of relevant previous studies undertaken and surveys undertaken by ngh environmental (2007) as part of the route options assessment for the project. The survey area covered Options A, B and C (refer Chapter 4). This is referred to as the flora and fauna assessment area for the project. This approach was discussed with, and agreed to by, the Department of Environment and Climate Change (DECC) (now the Department of Environment Climate Change and Water (DECCW)) and the Department of Planning with a commitment made to undertake targeted surveys for identified species and communities within the project in Spring 2009 (see Appendix B for correspondence from the Department of Environment and Climate Change). A detailed description of the methodology for this assessment is provided in Chapter 2 of Technical Paper 1 (Volume 2). The assessment included:

- Review of databases and literature to identify threatened flora, fauna and ecological communities previously recorded, or predicted to occur, in the NSW south-western slopes bioregion.
- Review of aerial photography, available vegetation mapping and digital elevation modelling to assess the size of remnant vegetation patches in the assessment area and connectivity to other areas of native vegetation.
- Terrestrial survey of the study area between 17 and 21 December 2006 and an aquatic survey of Mountain Creek on 27 and 28 May 2009. The surveys sought to assess the extent and condition of vegetation communities and potential flora and fauna (including fish) habitat, with particular consideration given to species of conservation concern (eg threatened and migratory species or locally significant species). Due to access restrictions later in the project development, further targeted surveys were not completed in the appropriate season. As such, a precautionary approach was adopted for the assessment in terms of the presence of rare and threatened flora and fauna and the impacts of the project. The RTA has committed to carrying out further ecological surveys including targeted surveys of identified species (White Box, Yellow Box, Blakely's Red Gum Woodland, Hooded Robin, Brown Treecreeper and Squirrel Glider) in Spring 2009 to assist in further refining the mitigation measures and offset strategies as required.
- Significance assessments for those threatened species and ecological communities recorded or predicted to occur with a moderate or greater likelihood. Assessments on species, populations and communities listed under the *Threatened Species Conservation Act 1995* and *Fisheries Management Act 1994* were based on the heads of consideration detailed in the *Draft Guidelines for Threatened Species Assessment under Part 3A* (DEC 2005b). Species and communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* were assessed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (DEH 2006).
- Recommendations for further investigation.

9.1.2 Existing environment

Landscape context

The project is located within the NSW south-western slopes bioregion, which consists of more than eight million hectares of foothills and ranges, comprising the western fall of the Great Dividing Range to the edge of the Riverina bioregion.

Remaining native vegetation in the bioregion is dominated by eucalypt woodlands, *Callitris* forests and woodlands, and eucalypt tall open forests. Patches of low closed forests and closed shrublands, eucalypt open woodlands, grasslands, and *Acacia* forests and woodlands occur. The region has been largely cleared of eucalypt woodlands for grazing and dryland agriculture, such that the larger areas of remnant vegetation occur on the rockier, hilly areas or as roadside vegetation.

Wildlife corridors and connectivity

Wildlife corridors are retained or restored linear vegetation systems that, at a minimum, enhance the connectivity of wildlife populations. These wildlife corridors are important for a range of species, functioning as areas of cover, foraging and habitat resources, and movement between habitat patches.

Vegetation within the locality is highly fragmented, with isolated patches of vegetation surrounded by large expanses of cleared land. Although some vegetation patches are of sufficient size to maintain viable populations, in many cases there may be only limited connectivity among the patches, given the extent of clearing and the distance to core areas. In such a modified landscape, vegetation within roadside reserves and riparian corridors can play an important role in the connectivity of remnant patches of vegetation.

Vegetation communities, including threatened communities

Vegetation communities

Four broad vegetation communities were identified in the flora and fauna assessment area. These comprise:

- Box-Gum Woodland.
- Rocky outcrop woodland.
- Cleared land with scattered eucalypts.
- Riparian vegetation.

The Box-Gum Woodland was identified as being consistent with threatened ecological communities: White Box Yellow Box Blakely's Red Gum Woodland (*Threatened Species Conservation Act 1995*) and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (*Environment Protection and Biodiversity Conservation Act 1999*). Due to limited site survey assessment, a precautionary approach has been adopted and the cleared land with scattered eucalypts community is assumed to be part of these communities. The classification of these communities would be confirmed during the proposed Spring 2009 targeted surveys. This would include determining whether they correspond with the definitions of Box-Gum Woodland under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.

Table 9-1 provides details of the vegetation communities identified within the flora and fauna assessment area. The distribution of these communities is shown in Figure 9-1.

Table 9-1 Broad vegetation communities identified in the flora and fauna assessment area

Broad community type	Corresponding rare or threatened community ¹	Observations
Box-Gum Woodland	White Box, Yellow Box Blakely's Red Gum Woodland (TSC Act) and White Box- Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).	Agricultural clearing has resulted in most of the remnants of this community being confined to the Hume Highway roadside corridor. Patches that exist away from the roadside corridor have generally been subject to higher levels of disturbance from heavy grazing, firewood removal and invasion of introduced flora species. All remnants suffer from weed invasion.
Rocky outcrop woodland	-	Within the flora and fauna assessment area, remnants of this community were dominated by Tumbledown Red Gum. Numerous species of forbs, lilies and native grasses were present, with all remnants showing high levels of diversity. The remnants had a moderate level of weed invasion.
Cleared land with scattered eucalypts	White Box, Yellow Box Blakely's Red Gum Woodland (TSC Act) and White Box- Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).	The intensive grazing practices associated with this community have resulted in high levels of disturbance, more evident in periods of drought. Isolated paddock trees in this community are likely to provide an important habitat feature. This community is dominated by exotic species.
Riparian vegetation ²	River Red Gum very tall open forest of the NSW South-western Slopes Bioregion.	Exotic floral species dominated most of the remnants of this community. One area of Mountain Creek was dominated by native species (e.g. Spiny-headed Mat Rush) and did not appear to have been extensively cleared. Structural integrity of the shrub layer was generally absent in all remnants; a likely result of heavy grazing. Riparian areas were characterised by the presence of River Red Gum as well as the occurrence of willows.

Note: 1. TSC Act = *Threatened Species Conservation Act 1995*; EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*.

2. Riparian vegetation community fits within the River Red Gum very tall open forest of the NSW Western Slopes Bioregion. This is a regionally rare community, classified as an over-cleared vegetation type within the Murray catchment.

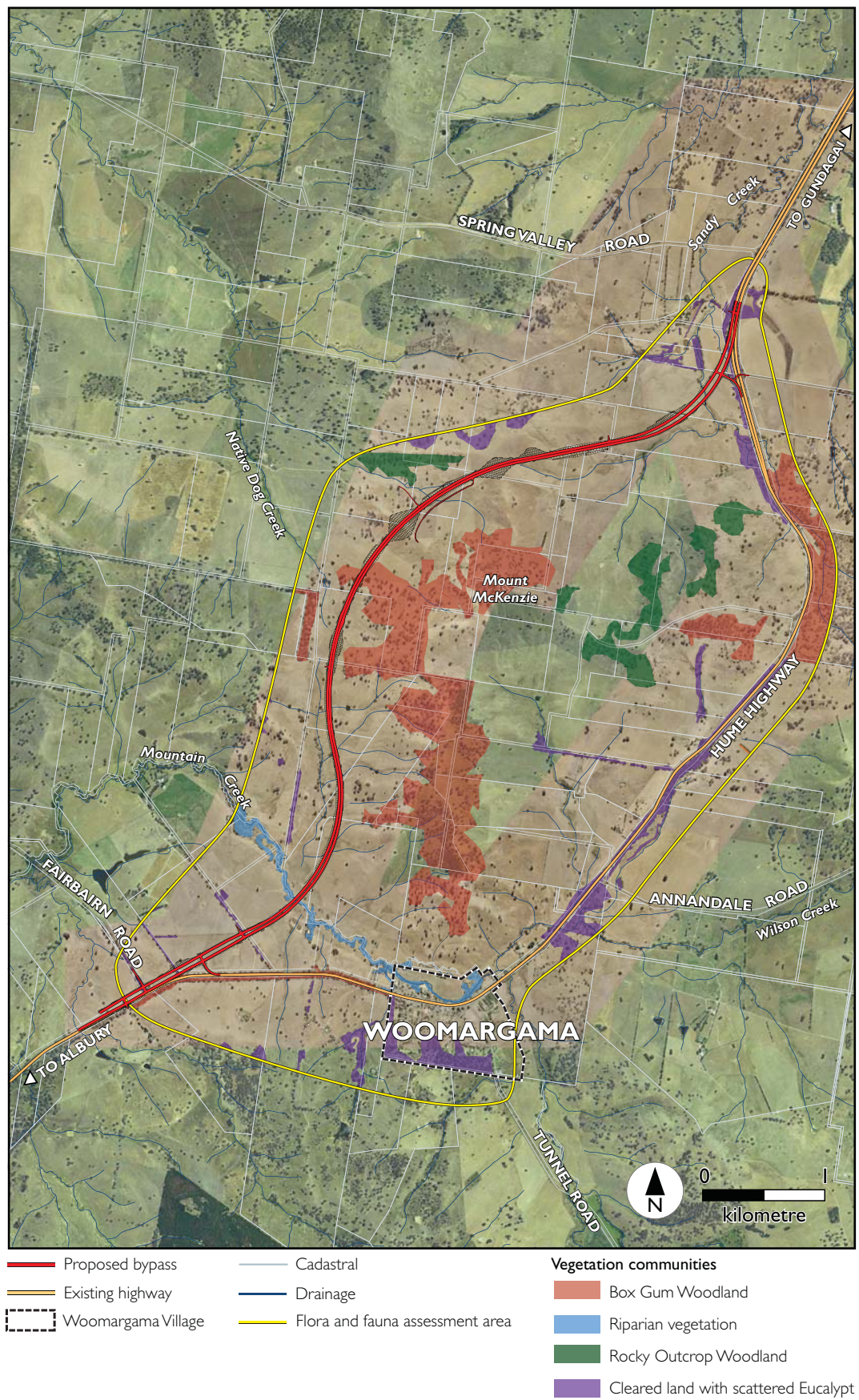


Figure 9-1 Vegetation communities in the flora and fauna assessment area

Threatened ecological communities

Box-Gum Woodland is protected under both Commonwealth and State legislation. Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, White Box-Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland is listed as a critically endangered ecological community. Under the NSW *Threatened Species Conservation Act 1995*, White Box, Yellow Box, Blakely's Red Gum Woodland is listed as an endangered ecological community. It should be noted that the classification of the Box-Gum Woodland threatened ecological community differs under Commonwealth and State legislation.

The *Fisheries Management Act 1994* lists the Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment as an endangered ecological community (the Lower Murray River endangered ecological community). The Lower Murray River endangered ecological community includes all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River below the Hume Weir, the Murrumbidgee River below Burrinjuck Dam, and the Tumut River below Blowering Dam, as well as all their tributaries and branches. Mountain Creek is a tributary of Billabong Creek, which is a tributary listed under the definition, and therefore, forms part of this community. Sandy Creek flows to the north where it joins Ten Mile Creek near Holbrook. Ten Mile Creek flows to Billabong Creek so is also part of this community.

Regionally rare communities

The riparian vegetation within the assessment area (eg along Mountain Creek) fits within the definition of River Red Gum very tall open forest of the NSW South-western Slopes Bioregion. This is a regionally rare community estimated as having an 85 per cent reduction in its pre-European distribution due to clearing (Benson 2008) and is classified by Biometric (DEC 2005c) as an over-cleared vegetation type within the Murray catchment.

Terrestrial flora, including threatened plants

A total of 103 species of plant were recorded in the flora and fauna assessment area, of which 67 species were native. The highest diversity of species was recorded in woodland areas, then riparian and rocky areas, with the least number of species present in cleared areas.

Threatened flora

Five threatened species of plant listed under the *Environment Protection and Biodiversity Conservation Act 1999* and seven threatened species of plant listed under the *Threatened Species Conservation Act 1995* have been recorded, are predicted to occur, or have habitat in the flora and fauna assessment area. None of these plant species were identified during the 2006 field surveys. Three species are considered to have a moderate likelihood of occurrence in the flora and fauna assessment area based on the presence of potential habitat. Table 9-2 lists these species.

Table 9-2 Threatened plant species recorded or predicted to occur in the flora and fauna assessment area

Scientific name	Common name	Conservation significance		Habitat within the flora and fauna assessment area	Likelihood of occurrence in flora and fauna assessment area ³
		TSC Act ¹	EPBC Act ²		
<i>Swainsona sericea</i>	Silky Swainson-pea	V		Box-Gum Woodland	Moderate
<i>Diuris tricolor</i>	Pine Donkey Orchid	V	V	Box-Gum Woodland	Moderate
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass	V	V	Water bodies	Moderate

Notes:

1: *Threatened Species Conservation Act 1995*, V = vulnerable.

2: *Environment Protection and Biodiversity Conservation Act 1999*, V = vulnerable.

3: See Appendix C of Technical Paper 1 (Volume 2) for more information on likelihood of occurrence.

Weeds

Thirty-six weed species were observed within the flora and fauna assessment area. Amongst these were five species of noxious weed listed under the *Noxious Weed Act 1993* for the Greater Hume local government area (LGA), including:

- Scotch Thistle.
- St. Johns Wort.
- Sweet Briar.
- Blackberry.
- Black Willow.

Fauna habitats

Terrestrial habitats

The suitability, size and configuration of the fauna habitats correlated broadly with the structure, floristic, connectivity and quality of the local and regional vegetation types. The majority of the fauna habitat was restricted to remnant stands of vegetation in an otherwise modified landscape. These areas of vegetation provide habitat for a range of woodland birds and mammals and limited reptiles, and were in low to good condition.

Habitat features recorded along the alignment generally include those associated with woodland, rock outcrops, cleared land with scattered eucalypts and riparian areas. These habitat types are described in detail in Section 3.3 of Technical Paper I (Volume 2) and are summarised below:

- Box-Gum Woodland — woodland habitat corresponds with the Box-Gum Woodland vegetation community. All areas of woodland habitat surveyed provide a variety of tree hollows suitable for microbats and gliders. Roadside woodland remnants were diverse in terms of native flora due to less grazing; however, fallen timber and logs were generally absent, most likely due to firewood collection. There were indications of heavy effects of grazing, apart from areas within the current highway road reserve.
- Rock outcrops — this habitat type corresponds with rocky outcrop woodland and is present to the east and west of the project. The main fauna habitat feature present within this habitat type was partially imbedded rocks with moderate to good native ground cover diversity. This habitat type could support lizards. Disturbance of this habitat type was far less than the woodland areas. Due to prolonged drought, the general flora abundance was much lower than expected, with a moderate level of weed invasion. In times of average rainfall, the area is expected to be dominated by native grasses and forbs. Habitat features present within this habitat type would be further investigated during the proposed Spring 2009 surveys.
- Cleared land with scattered eucalypts — this habitat type corresponds with the cleared land with scattered eucalypts vegetation community and offers little resource for threatened species, apart from the presence of mistletoe and some tree hollows. These areas have suffered substantial degradation and disturbance throughout the current drought with graziers giving preference to these areas over woodland areas. Extensive trampling of leaf litter by stock is evident around these areas. Removal of fallen timber for firewood has resulted in the loss of suitable microhabitat structure for fauna. Scattered paddock trees have been recognised as providing important habitat features for fauna within an agricultural landscape (Gibbons and Boak 2002) and have been known to support Squirrel Gliders (van der Ree 2006). The presence of Squirrel Gliders within this habitat type would be confirmed during the targeted surveys.

- Riparian areas — this habitat type corresponds with the riparian vegetation community and was observed to have hosted numerous species, such as waterbirds and migratory birds (Rainbow Bee-eaters). This habitat type is in good condition to the west of where the project would cross Mountain Creek where River Red Gums and a predominantly native understorey are present. The flowering eucalypts were observed providing honeyeaters with a reliable food source. This habitat is considered to be especially important during the present drought conditions (ng environmental 2007).

Aquatic habitats

Mountain Creek has been modified as a result of agricultural activities, clearing and grazing of cattle. Mountain Creek is classed as Class 1 Major Fish Habitat under the Department of Industry and Investment (formerly the DPI) guidelines on fish passage requirement (Fairfull and Witheridge 2003) and, as such, a bridge structure is required.

The riparian bank vegetation of Mountain Creek was dominated by weeds. Water quality within the creek was generally considered poor with some variables outside of the relevant ANZECC (2000) guidelines (see Section 3.4 of Technical Paper 1 (Volume 2)).

Surface water sampling (see Section 9.3) indicated that surface water within the Mountain Creek, Native Dog Creek and Sandy Creek catchments has elevated nutrient and zinc levels, most likely due to grazing and cropping activities in the area. The sampling also indicated elevated electrical conductivity (EC) levels in Mountain and Sandy creeks.

Sandy Creek is currently degraded with little riparian vegetation. Fish and aquatic surveys have not been completed in Sandy Creek due to a lack of water present. The waterway is considered to be Class 3 Minimal Fish Habitat (Fairfull and Witheridge 2003). As such, any crossing would need to meet, as a minimum, low flow design requirements and consist of a culvert or ford (Fairfull and Witheridge 2003). Currently, there is little terrestrial connectivity along the creek due to the lack of riparian vegetation.

Fauna, including threatened and migratory species

A total of 110 species were recorded within the flora and fauna assessment area during the surveys, 103 of which were native species. This included eight species of mammal, 82 species of bird, two species of amphibian, nine species of reptile and two species of fish. The highest diversity of fauna species was identified in the riparian and woodland areas, and then rocky areas, with the least number of species present in cleared areas. Appendix B of Technical Paper 1 (Volume 2) identifies species recorded within the flora and fauna assessment area.

Threatened fauna

Fourteen threatened fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* have been recorded, are predicted to occur, or have potential habitat within the flora and fauna assessment area. None were recorded in the flora and fauna assessment. Ten of these 14 species are considered to have a low likelihood of occurrence due to a lack of suitable habitat. The remaining four have either a moderate or high likelihood and are listed in Table 9-3. These species would likely occur in the Box-Gum Woodland and the riparian areas.

Forty-six threatened fauna species listed under the *Threatened Species Conservation Act 1995* and *Fisheries Management Act 1994* have been recorded, are predicted to occur, or have potential habitat in the locality of the flora and fauna assessment area. Twenty-six of the 46 species are considered to have a low likelihood of occurrence. The remaining 20 have either a moderate or high likelihood and are listed in Table 9-3. Four of these species were recorded in the flora and fauna assessment area.

One recorded species, the Squirrel Glider, listed as vulnerable under the *Threatened Species Conservation Act 1995*, is also listed as an endangered population under Schedule 1 of the *Threatened Species Conservation Act 1995* within the Wagga Wagga LGA. Wagga Wagga LGA borders the Greater Hume Shire LGA to the north. A recent review of this listing suggests that populations of Squirrel Gliders within the south-western slopes bioregion are wider spread than originally thought, and that other disjunct populations within the bioregion are also likely to be endangered (Claridge and van der Ree 2004). Some connectivity between individuals and habitats within the assessment area and the populations within the Wagga Wagga LGA may also exist.

Table 9-3 Threatened fauna recorded or predicted to occur in the flora and fauna assessment area

Scientific name	Common name	TSC Act ¹	EPBC Act ²	Likelihood of occurrence ⁴
Birds				
<i>Burhinus grallarius</i>	Bush Stone-curlew	EI		Moderate
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies) ³	V		High
<i>Grantiella picta</i>	Painted Honeyeater	V		Moderate
<i>Lathamus discolor</i>	Swift Parrot	EI	E	Moderate
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form) ³	V		High
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Moderate
<i>Neophema pulchella</i>	Turquoise Parrot	V		Moderate
<i>Ninox connivens</i>	Barking Owl	V		Moderate
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Moderate
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	V		Moderate
<i>Pyrholaemus sagittatus</i>	Speckled Warbler	V		Moderate
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Moderate
<i>Tyto novaehollandiae</i>	Masked Owl	V		Moderate
<i>Xanthomyza phrygia</i>	Regent Honeyeater	EI	EM	Moderate
Mammals				
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		Moderate
<i>Myotis adversus</i>	Large-footed Myotis	V		Moderate
<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V	V	Moderate
<i>Petaurus norfolcensis</i>	Squirrel Glider ³	V		High
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	V		Moderate

Scientific name	Common name	TSC Act ¹	EPBC Act ²	Likelihood of occurrence ⁴
Fish and aquatic invertebrates				
<i>Nannoperca australis</i>	Southern Pygmy Perch ³	EI		High

- Notes:
1. *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994*, V = vulnerable, EI = endangered.
 2. *Environment Protection and Biodiversity Conservation Act 1999*, V = vulnerable, E = endangered, M = migratory.
 3. Species was recorded during field surveys.
 4. Refer to Appendix D of Technical Paper I (Volume 2) for more information on likelihood of occurrence.

Migratory species

Migratory species are protected under the international agreements to which Australia is a signatory. Migratory species are considered matters of national environmental significance and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

One species of bird, the Rainbow Bee-eater, recorded during the flora and fauna assessment is currently recognised under the migratory provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (see Appendix B of Technical Paper I (Volume 2)). A further 10 migratory species have the potential to occur in the flora and fauna assessment area based on the EPBC Protected Matters Search Tool.

For five species of migratory bird recorded or considered likely to occur, the flora and fauna assessment area is not considered to comprise important habitat.

One species, the Regent Honeyeater, is listed as endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. The flora and fauna assessment area could be considered to contain habitat where the species is declining. An assessment of significance was carried out for this species (see Appendix E of Technical Paper I (Volume 2)). The Regent Honeyeater is not likely to be significantly affected by the project.

9.1.3 *Impacts on flora and fauna*

Loss of native vegetation and fauna habitats

The project would require the clearing of eight hectares of native vegetation and identified fauna habitat within the construction site boundary. The areas identified for clearing are shown on Figure 5-1 (Maps a and b) of Technical Paper I (Volume 2). The clearing would comprise:

- Seven hectares of vegetation assumed to be an endangered ecological community listed under the *Threatened Species Conservation Act 1995* and under the *Environment Protection and Biodiversity Conservation Act 1999* — Box-Gum Woodland and cleared land with scattered eucalypts.
- One hectare of riparian vegetation.

The vegetation and habitat loss is detailed in Table 9-4.

Table 9-4 Vegetation communities and fauna habitat loss

Vegetation community/ fauna habitat	Corresponding threatened ecological community ¹	Total clearing ² (hectares)
Vegetation community / fauna habitat		
Box-Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland (TSC Act) and White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).	6
Cleared land with scattered eucalypts	White Box Yellow Box Blakely's Red Gum Woodland (TSC Act) and White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).	1
Riparian vegetation	River Red Gum very tall open forest of the NSW south-western slopes bioregion (regionally rare community).	1
Total		8

Notes: 1: TSC Act = *Threatened Species Conservation Act 1995*; EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*.

2. Refer to Figure 5-1 (Maps A, B and C) of Technical Paper 1 (Volume 2) for areas to be cleared.

Habitat fragmentation and wildlife corridor impacts

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. This new dividing habitat is often artificial and inhospitable to the species remaining within the fragments (Johnson et al 2007; Bennett 1993, 1990). Habitat fragmentation can result in a number of impacts, including:

- Barrier effects: where particular species are either unable or unwilling to move between suitable areas of fragmented habitat.
- Genetic isolation: where individuals from a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments.
- Edge effects: where a zone of changed environmental conditions (ie altered light levels, wind speed and/or temperature) occurs along the edges of habitat fragments (see below).

The construction and operation of the project would further fragment habitat and increase the isolation of remnant vegetation. With the project traversing roadside and modified agricultural landscapes, the project would present a barrier within the landscape, particularly within the Mountain Creek riparian corridor and remnant patches of Box-Gum Woodland in the centre of the project. The barrier effects would be greatest for small and sedentary fauna, such as ground-dwelling/arboreal mammals, reptiles and amphibians. However, given the existing disturbances in the flora and fauna assessment area due to a history of agricultural land uses and the existing Hume Highway, the disrupted wildlife corridors are likely to be used mostly by highly mobile species, such as birds and bats, primarily as marginal foraging habitats within a greater foraging range. Therefore, the project is unlikely to have a significant impact on these highly mobile species provided that the impacts to wildlife corridors are mitigated through the measures identified in Section 9.1.4.

Edge effects

Edge effects are zones of changed environmental conditions occurring along the edges of habitat fragments. These new environmental conditions can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammals and native birds.

The majority of vegetation in the flora and fauna assessment area occurs within relatively small, fragmented patches, many of which are subject to past and present disturbance regimes (eg grazing) and hence, already consist of edge-affected habitats. Construction of the project is likely to introduce new edge effects to the larger remnants of vegetation.

A change in the microhabitat conditions in remnant vegetation patches as a result of vegetation clearing and earthworks increases the likelihood of the germination and establishment of weeds. Given the significant disturbances associated with edge effects from grazing and adjoining agricultural land practices, it is considered that any marginal increase in these effects caused by the project is not likely to be significant.

Vehicle strike and direct mortality of animals

Fauna injury or death could occur during construction, when vegetation and habitats are being cleared. While some mobile species (eg birds) have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may have difficulty moving over relatively large distances.

During operation of the project, fauna injury or death could also occur as a result of collision with vehicles. Threatened fauna that may be affected by vehicle strikes include the Squirrel Glider, Swift Parrot and woodland bird species, such as the Grey-crowned Babbler. The greatest road kill risk for these species would likely occur in the central and southern portions of the project, where it traverses existing remnant vegetation.

As detailed in Table 9-6, the project would adopt measures to prevent fauna mortality during construction and operation.

Invasion and establishment of weeds and pests

As identified in Section 9.1.2, 36 weed species were observed in the flora and fauna assessment area, five of which are listed as noxious weeds under the *Noxious Weed Act 1993*. The distribution of these weed infestations can generally be split into the following broad distributional areas:

- Riparian areas associated with the River Red Gum very tall open forest of the NSW South-western slopes bioregion vegetation community.
- Paddock remnants of natural vegetation communities to the north and to the south of the project.

Construction of the project has the potential to disperse weeds into areas of remnant vegetation. The most likely causes of weed dispersal would include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery. Given that most of the vegetation in the flora and fauna assessment area already has weed growth, the overall extent of habitat modification is not likely to increase significantly.

Weed management during construction and operation would be carried out as part of regular maintenance activities, as required.

Aquatic flora and fauna impacts

The construction of waterway crossings for the project (temporary and permanent) has the potential to modify the natural hydrology of creeks within the flora and fauna assessment area, which could affect the aquatic assemblages that use these areas. Impacts from the construction of waterway crossings include:

- Excessive flow velocities.
- Modified water depths in the creeks.
- Increased water turbulence.

Barriers to fish passage from the installation of waterway crossings (including bridges and culverts) can occur temporarily (ie during construction) and/or over the long term if inappropriate structures are used. In addition to potential impacts from alteration of natural hydrology at waterway crossings, other impacts, such as decreased light levels and blocked debris, may affect fish passage. Existing culverts and bridge piers are located within Mountain and Sandy creeks, which may potentially disrupt fish passage currently.

Fish and mobile invertebrate assemblages surveyed in Mountain Creek were fairly typical of freshwater habitats in the region. The fish assemblage included the threatened Southern Pygmy Perch. A small area of the Southern Pygmy Perch habitat could be removed as a result of the proposed waterway crossing at Mountain Creek. However, no bridge piers would be located in the preferred habitat of this species (the low flow channel of the creek). Given that suitable habitat exists upstream and downstream of the project, and provided that fish passage is maintained in accordance with the Department of Industry and Investment (formerly DPI) guidelines (Fairfull and Witheridge 2003) no long-term impacts from the proposed waterway crossings would be expected for the Southern Pygmy Perch (see Appendix C of Technical Paper 1 (Volume 2)) or other fish species.

As identified in Section 5.3.4, no realignments of drainage lines and/or overflow channels are required for the project. The realignment of waterways would have the potential to impact on aquatic flora and fauna through removal of habitat, increased flow velocities and reduced water quality (through increased sedimentation). If it is determined that realignment or diversion of Mountain or Sandy creeks is required, the need for and design of the realignment or diversion would be determined in consultation with the DECCW, the Department of Industry and Investment and other relevant stakeholders.

Both Mountain and Sandy creeks form part of the Lower Murray River endangered ecological community. The project would include waterway crossings within these endangered ecological communities, which would add to the overall disturbance regime in the creeks. The waterways within the project are currently affected by riparian vegetation clearance, erosion and sedimentation, alteration to flows and bank instability due to stock access and vegetation removal. Given that suitable habitat exists up and down stream of the proposed creek crossings and that all crossings would be constructed in accordance with the Department of Industry and Investment (formerly the DPI) guidelines, it is unlikely that there would be long-term impacts on the endangered ecological community.

Impacts on groundwater dependent ecosystems

Groundwater dependent ecosystems are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (DLWC 2002). Within the flora and fauna assessment area, there are two main groundwater flow systems: alluvial and fractured rock aquifers (see Section 9.3.2). Much of the vegetation within the assessment area is likely to access these groundwater resources. However, given the broad regional distribution of these communities and the varied topography over which they occur, it is unlikely that they

would be dependent on the groundwater resources. Riparian vegetation may show a partial dependence on the groundwater but the extent and life processes of the vegetation are not wholly dependent on groundwater.

The project would require the excavation and shaping of the upper soil profile and minor alterations to the existing surface water drainage. Some groundwater extraction is likely to be required during construction activities. However, this is not expected to have a significant impact on the existing subsurface aquifers and any associated groundwater dependent ecosystems.

Cumulative impacts

The cumulative biodiversity impacts of the project considered in this environmental assessment are likely to be more substantial as a result of biodiversity impacts from the surrounding Hume Highway duplication projects. These cumulative impacts would include a greater extent of clearing of native vegetation and habitats, including threatened ecological communities, as well as further fragmentation of habitats, including habitat for threatened flora and fauna.

It is estimated that a total of approximately 128 hectares of native vegetation has been, or will be, cleared for the current duplication and proposed town bypass projects on the Hume Highway. The project would contribute approximately six per cent of this clearing. The total extent includes an estimated 98 hectares of endangered ecological communities, of which the project contributes up to seven hectares. The loss of 98 hectares of endangered ecological communities is considered a significant loss given the threatened status of these communities and the largely fragmented nature of remnant vegetation patches within the south western slopes bioregion. To offset the loss of native vegetation as a result of the Hume Highway duplication projects, the RTA is implementing a biodiversity offset package.

While similar or better quality vegetation and habitat remain within the bioregion, the extent of clearing for the Hume Highway duplication and proposed bypass projects would reduce the extent of viable habitat. However, this would be a minimal loss of vegetation and fauna habitat in the context of the wider bioregion.

Significance of impacts

Significance assessments were completed for threatened biodiversity that were known or likely to occur in the flora and fauna assessment area, including two endangered ecological communities, three species of plant and 20 species of animal. Table 9-5 summarises the significance assessments. This is supported by the detailed assessments in Appendix E of Technical Paper 1 (Volume 2).

Table 9-5 Summary of significance assessments for threatened biodiversity

Threatened biodiversity	TSC Act ¹	FM Act ²	EPBC Act ³	Likely significant impact
<i>Ecological communities</i>				
Box-Gum Woodland	E		CE	No
Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment		E		No
<i>Plants</i>				
Swainsona serica	V			No
Diuris tricolor (Pine Donkey Orchid)	V		V	No
Amphibromus fluitans (River Swamp Wallaby-grass)	V		V	No

Threatened biodiversity	TSC Act ¹	FM Act ²	EPBC Act ³	Likely significant impact
<i>Animals</i>				
Threatened woodland birds assessed as a group (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail)	V			No
Barking Owl and Masked Owl	V			No
Bush Stone-curlew	E			No
Regent Honeyeater	E		EM	No
Superb Parrot	V		V	No
Swift Parrot	E		E	No
Turquoise Parrot	V			No
Squirrel Glider	V			No
Microbats assessed as a group (Eastern False Pipistrelle, Greater Long-eared Bat, Large-footed Myotis, Yellow-bellied Sheathtail Bat)	V		V	No
Southern Pygmy Perch		E		No

Notes: 1: *Threatened Species Conservation Act 1995*, V = vulnerable, E = endangered.

2: *Fisheries Management Act 1994*, V = vulnerable, E = endangered.

3: *Environment Protection and Biodiversity Conservation Act 1999*, V = vulnerable, E = endangered, CE = critically endangered, M = migratory.

These assessments suggest that the project is not likely to have a significant or long lasting impact on any species or ecological community listed under the *Threatened Species Conservation Act 1995*, the *Fisheries Management Act 1994* or the *Environment Protection and Biodiversity Conservation Act 1999*.

9.1.4 Management of impacts

Management measures for flora and fauna impacts were developed following the general principles, in order of preference, of:

- Avoiding impacts.
- Minimising impacts.
- Mitigating impacts.
- Offsetting of residual impacts (this is considered a last resort, once the above options have been investigated).

The planning and route selection processes have, as far as possible, avoided impacts on flora and fauna habitats. Chapter 4 discusses the route selection process that was undertaken for this project, and particularly identifies flora and fauna as a key consideration in the planning and route selection. Due to limited site survey assessment, a precautionary approach has been adopted for the flora and fauna assessment. The RTA has committed to carrying out further targeted surveys of identified species (White Box, Yellow Box, Blakely's Red Gum Woodland, Hooded Robin, Brown Treecreeper and Squirrel Glider) in Spring 2009. The targeted surveys would confirm the classification of vegetation communities, including Box-Gum Woodland under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.

Table 9-6 identifies the mitigation and management measures that would be implemented for flora and fauna impacts. These measures have been incorporated into the draft statement of commitments in Chapter 11.

Table 9-6 Flora and fauna mitigation and management measures

Potential impact	Mitigation and management measure
<i>Pre-construction</i>	
Impacts on flora and fauna due to limitations of survey data	Undertake targeted surveys for threatened flora and fauna species in Spring 2009 to assist in further refining the mitigation measures as required. Should any additional impacts be identified, develop mitigation and management measures in consultation with DECCW and other relevant agencies.
Impacts on flora and fauna from construction of the project	Prior to the commencement of construction, prepare and implement a Flora and Fauna Management Plan through the CEMP.
<i>Construction</i>	
Removal of native vegetation and increased edge effects	Limit clearing and disturbance of native vegetation to the minimum necessary to construct and operate the project through detailed design.
Removal of habitat	- Implement clearing protocols that involve checking hollow-bearing trees for the presence of bird nests and arboreal animals, such as possums, gliders and bats, prior to felling or pushing. Safely remove any animals found to be occupying trees. Have a qualified ecologist relocate any fauna with the potential to be harmed into suitable adjacent habitat. - Implement a two stage clearing protocol for all hollow-bearing tree clearing. - Attach salvaged sections of hollows or nest boxes to trees in a way that allows for tree expansion and does not poison the tree. When locating hollows or nest boxes to trees, consider appropriate aspect, height and location for the target fauna species. - Collect native seed prior to clearing, for use in the revegetation of disturbed areas. - Landscape areas within the project corridor, including the use of native plant species endemic to the area. - Implement strategic revegetation works in the highway corridor to increase fauna habitat linkages and enhance riparian areas.
Increased weed invasion in adjacent areas due to edge effects	Undertake ongoing management of weeds in consultation with the Greater Hume Shire Council.
Inadvertent disturbance of Box-Gum Woodland and other areas of habitat outside construction areas	Clearly demarcate the limits of clearing within the construction site boundary prior to construction activities commencing to avoid unnecessary vegetation and habitat removal.
Cumulative loss of habitat	Place natural and artificial habitat features into suitable areas to provide alternative habitat for fauna.
Fragmentation of habitat and barrier effects	Develop fauna crossing treatments if required in consultation with relevant government agencies.

Potential impact	Mitigation and management measure
Changed hydrology and aquatic disturbance and barriers to fish passages	▪ Avoid works within the main watercourse of Mountain Creek during the breeding season of the Southern Pygmy Perch (September to January) unless mitigation measures are developed in consultation with the Department of Industry and Investment. ▪ Maintain fish passage during construction. ▪ Design waterway crossings, including temporary works, in accordance with the fish habitat classification of each waterway and in consultation with the Department of Industry and Investment. ▪ Follow Department of Industry and Investment (formerly DPI) guidelines, so as to maintain the natural flow of all water bodies directly affected by the project in the study area.
Decreased water quality	▪ Develop and implement standard best practice environmental management measures during construction in accordance with <i>Managing Urban Stormwater: soils and Construction, Volume 1, 4th Ed.</i> (Landcom 2006) and <i>Managing Urban Stormwater: Soils and Construction, Volume 2D, Main Road Construction</i> (DECC 2008b).
Operation	
Offset the loss of vegetation and fauna habitat, and residual impacts	▪ Develop a biodiversity offset package in consultation with DECCW and other relevant stakeholders to detail how the residual impacts on ecological values as a result of the project would be managed. The package would address the potential cumulative impacts resulting from the proposed Tarcutta and Holbrook bypasses. This offset package would be guided by the RTA's (2007c) <i>Hume Highway Duplication Biodiversity Offset Strategy</i> (RTA 2007c).

9.2 Aboriginal heritage

An assessment of Aboriginal cultural heritage impacts has been undertaken for the project as presented below. This is supported by an Aboriginal Cultural Heritage Assessment Report (CHAR) in *Technical Paper 2 — Aboriginal Heritage* (Volume 2).

DGRs	Where addressed
Aboriginal heritage (including but not limited to):	
Detailed archaeological heritage assessment, including archaeological survey to determine the extent of Aboriginal occupation and land use.	Sections 9.2.1, 9.2.2, 9.2.3 Technical Paper 2 (Volume 2)
Cultural heritage assessment to identify the cultural value of the area to Aboriginal people in the present and historically.	Sections 9.2.1, 9.2.2, 9.2.3 Technical Paper 2 (Volume 2)

9.2.1 Assessment approach

The Aboriginal cultural heritage assessment was undertaken in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005a), *Interim Community Consultation Requirements for Applicants* (DEC 2004) and the *RTA Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (RTA 2008d) (the Procedure).

The assessment of Aboriginal cultural heritage consisted of desktop research, database searches, Aboriginal community consultation, cultural interviews, cultural mapping and archaeological field surveys. The assessment included the following elements:

- A search of the DECCW Aboriginal Heritage Information Management System (AHIMS) database within five kilometres of Woomargama village.
- A review of previous archaeological surveys undertaken for the Hume Highway upgrade including Kelleher Nightingale Consulting Pty Ltd (2007a, b, c) and preliminary archaeological assessment and cultural mapping undertaken as part of the preliminary environmental assessment.
- Identification, registration and consultation with Aboriginal stakeholders.
- Two Aboriginal focus group meetings were held to discuss the results of:
 - The preliminary archaeological and Aboriginal cultural heritage assessments and methodology for the Aboriginal cultural assessment.
 - The draft CHAR, prior to submission of comments.
- Aboriginal cultural knowledge holders were identified through consultation and the Aboriginal focus group process. Seven of the identified knowledge holders were provided the opportunity to participate in the cultural assessment process. As a result, three of the identified knowledge holders participated in the cultural heritage assessment through field surveys and interviews.
- Archaeological surface surveys of the assessment area were conducted in June 2009. The surveys consisted of two teams of four to five people, including archaeologists and Aboriginal stakeholders, walking the assessment area to identify areas of archaeological significance or potential significance.
- An assessment of Aboriginal cultural heritage was undertaken, consisting of both interviews and field surveys.
- An assessment of archaeological and cultural significance, in accordance with *Standards for Archaeological Practice in Aboriginal Heritage Management Guidelines* (NPWS 1997):
 - Archaeological significance rankings for archaeological sites includes consideration of archaeological research potential, representativeness and rarity. Levels of significance include low, moderate and high.
 - Cultural significance refers to the values of a place, feature or site to a particular community group and can include social, spiritual, historic and archaeological values. Cultural significance for the places and items identified in the Aboriginal cultural heritage assessment were given a relative ranking of high or very high.
- A draft Aboriginal CHAR was prepared and circulated to registered stakeholders for comment. The CHAR was finalised following consideration of comments from stakeholders and DECCW. This is included as Technical Paper 2 (Volume 2).

9.2.2 Existing environment

Aboriginal archaeology

Significant occupation by Aboriginal people of the Woomargama area has been occurring for at least 5000 years. It is possible that the area around Woomargama is related to an extensively used transitory route from the Billabong catchment to the Mullengandra catchment. The various creek systems offered good camping/occupation locations for past Aboriginal people.

Archaeological sites in the assessment area predominantly occur as artefact scatters and potential archaeological deposits (PADs). Artefact scatters are areas in the landscape that contain two or more stone artefacts, generally located within 100 metres of each other. They may result from the activities of a single person or a group of people and can be the result of a single occupation or multiple episodes of occupation of a single place. PADs are areas that potentially contain intact archaeological sub-surface deposits. Scarred trees are trees that have had bark deliberately removed that leaves scars on the tree trunk, which indicates the Aboriginal use of an area. The bark was used for many purposes, including canoes, shelters, shields and container vessels.

The AHIMS search identified six previously recorded sites within the locality, including one isolated find, two artefact scatters and three scarred trees. All of these sites were identified during previous surveys undertaken for the Hume Highway duplication project. The majority of these sites are located outside the construction site boundary and would not be impacted by the project. One site, a scarred tree (56-4-0249) is located close to the project, but would not be directly impacted.

A total of 24 Aboriginal archaeological sites and four PAD areas were identified during the archaeological surface survey for the project. The sites were generally identified where surface visibility was high such as where large surfaces have eroded in margins of slopes or in disturbed areas. The majority of sites were located in areas associated with Mountain and Sandy creeks.

The identified Aboriginal archaeological items within the assessment area are listed in Table 9-7. The archaeological significance ranking of these sites is also provided. All identified sites were considered to be of high cultural significance to the Aboriginal stakeholders.

The approximate locations of the archaeological sites are shown in Figure 9-2.

Cultural places

Five locations of specific Aboriginal cultural value were identified by the knowledge holders within the assessment area. These places are recognised by the knowledge holders as being part of one interlinked element within the larger cultural landscape. The cultural significance of these places ranged from high to very high. This ranking was developed in consultation with the knowledge holders. All identified places hold Aboriginal cultural heritage significance, the relative ranking is designed only to assist future planning. The identified Aboriginal cultural places are listed in Table 9-7. Locations of the identified places have been kept confidential due to the culturally sensitive nature of this information.

Table 9-7 Identified items of archaeological and cultural significance

Site	Site type	Significance
W1	Artefact scatter	Moderate to high
W2	Isolated find	Moderate
W3	Artefact scatter	High
W4	Artefact scatter	Moderate to high
W5	Artefact scatter	Moderate
W6	Artefact scatter	High
W7	Artefact scatter	Moderate to high
W8	Artefact scatter	Moderate
W9	Artefact Scatter	Moderate
W10	Artefact scatter	Moderate

Site	Site type	Significance
W11	Artefact scatter	Moderate
W12	Artefact scatter	Moderate to high
W13	Artefact scatter	Low to moderate
W14	Artefact scatter	High
W15	Artefact scatter	Moderate
W16	Artefact scatter	Moderate to high
W17	Artefact scatter	Low to moderate
W18	Artefact scatter	High
W19	Artefact scatter	Moderate to high
W20	Artefact scatter	Moderate to high
W21	Artefact scatter	Low
W22	Artefact scatter	Low
W23	Artefact scatter	High
W24	Artefact scatter	High
W-PAD-1	PAD	-
W-PAD-2	PAD	-
W-PAD-3	PAD	-
W-PAD-4	PAD	-
56-4-0249	Scarred tree	-
Place 1	Ceremonial area	Very high
Place 2	Gendered Ancestor figure in the landscape	Very high
Place 3	Gendered ceremonial area marker	High
Place 4	Gendered ceremonial area marker	High
Place 5	Ancestral figure in landscape	High

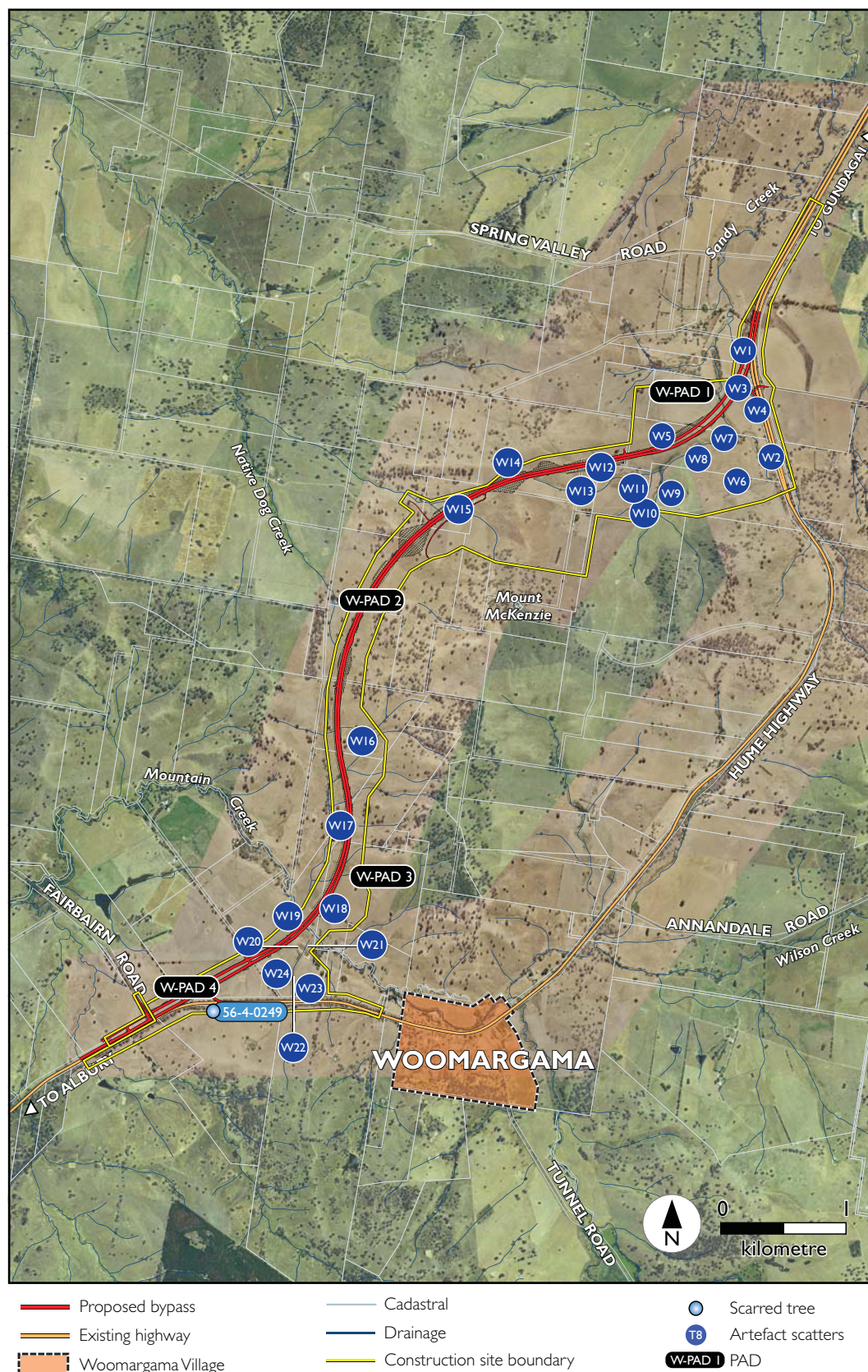


Figure 9-2 Locations of identified Aboriginal archaeological sites

9.2.3 Impacts on items of heritage significance

All identified Aboriginal cultural places and archaeological sites recorded within the assessment area have been considered throughout the route selection and environmental assessment process. Where significant sites or places were identified, the concept design has been modified where possible to avoid or limit the impact to the identified cultural places and archaeological sites. Some level of impact has been unavoidable.

Cultural places

None of the identified cultural places are located within the construction site boundary. Therefore, there would be no direct impacts to these places.

Archaeological sites

Of the 25 archaeological sites and four PADs identified within the assessment area, 16 archaeological sites and two PADs are located wholly or partially within the construction site boundary and would be directly impacted by the project. In some cases, the impacts amount to only a relatively small portion of the site. Detailed design would seek to further minimise impacts on these archaeological sites, where feasible.

Nine archaeological sites and two PADs identified in the assessment area are located outside the construction site boundary and would not be directly impacted by the project.

A summary of the archaeological and cultural heritage impacts is provided in Table 9-8.

Table 9-8 Summary of impacts to, and mitigation measures for, Aboriginal archaeological sites and cultural heritage places

Site	Extent of impact and mitigation measures
W1 — Artefact scatter	Would be impacted, partial impact only. Salvage excavation would occur prior to construction.
W2 — Isolated find	No impact. The location of the site would be identified in the construction sensitive area map.
W3 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction.
W4 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W5 — Artefact scatter	Would be impacted, partial impact only. Salvage excavation of the eastern portion of the site would occur prior to construction.
W6 — Artefact scatter	Would be impacted, partial impact only. This would only be a minor impact on the site's archaeological significance. No mitigation required. Barrier fencing would be erected along the construction boundary and the location of the site would be identified in the construction sensitive area map.
W7 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W8 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W9 — Artefact scatter	Would be impacted, partial impact only. This would be only a minor impact on the site's archaeological significance. Barrier fencing would be erected along the construction boundary and the location of the site would be identified in the construction sensitive area map.
W10 — Artefact scatter	Would be impacted, partial impact only. This would be only a minor impact on the site's archaeological significance. Barrier fencing would be erected along the construction boundary and the location of the site would be identified in the construction sensitive area map.

Site	Extent of impact and mitigation measures
W11 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W12 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction.
W13 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W14 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction if impacts to the site could not be avoided. Impacts to this site would be confirmed during detailed design.
W15 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction.
W16 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction.
W17 — Artefact scatter	Would be impacted. Salvage by surface collection with Aboriginal stakeholders would occur prior to construction.
W18 — Artefact scatter	Would be impacted. Salvage excavation would occur prior to construction.
W19 — Artefact scatter	Would be impacted, partial impact only. The most significant portion of the site would not be impacted. No mitigation required. Barrier fencing would be erected along the construction boundary and the location of the site would be identified in the construction sensitive area map.
W20 — Artefact scatter	Would be impacted, partial impact only. The most significant portion of the site would not be impacted. No mitigation required. Barrier fencing would be erected along the construction boundary and the location of the site would be identified in the construction sensitive area map.
W21 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W22 — Artefact scatter	No impact. The location of the site would be identified in the construction sensitive area map.
W23 — Artefact scatter	Would be impacted, partial impact only. Salvage excavation required for directly impacted portion where surface disturbance is required. The remainder of the site would be conserved by installing a geofabric protective layer for the duration of the construction period. Surface artefacts would be collected prior to the installation of the geofabric protective layer. The protective layer would be removed post construction. Investigative excavation would be carried out post-construction to verify the effectiveness of conservation management.
W24 — Artefact scatter	Would be impacted, partial impact only. Salvage excavation required for directly impacted portion where surface disturbance is required. The remainder of the site would be conserved by installing a geofabric protective layer for the duration of the construction period. Surface artefacts would be collected prior to the installation of the geofabric protective layer. The protective layer would be removed post construction. Investigative excavation would be carried out post-construction to verify the effectiveness of conservation management.
W-PAD-1	No impact. The location of the site would be identified in the construction sensitive area map.
W-PAD-2	Would be impacted. Investigative excavation would occur prior to construction. If significant archaeological deposit is identified during investigative excavation, salvage excavation would occur prior to construction activities commencing at this location.

Site	Extent of impact and mitigation measures
W-PAD-3	No impact. The location of the site would be identified in the construction sensitive area map.
W-PAD-4	Would be impacted. Investigative excavation would occur prior to construction. If significant archaeological deposit is identified during investigative excavation, salvage excavation would occur prior to construction activities commencing at this location.
56-4-0249 — Scarred tree	No impact. The location of the site would be identified in the construction sensitive area map.
Place 1 — Ceremonial area	No impact. Barrier fencing would be erected around the tree element of this place, one metre from the drip line of the tree, for the duration of construction. Signage stating 'Significant Environmental Area – No Entry Permitted' would be erected for the duration of construction.
Place 2 — Gendered Ancestor figure in the landscape	No impact. No mitigation would be required.
Place 3 — Gendered ceremonial area marker	No impact. No mitigation would be required.
Place 4 — Gendered ceremonial area marker	No impact. No mitigation would be required.
Place 5 — Ancestor figure in the landscape	No impact. No mitigation would be required.

As identified in Section 6.6.3, the temporary haul road in the north of the project would result in a partial impact on three archaeological sites (W6, W9 and W10). The partial impact on these sites would result from the widening of an existing single-lane road, which connects to the existing Hume Highway. This widening is required to facilitate safe site access. Impacts on archaeological sites in this area have been minimised through the reorientation of ancillary facilities where possible. Alternate locations for the access road were considered; however, due to the large number and extent of Aboriginal archaeological sites and PADs in this area, an alternate location would likely result in more significant impacts on Aboriginal heritage.

The impacts on the archaeological significance of these sites are considered to be minor (refer Table 9-8 above and Table 4 in Technical Paper 2 (Volume 2)). No mitigation is required.

As identified in Section 6.6.1, the construction site compound in the south of the project would result in a partial impact on two archaeological sites (W23 and W24). The partial impact on these sites would result from activities requiring surface disturbance for the construction of the site compound facilities (ie installation of drainage, excavation for building footings etc). Ancillary facilities within the construction site compound have been oriented to minimise impacts as far as possible.

The direct impacts on these sites would require salvage excavation in the portion of the sites directly impacted. Where the surface would not be disturbed, the portions would be conserved by the placement of a geo-fabric protective layer over the site. The protective layer would be removed upon completion of construction. Salvage would be carried out to confirm the effectiveness of the conservation management approach (refer Table 9-8 above and Table 4 in Technical Paper 2 (Volume 2)).

Indirect impacts

The project may have some indirect impacts on archaeological and cultural sites. Aboriginal stakeholders involved in the project did not identify indirect impacts as an issue. Consultation with Aboriginal stakeholders would continue throughout the project as provided for by the CHAR.

9.2.4 Management of impacts

The route selection and environmental assessment process has, as far as possible, avoided impacts on Aboriginal archaeological and cultural heritage. Chapter 4 discusses the route selection process that was undertaken for this project, and particularly identifies that Aboriginal heritage was a key consideration in the planning and route selection.

Table 9-8 and Table 9-9 summarise the management measures to be implemented for identified archaeological and cultural sites. Further detail is provided in the CHAR (see Chapters 8 and 9 of Technical Paper 2 (Volume 2)). These measures have been incorporated into the draft statement of commitments in Chapter 11.

Table 9-9 Aboriginal heritage mitigation and management measures

Potential impact	Mitigation and management measure
<i>Pre-construction</i>	
Impacts to Aboriginal heritage	▪ Prior to the commencement of construction, prepare and implement an Aboriginal heritage management plan as part of the CEMP. ▪ Identify all archaeological sites and cultural heritage places located outside the construction site boundary on construction sensitive area maps so that these areas can be avoided during construction.
<i>Construction</i>	
Impacts to Aboriginal heritage	▪ Manage Aboriginal heritage items in accordance with the Aboriginal Cultural Heritage Assessment Report (CHAR), which identifies mitigation measures, developed in consultation with Aboriginal stakeholders and DECCW. ▪ Prior to the commencement of construction activities, fence all archaeological and cultural sites within the construction site boundary that are not to be impacted in consultation with a qualified archaeologist and/or knowledge holders. ▪ Seek to further minimise impacts on archaeological sites during detailed design, where feasible. ▪ Undertake salvage of impacted sites (where required) prior to construction commencing in those areas. ▪ Ensure all construction personnel receive training regarding Aboriginal heritage issues associated with the project.
Inadvertent impacts to identified cultural places	▪ Consult with the Aboriginal knowledge holder(s) if there are any changes to impacts on identified places.
Inadvertent impacts to identified archaeological sites	▪ Consult with the Aboriginal stakeholders if there are any changes to impacts on archaeological sites.
Potential for discovery of human skeletal materials	▪ If any skeletal remains are encountered immediately stop any works that would potentially impact the find. Do not re-commence works until appropriate clearance is received.