

Forest and woodland

Dry sclerophyll forest and woodland vegetation communities within the survey corridor are likely to have equivalent habitat value for native fauna and so are assessed together. Forests and woodlands within the survey corridor occur predominantly in the Towrang, Marulan and Paddy's River sectors (Figure 10.2). Other sections of the corridor contain small and modified patches of forest and woodland habitat.

Some areas of forest contain better quality habitat. These typically consist of: (a) native grasses with a mixture of small shrubs and forbs dominating the ground layer; and/or (b) moderate to high density of leaf litter; (c) some coarse woody debris; (d) connectivity to other areas of habitat and larger forest or woodland patches. These areas are often larger in size and contain relatively low levels of disturbance providing high quality habitat for a wide range of reptiles, frogs and mammals. Fallen hollow logs provide shelter for a range of ground-dwelling mammals and reptiles. However, forest or woodland habitats along the survey corridor are often modified, fragmented and poorly linked to other areas.

Forests and woodlands in the Goulburn and Murray's Flat sectors are generally intact and maintain relatively reasonable structural diversity. Tree cover in wooded areas on the western side of the Goulburn township is fragmented and of low to moderate density. Hollow-bearing trees are sparse along the majority of the survey corridor within this section. A higher abundance of hollow-bearing trees occur in forest north of Sydney Road. Mid-canopy and ground layer vegetation is of low to moderate density and comprises low grasses and some scattered low forbs and shrubs. This area supports woodland birds such as the Mistletoe Bird (*Dicaeum hirundinaceum*), Red Wattlebird (*Anthochaera carunculata*) and Grey Fantail (*Rhipidura albiscapa*).

The overstorey of forests within the Towrang section contains a range of different tree sizes and ages, though many areas predominantly consist of juvenile and/or sub-adult trees. Mid-canopy trees and shrubs are generally of low to moderate density. Ground vegetation cover is typically a mix of low to moderate density of exotic and native grasses, occasional shrubs and leaf litter. The moderately dense forest canopy provides foraging and breeding habitat for a wide range of woodland birds and arboreal mammals. Mature, fibrous barked trees such as *Eucalyptus cinerea* and *E. macrorhyncha* provide foraging resources for bark-foraging species such as the Brown Treecreeper (*Certhia familiaris* - threatened under the TSC Act), White-throated Treecreeper (*Cormobates leucophaea*) and Varied Sittella (*Daphoenositta chrysoptera*). All of these species were recorded during the field surveys.

On the slopes in the drier sclerophyll forests of the Marulan area, stringybark species such as the prevalent Red Stringybark (*Eucalyptus macrorhyncha*), are nectar-bearing and are likely to provide a food resource for native fauna including birds such as the Red Wattlebird (*Anthochaera carunculata*) and Yellow-faced Honeyeater (*Lichenostomus chrysops* - observed in the survey corridor) as well as other nectar feeding birds and arboreal mammals. These stringybark *Eucalyptus* species are autumn and winter-flowering and may provide seasonal nectar resources for the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia*) also.



Local populations of Gang-Gang Cockatoos (*Callocephalon fimbriatum*) have been recorded to feed on stringybark flowers and fruits during their annual winter feeding migrations (URS, 2008).

Acacia regrowth in some areas along the existing easement is important for a range of forest birds and marsupials such as the Sugar Glider (*Petaurus breviceps*) and potentially the Squirrel Glider (*Petaurus norfolcensis*), as it provides valuable shelter, nectar and sap to local wildlife. Noisy Miners were observed to be nesting in the *Acacia* regrowth along the edge of the existing easement also.

The understorey is moderately to highly disturbed and provides limited habitat value for fauna. Low to moderate densities of exotic and native grasses and forbs limit feeding opportunities for many woodland fauna species, and those requiring dense undergrowth for nesting and foraging, such as the Superb Fairy Wren (*Malurus cyaneus*) and Diamond Firetail (*Stagonopleura guttata*), are less likely to occur.

Coarse woody debris and leaf litter were generally of low to moderate density along the survey corridor, providing limited habitat for small mammals, reptiles and frogs. Several areas containing higher densities of leaf litter and fallen timber are likely to support a diverse invertebrate assemblage and in turn provide good quality foraging and sheltering habitat for a wide range of birds, reptiles, frogs and small mammals.

The combination of several relatively large areas of intact vegetation, some moderately large hollow-bearing trees, a moderately diverse structure and some vegetated drainage lines in the Marulan and Paddy's River sectors suggests that the survey corridor is likely to provide foraging habitat for large forest owls, such as the Powerful Owl (*Ninox strenua*) and the Masked Owl (*Tyto novaehollandiae*).

Forests and woodlands within the Sutton Forest-Exeter, Werai-Moss Vale, and Glenquarry sections of the pipeline corridor contained relatively degraded and unstructured communities. The forest and woodland areas comprised a dominant overstorey of *Eucalyptus* species over a highly disturbed grass layer. The canopy potentially contains several features representative of good-quality habitat (i.e. hollows) for many fauna species, however, the often small size of these unstructured forest/ woodland areas, their fragmented and isolated position and simple vegetation structures limit these areas as being high value habitat. These disturbed forest/ woodland areas support several disturbance-tolerant species such as Magpies (*Pica pica*) and Noisy Miners (*Manorina melanocephala*). Exotic species such as Rabbits (**Oryctolagus cuniculus*) and Foxes (**Vulpes vulpes*) were abundant in these patches also.

Forest (planted)

One patch of exotic plantation forest occurred in the Marulan section (Figure 10.2). Other exotic trees and shrubs occurred throughout the survey corridor. Some of these comprised small patches, while numerous scattered and isolated single trees exist. In general, this habitat type contains relatively little value for many fauna species; however they may be used to a limited extent by adaptable species for foraging and shelter.



Acacia scrub (Shrubland)

Acacia scrub is a regrowth community and does not contain mature habitat trees. It occurs in several patches along the edge of the existing easement that traverses forest habitat (Figure 10.2). Structural diversity within the community is limited; however, most patches occur in close proximity to *Eucalyptus* Woodland and Forest. Acacia regrowth in some areas along the existing easement is important for a range of forest birds and marsupials such as the Sugar Glider (*Petaurus breviceps*) and potentially the Squirrel Glider (*Petaurus norfolcensis*), as it provides valuable shelter, nectar and sap to local wildlife. Noisy Miners were observed to be nesting in the Acacia regrowth along the edge of the existing easement also.

Grassland

Areas of grassland within the survey corridor are shown in Figure 10.2 and comprise mainly exotic grass species within grazing land. Exotic grassland is a secondary, or derived, vegetation community with the original shrub and grass species replaced with pasture grasses. It may support a lower abundance and diversity of native fauna than in its natural state. Cleared grassland provides good quality foraging habitat for larger native mammals and many native bird species, but marginal shelter and foraging habitat for native reptiles and small terrestrial mammals. These areas are likely to be utilised by open country birds, such as the Eastern Rosella (*Platycercus eximius*), Red-rumped Parrot (*Psephotus haematonotus*), Wedge-tailed Eagle (*Aquila audax*) and Australian Magpie (*Cracticus tibicen*), and mammals including the Eastern Grey Kangaroo (*Macropus giganteus*) and Common Wombat (*Vombatus ursinus*). These species are generally widespread and common. Threatened fauna may occasionally forage in grazing land; however, this community is unlikely to contain important resources for these species. Grassland within the survey corridor is predominantly exotic pasture.

Native grassland present within the survey corridor has the potential to provide important foraging habitat for many native bird species, particularly finches and parrots. Native grasses provide a more valuable food resource, over exotic pasture for many native birds including threatened species such as Diamond Firetail (*Stagonopleura guttata*) and Turquoise Parrot (*Neophema pulchella*). This community is in close proximity to intact woodland and may provide foraging habitat for threatened shelter-dependent bird species such as the Speckled Warbler (*Pyrrholaemus sagittatus*) and Brown Treecreeper (*Climacteris picumnus*).

Less intensely grazed portions of the survey corridor contain good growth of native tussock grasses. These areas also contain some limited quantities of fallen timber and rock fragments and may support the Striped Legless Lizard (*Delma impar*) or the Pink-tailed Worm-lizard (*Aprasia parapulchella*).

Aquatic

Creek crossings/riparian habitats

The proposed pipeline route crosses numerous creeks, streams and rivers. At the time of the ecological surveys conducted as part of the current investigation, the majority of these waterways did not contain water. The majority of drainage lines within the survey corridor are in poor condition and provide little habitat for fauna. Many are eroded and contain little riparian



vegetation and a variety of exotic grasses and forbs. They are ephemeral, channel confined streams which would form a chain of shallow ponds after heavy rain.

A total of 138 waterway crossings have been classified along the pipeline route, of which 12 are classified as Major Creeks/Rivers, eight as Moderate Creeks, 25 as Minor Creeks and 93 as Drainage Lines which are all unnamed. A summary of the aquatic and riparian habitats recorded at major waterway crossings along the survey corridor is provided in Appendix E. Areas mapped as 'Riparian scrub' habitat are shown in Figure 10.2.

The Wollondilly and Paddy's Rivers traverse the survey corridor on six occasions. These rivers are expected to flow at most times of the year and would support a diverse aquatic ecological community (e.g. aquatic vegetation, submerged and emergent woody debris) and a range of waterbirds, frogs and reptiles. A number of waterbirds (e.g. Australian Wood Duck, Dusky Moorhen) were observed in the vicinity of these crossings. Others would be expected, including additional ducks and water hens, cormorants and kingfishers. Reptiles, such as turtles, and frogs would also be expected to occur in these rivers. The existing easement has altered the riparian vegetation at these crossings and decreased the amount and quality of riparian habitat present. The majority of vegetation at these crossings comprises exotic species.

All moderate creeks, minor creeks and drainage lines across the survey corridor are in poor condition and provide little habitat for fauna. Many are eroded and contain little riparian vegetation and a variety of exotic grasses and forbs. They are ephemeral, channel confined streams which would form a chain of shallow ponds after heavy rain. Accordingly, they are unlikely to support shelter-dependant wetland birds.

Farms dams/wetlands

Several farm dams were recorded within the survey corridor and contain permanent or near-permanent water in areas of cleared grassland that would provide important refuges and breeding habitat for native frogs, as well as fish, crustaceans and aquatic invertebrates. They would provide foraging habitat for some microbat species. Dams provide nocturnal refuge and foraging habitat for waterfowl including the recorded Pacific Black Duck (*Anas superciliosa*) and Australian Grebe (*Tachybaptus novaehollandiae*). They contain limited cover of aquatic and semi-aquatic vegetation and are surrounded by cleared grassland. Accordingly, they are unlikely to support shelter-dependant threatened wetland birds such as the Australian Painted Snipe (*Rostratula australis*) and Australasian Bittern (*Botaurus poiciloptilus*).

The survey corridor is also unlikely to support the open water species Blue-billed Duck (*Oxyura australis*) and Freckled Duck (*Stictonetta naevosa*) as suitable habitat for these species (i.e. large, permanent wetlands with dense fringing vegetation) is not present.

Several other small waterbodies provide permanent foraging and shelter resources for a range of frogs and small mammals, including microbats. One small (approximately 1 ha) wetland was observed north-east of the Goulburn township on Kenmore Creek. This wetland contains a mixture of native and exotic grasses and low forbs. Tree species include the exotic willow (**Salix* spp.) and White Poplar (**Populus alba*). Several frog species were observed calling and the wetland contains suitable habitat for a range of other frog and reptile species. The proposed pipeline alignment passes immediately adjacent to this wetland and the construction corridor



would likely intersect the wetland. It is proposed to deviate the proposed pipeline at this location during the detailed design phase to avoid impacts on the wetland.

Two wetlands listed in the Directory of Important Wetlands in Australia occur within 10 km of the proposed pipeline corridor. These include the Wingecarribee Swamp and Hanging Rock Swamp. The Wingecarribee Swamp lies upstream of the Wingecarribee Reservoir, approximately 5 km southeast of the eastern end of the pipeline corridor. The Hanging Rock Swamp is located upstream along Paddy's River to the south of the Hume Highway near Hanging Rock Road in the Paddy's River sector.

EECs relating to upland or hanging swamps, including the EPBC Act listed Temperate Highland Peat Swamps on Sandstone EEC (represented at Wingecarribee Swamp), and the TSC Act listed Montane Peatlands and Swamps EEC, are both present within the locality. However, none of the wetlands recorded within the survey corridor constitute upland swamps or hanging swamps. Hence, these EECs are not present within the survey corridor.

No wetlands of International Significance (Ramsar Sites) were revealed within a 10 km buffer of the survey corridor in an EPBC Protected Matters Database search.

Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) fall into two main categories: those dependent on surface expression of groundwater (e.g. wetlands, swamps) and those that rely on subsurface water within the rooting depth of vegetation (e.g. riparian forests, arid zone ecosystems) (Eamus 2009).

The desktop review identified a range of sites where GDEs might occur within the survey corridor. These include all riparian and aquatic vegetation present at creek crossings and wetlands (see Figure 10.1). Other GDEs identified as potentially occurring within the locality include areas of upland swamps (or 'hanging swamps') or peatlands. The EPBC Act listed Temperate Highland Peat Swamps on Sandstone EEC, represented at Wingecarribee Swamp, and the TSC Act listed Montane Peatlands and Swamps EEC are both present within the locality. However, neither of these communities was recorded within the survey corridor and no evidence of upland swamps or hanging swamps was recorded within the survey corridor.

Regional Biodiversity Corridors

Parts of the proposed pipeline route cross through two regional biodiversity corridors mapped by Hawkesbury Nepean CMA (2005). The vegetated corridors crossed by the pipeline are the Abercrombie River to Morton National Park corridor around the Murrays Flats and Nattery Hill areas towards the western end of the pipeline, and the Bargo to Morton National Park corridor around the Penrose State Forest within the eastern section of the pipeline (Ecological Australia 2009).

The Abercrombie River to Morton NP corridor connects the highland communities of the Blue Mountains with those in Morton NP. It contains an east west altitudinal and rainfall gradient that connects dry forests and woodlands and escarpment moist forests between the South-western Slopes and Southern Highlands. This Corridor falls within the Abercrombie to Blue Mountains



Regional Pathway, and the Southern Highlands Regional Pathway, providing a connection between the two (DECC 2007).

The Bargo to Morton NP corridor connects the Nattai Sandstone landscape and Bargo area with the sandstone country of Morton NP. This corridor also falls within the Southern Highlands Regional Pathway (DECC 2007).

10.2.6 Other habitat resources

The DEC (2004) guidelines identify “special habitats” (e.g. tree hollows, water bodies, rocky outcrops and cliffs) that are likely to support specific fauna assemblages. These resources may be significant for threatened species (DECC, 2008b). Special habitats recorded during the current investigations include hollow-bearing (habitat) trees, rock outcrops and termite mounds. The locations of these resources are shown in Figure 10.2.

Hollow-bearing trees

The density of hollow-bearing trees within the survey corridor was classified as low (0-2.5 trees/ha), medium (3-10.5 trees/ha) or high (11-15 trees/ha) based on field observations at survey sites. The total area of each density class was calculated in GIS and multiplied by the number of trees per hectare to provide an estimate of the total number of hollow-bearing trees within the survey corridor. The results are presented in Table 10.4.

Table 10.4 Estimates of Hollow-bearing Trees within the 400m survey corridor

Density Class	HBT (Treated Pipeline)		HBT (Raw Pipeline)	
	<i>Hectares</i>	<i>Estimated number of trees</i>	<i>Hectares</i>	<i>Estimated number of trees</i>
Low (0-2.5 trees/ha)	2287.00	0 - 5718	2666.60	0-6667
Medium (3-10.5 trees/ha)	390.52	1172 - 4100	315.71	947-3315
High (11-15 trees/ha)	243.33	2677 - 3650	243.33	2677 - 3650
Total Survey Corridor	2920.85	3849 - 13468	3225.64	3624 - 13632

The results in Table 10.4 support field observations that most of the pipeline route contains low densities of hollow-bearing trees. Of the total survey corridor (2920.85 ha) for the treated water pipeline, 2287 ha has been classed as low density, which represents 78% of the survey corridor. The spatial variability of hollow-bearing trees is such that anywhere between 3849 and 13468 hollow-bearing trees could be present within the survey corridor for the treated water pipeline (Table 10.4). A similar number of hollow-bearing trees has been estimated for the raw water pipeline (Table 10.4).

The majority of hollow-bearing (habitat) trees were recorded within forest and woodland habitats within the survey corridor, although there are also widely scattered large hollow-bearing paddock



trees recorded within grazed pasture. Overall the survey corridor is likely to contain limited quantities of these resources to support local populations of many hollow-dependant fauna.

Habitat trees are mostly absent from the eastern sections of the proposed pipeline corridor (i.e. Glenquary, Werai, Moss Vale, Sutton Forest, Exeter). The Paddy's River and Marulan sections contain several significant patches of forest containing habitat trees. The combination of these trees, a complex vegetation structure and the presence of other key habitat features (e.g. rocky outcrops or termite mounds) indicate potentially important habitat for threatened fauna. These areas provide food, shelter and breeding resources for both predators and prey. Forest along the western section of the corridor (Towrang, Murray's Flat and Goulburn) typically contains no or low densities of habitat trees.

The hollow-bearing trees observed within the survey corridor may provide suitable diurnal roost sites for tree-roosting microbats, including the threatened Eastern Freetail Bat (*Mormopterus norfolkensis*), Little Bent-wing Bat (*Miniopterus australis*) and Eastern Bent-wing Bat (*Miniopterus schreibersii*). They are also likely to support native parrots, including the Sulphur-crested Cockatoo (*Cacatua galerita*), Yellow-tailed Black-cockatoo (*Calyptorhynchus funereus*) and threatened species such as the Gang-gang Cockatoo, Glossy Black-cockatoo and Powerful Owl (*Ninox strenua*). Few tree hollows suitable for owls were observed along the proposed pipeline corridor.

The survey corridor contains reasonable amounts of standing and fallen dead timber which would provide shelter and foraging resources for native invertebrates, reptiles and small terrestrial mammals.

Rock outcrops

Rocky outcrops were present within forest areas in the eastern end of the Paddy's River section of the pipeline route. These outcrops contain some large boulders and fragments. These areas may be used as potential den sites by the Spotted-tailed Quoll (*Dasyurus maculatus*, listed as Threatened). No areas of fissures or overhangs were observed; however diurnal roost sites for microbats may exist. No caves large or sheltered enough were located to provide suitable sites for maternity colonies.

There were no other large rock outcrops or substantial amounts of rock fragments observed in the survey corridor. There were moderate amounts of small conglomerate fragments which would provide good shelter for small native vertebrates. Lower slopes contain small areas of granitic rock outcrops, with moderate quantities of rock fragments. This may provide marginal shelter and foraging habitat for pink-tailed worm lizard (*Aprasia parapulchella*); however, the survey corridor does not contain large amounts of schist or other platy rock fragments that provide optimum habitat for the species (DECC, 2008b).

Termite mounds

Termite mounds are an important food, shelter and breeding resource for a wide range of fauna. Termites themselves are a crucial source of food and their mounds provide shelter for birds, mammals and reptiles, including the threatened Rosenberg's Goanna (*Varanus rosenbergi*). This species of goanna utilises termite mounds for nesting. The survey corridor generally contained low to moderate quantities of termite mounds, with the majority occurring in relatively undisturbed



native vegetation in the Paddy's River sector (see Figure 10.2). Termite mounds are mostly absent from the eastern sectors of the proposed pipeline corridor (i.e. Glenquary, Weraï, Moss Vale, Sutton Forest, Exeter), as shown in Figure 10.2.

10.2.7 Fauna species

The field surveys recorded a total of 139 species, including eight species of frogs, five reptiles, 98 birds and 28 mammals (including microchiropteran bats). The full list of fauna species recorded during field surveys is provided in Appendix E.

Birds

There was a moderate diversity of native birds within the survey corridor. These included species from a range of guilds (i.e. species with different niches or lifestyles) which suggests the survey corridor and surrounds provides diverse and potentially important habitat for native birds (Keast *et al.*, 1985).

Mammals

Native mammals observed included the common and widespread Eastern Grey Kangaroo (*Macropus giganteus*), Common Wombat (*Vombatus ursinus*), Common Brushtail Possum (*Trichosurus vulpecular*) and Common Ringtail Possum (*Pseudocheirus peregrinus*) in woodland and grassland across the survey corridor. Red-necked Wallabies (*Macropus rufogriseus*) were observed in steeper country with intact forest and rock outcrops. Sugar Gliders (*Petaurus breviceps*) were noted feeding on *Eucalyptus* blossoms. Exotic species included the European rabbit (**Oryctolagus cuniculus*), European Hare (**Lepus europeaus*) and the Red Fox (**Vulpes vulpes*).

Reptiles

Diurnal reptiles were relatively sparse, most likely reflecting the level of survey effort undertaken but also the disturbed and open nature of much of construction corridor. A single Three-toed Skink (*Hemiergis decresiensis*) was recorded and a number of Jacky Lizards (*Amphibolurus muricatus*) were observed in stringybark and gum forests.

Frogs

A moderate diversity and abundance of frogs were recorded within the survey corridor. Common Eastern Froglets (*Crinia signifera*) were abundant and calling in permanent open wetlands and ephemeral drainage lines and ponds across the survey corridor. Whistling Tree Frogs (*Litoria verreauxii*) and Spotted Marsh Frogs (*Limnodynastes tasmaniensis*) were observed sheltering beneath rocks and woody debris in grassland and woodland. Beeping Toadlets (*Crinia parinsignifera*) and Perons' Tree Frog (*Litoria peroni*) were heard calling from farm dams.

Microchiropteran bats

A total of 10 microchiropteran bat species ('microbats') were identified as a result of Anabat call analyses. It is likely that, given high levels of bat activity recorded during the field surveys, that additional species would occur within the survey corridor, including threatened species.



Exotic species

The predatory Red Fox was sighted numerous times within the survey corridor. It is expected that the Cat (**Felis catus*) would also occupy the survey corridor. A significant proportion of the survey corridor is agricultural land and stocked with sheep and domestic cattle. Moderate numbers of Rabbits (**Oryctolagus cuniculus*) were noted. These species may compete with native herbivores and suppress growth of palatable native herbs and grasses.

Soil pathogens

Phytophthora cinnamomi ('Phytophthora') is a soil borne pathogen that spreads in plant roots in warm, moist conditions. Phytophthora infects a large range of species resulting in a range of symptoms including reduced health or plant death, though some plants show no apparent symptoms. Phytophthora may contribute to plant death when plant health is exacerbated by other stresses (e.g. waterlogging, drought, and wildfire) (DEC 2005).

Phytophthora may occur in areas with an annual rainfall greater than 600 mm (McDougall and Summerell, 2003). Mean annual rainfall ranges from 965.3 to 635.7mm between Moss Vale and Goulburn. Hence, Phytophthora could be present within the locality based on broad climatic factors. However, no direct observations of Phytophthora dieback were observed within the survey corridor as part of the current study.

10.2.8 Threatened flora species

Database search results indicate that 47 threatened plant species have been previously recorded or are predicted to occur within the locality. Of these, 27 threatened species are assessed as likely to occur within the survey corridor, based on their habitat requirements, their known distributions and the habitats present. The full assessment of likelihood of occurrence of threatened species (within the survey corridor) is provided in Appendix E.

Two threatened plant species were recorded during the current surveys:

- ▶ Camden Woollybutt (*Eucalyptus macarthurii*), listed as a vulnerable species under the TSC Act; and
- ▶ Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) listed as endangered under the EPBC Act.

The locations of these species are shown in Figure 10.3.

Camden Woollybutt was recorded at a number of locations during targeted flora surveys, with the largest populations occurring in the Paddys River, Moss Vale-Werai and Glenquarry areas. It occurs as a canopy component of the River Peppermint - Narrow-leaved Peppermint open forest vegetation community and as small stands and isolated individuals within grazed pasture grass. Other stands occur along the Illawarra Highway and Iona Park Road, primarily isolated individuals or small degraded stands of semi mature and mature trees.

Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) listed as endangered under the EPBC Act, was recorded on the edge of Inland Scribbly Gum – Brittle Gum low woodland vegetation. A small number of individuals were recorded within vegetation occurring adjacent to the proposed raw water pipeline route behind an existing structure at the Goulburn water treatment plant. This



species was not recorded within the proposed pipeline construction corridor at this location, and was not recorded at any other site along the proposed pipeline route.

No other threatened species were recorded during targeted surveys; however suitable habitat for a number of listed species does occur within sections of the proposed route containing intact remnant vegetation, riparian and swampy areas and some areas of grassland not exposed to on-going disturbance such as grazing, clearing or heavy weed infestation.

10.2.9 Endangered Ecological Communities

Three endangered ecological communities (EEC's) listed under the TSC Act were recorded during the field surveys. However only one EEC, Southern Highlands Shale Woodlands, was recorded within the survey corridor and within the proposed construction corridor. Robertson Basalt Tall Open-forest, also listed as endangered under the TSC Act, was recorded immediately adjacent to the survey corridor, but did not occur within the construction corridor. White Box Yellow Box Blakely's Red Gum Woodland, listed as endangered under the TSC Act and critically endangered under the EPBC Act, was recorded within the Marulan area outside of the study corridor.

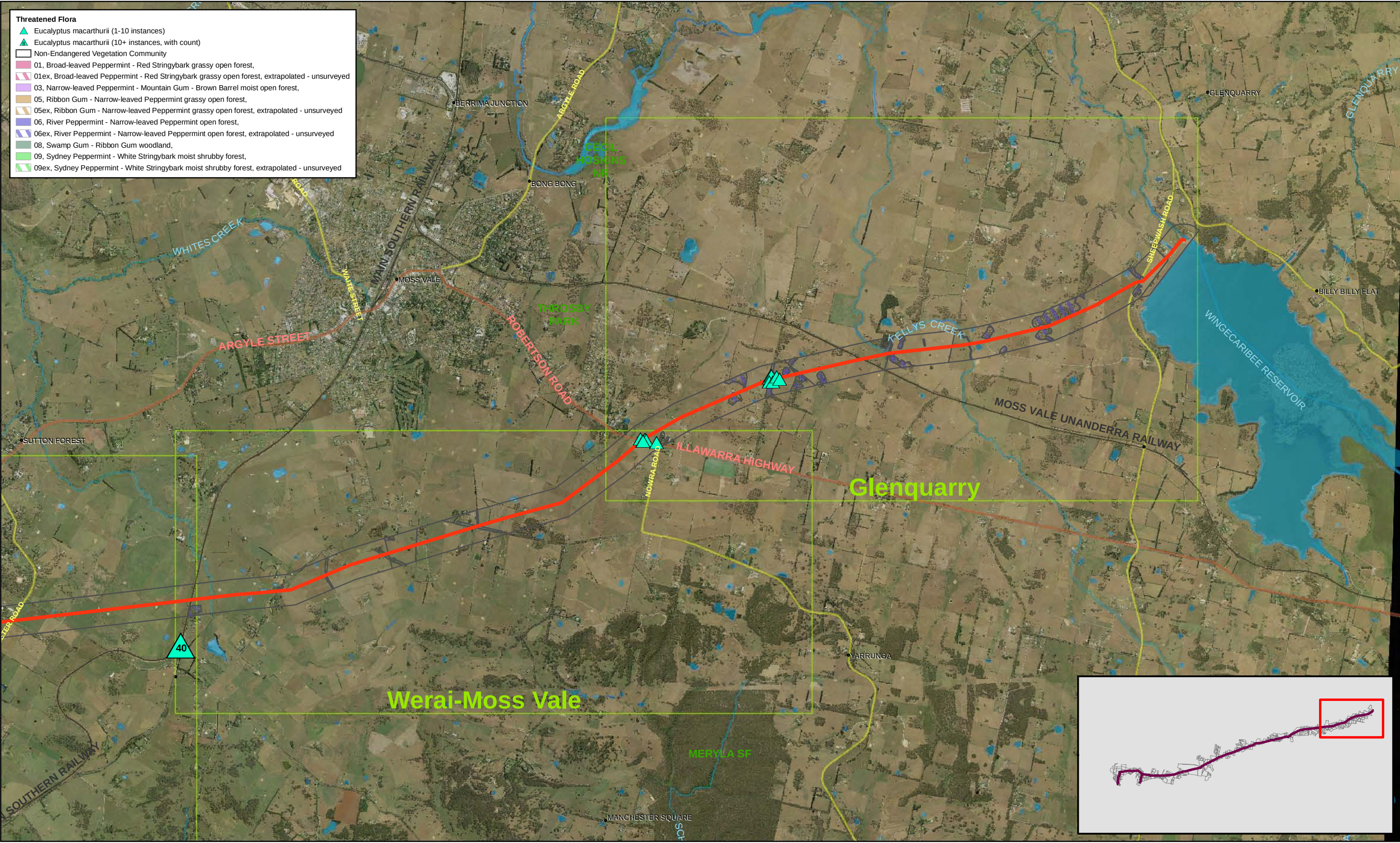
The mapped extents of these communities within the survey corridor are summarised in Table 10.5 and mapped in Figure 10.3. A total of 314.02 ha of Southern Highlands Shale Woodlands has been mapped within the survey corridor, whereas only 0.49 ha of Robertson Basalt Tall Open-forest is present within the survey corridor.

Table 10.5 Area of EEC mapped within 400m survey corridor (in hectares)

Pipeline Sector	EEC	Mapped Area of EEC within 400m corridor
Glenquarry	Southern Highlands Shale Woodlands	32.27
Werai – Moss Vale	Southern Highlands Shale Woodlands	3.46
	Robertson basalt Tall Open-forest	0.49
Sutton Forest – Exeter	Southern Highlands Shale Woodlands	30.69
Paddy's River	Southern Highlands Shale Woodlands	145.60
Marulan	Southern Highlands Shale Woodlands	102.00
Towrang	Southern Highlands Shale Woodlands	0
Goulburn – Murray's Flat	Southern Highlands Shale Woodlands	0



Pipeline Sector	EEC	Mapped Area of EEC within 400m corridor
Total		314.51



1:45,000 (at A3)

0 500 1,000 1,500 2,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Legend

Proposed Pipeline Alignment

- (Raw Water)
- - (Treated Water)
- Sector boundary

Primary Road

Arterial Road

Railway

Lakes, Dams

Rivers, Creeks

Local Government Area

GHD

CLIENTS | PEOPLE | PERFORMANCE

Goulburn Mulwaree Council

GOULBURN MULWAREE COUNCIL

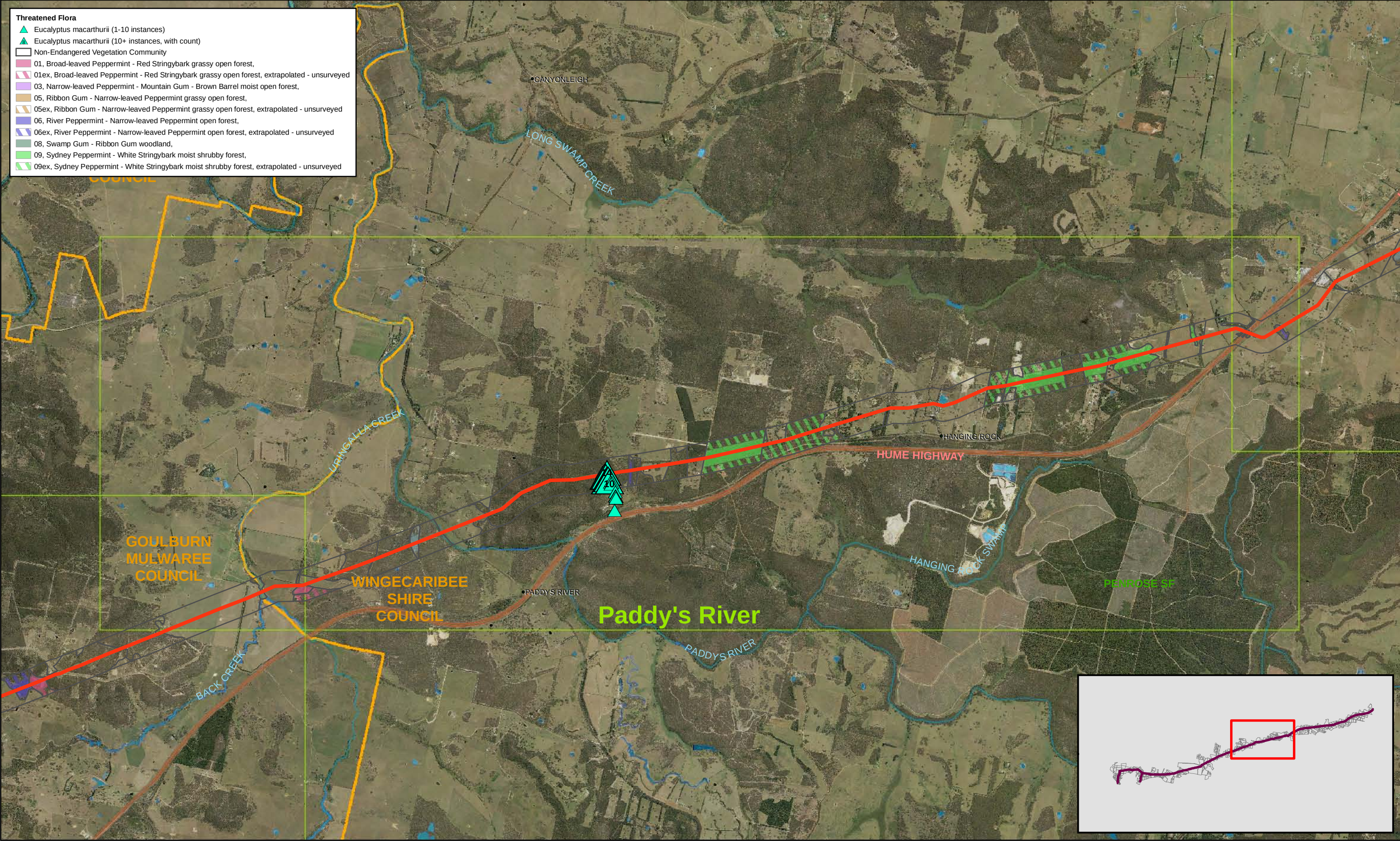
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Highlands Source Project

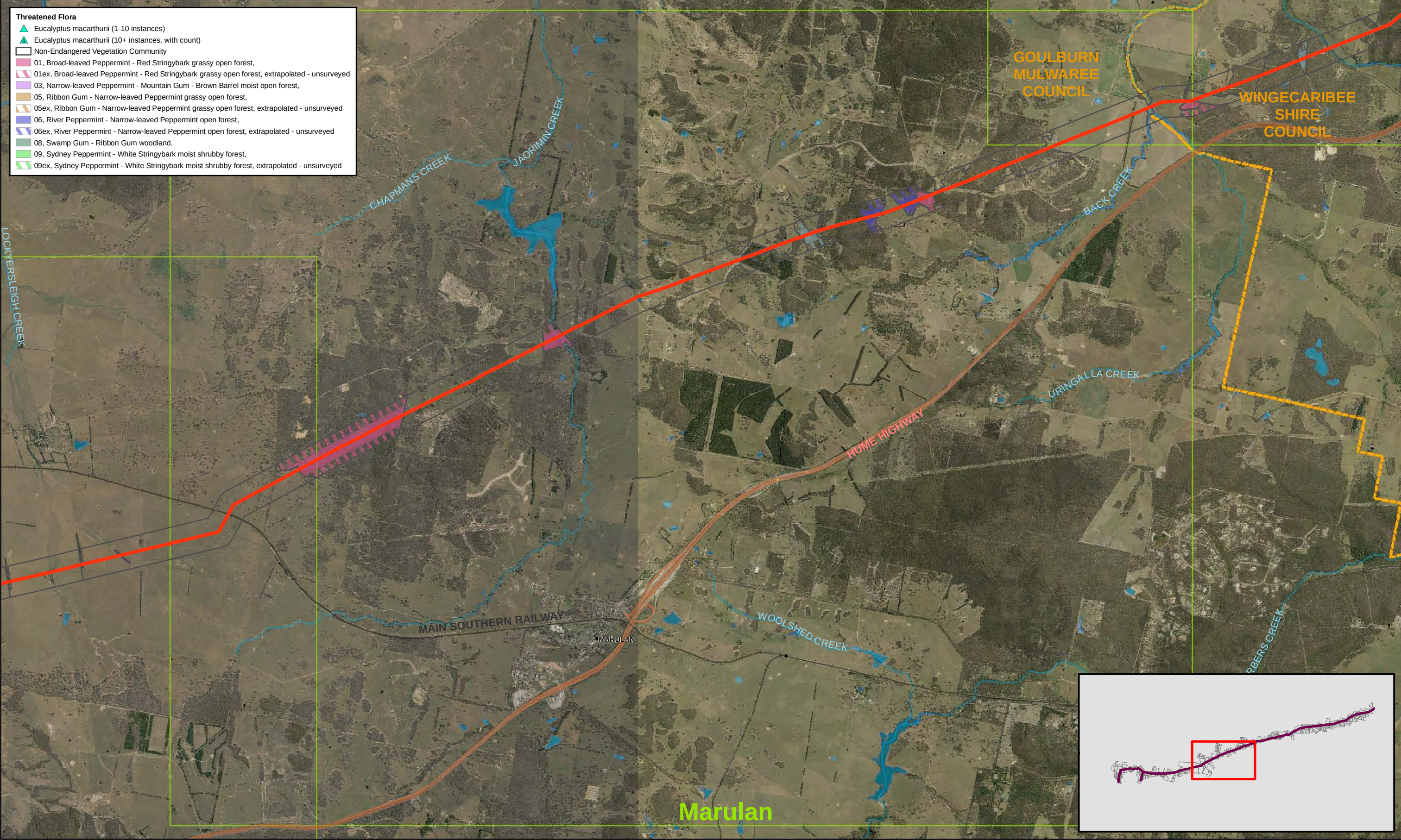
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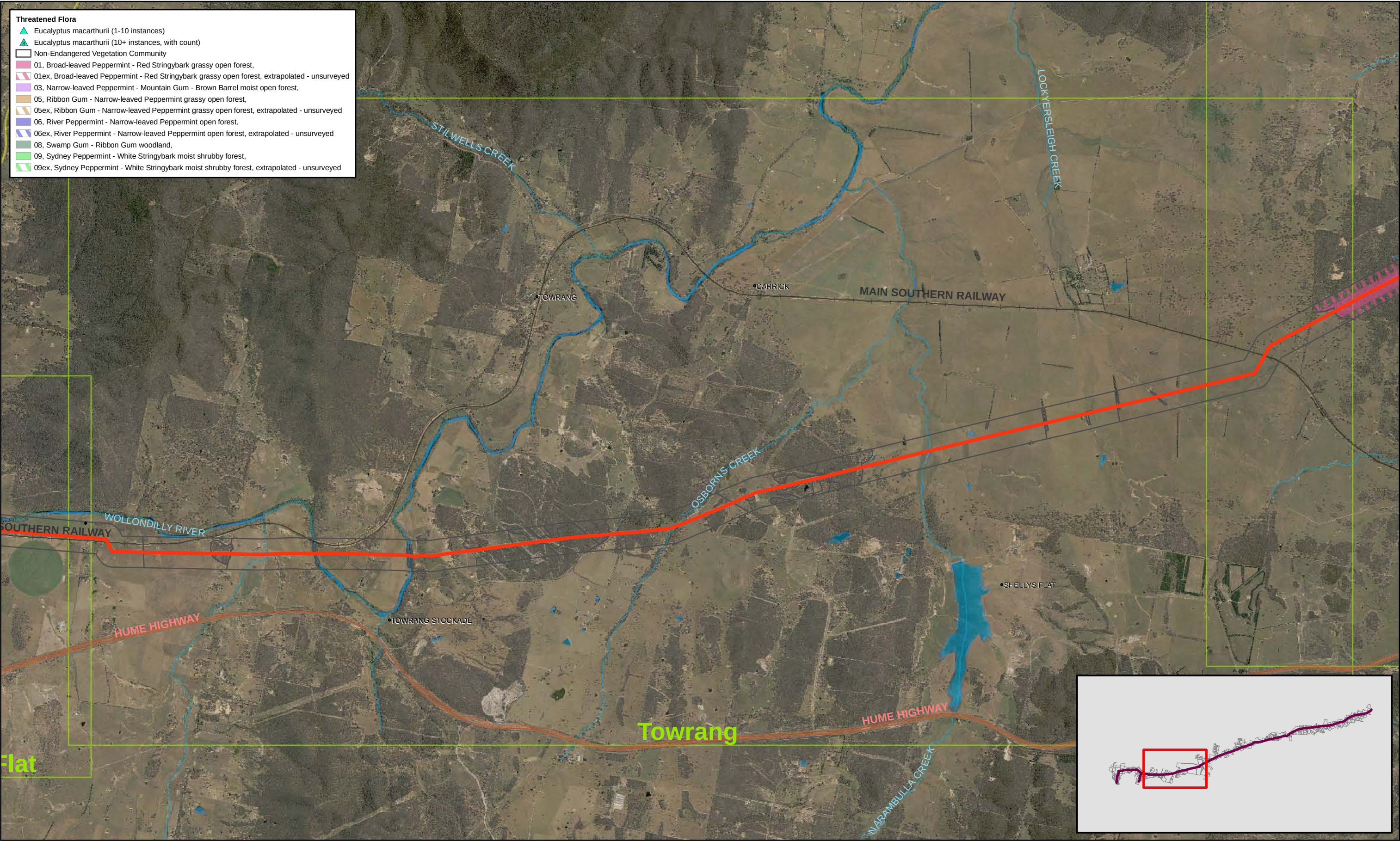
**Threatened Flora
(EECs and Threatened Species)
Sector: Werai - Glenquarry**

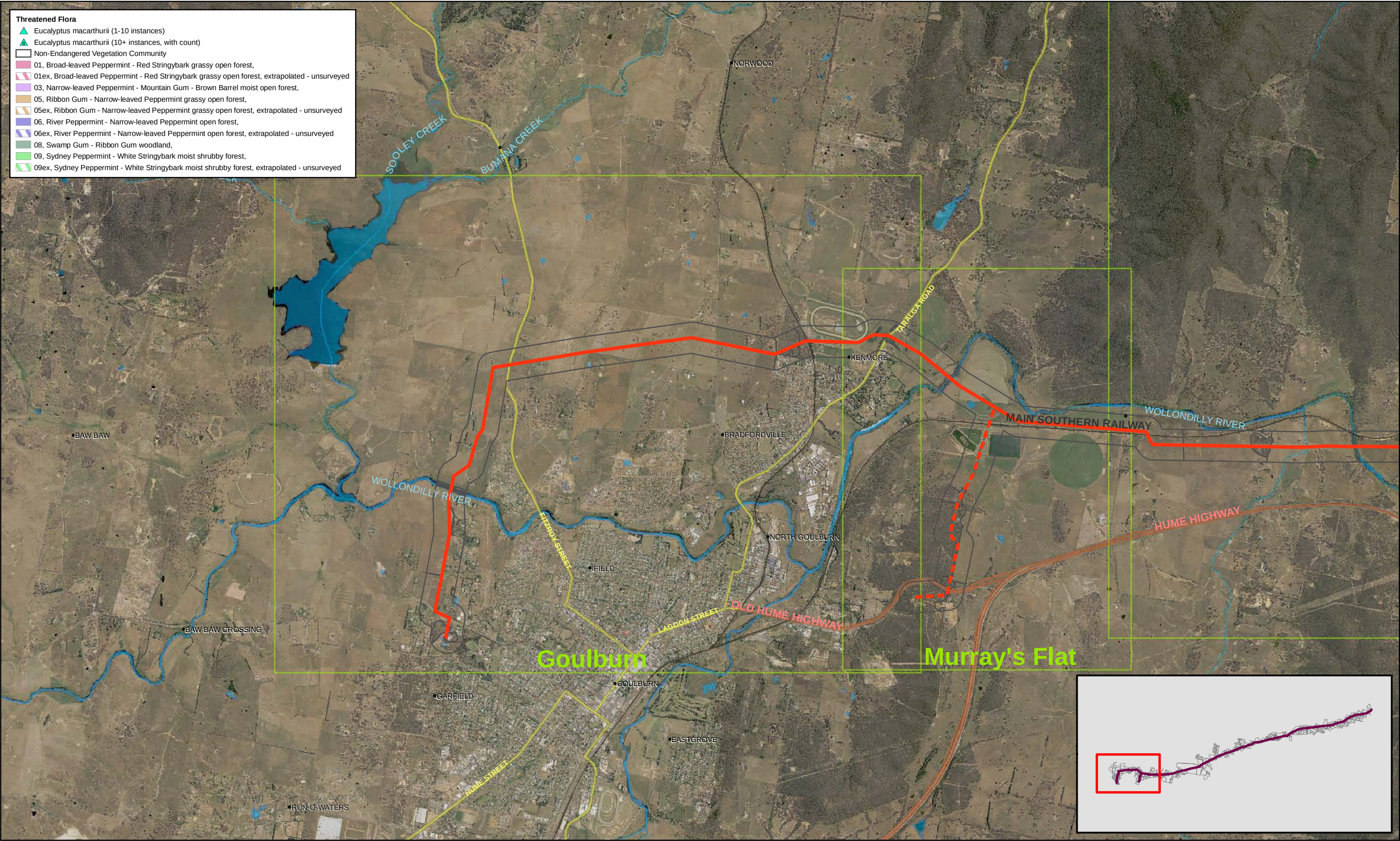
Figure 10.3a











10.2.10 Threatened fauna species

Terrestrial threatened fauna

Six threatened fauna species were observed during the field surveys, as follows:

- ▶ Gang-gang Cockatoo (*Callocephalon fimbriatum*) – (Vulnerable TSC Act). The Gang-gang Cockatoo was heard in the Marulan section of the corridor close to Red Hills Road. No sighting occurred;
- ▶ Glossy Black-cockatoo (*Calyptorhynchus lathami*) – (Vulnerable TSC Act). Two individuals of the Glossy Black-cockatoo were observed flying over the proposed pipeline corridor in the Towrang section close to Carrick Road. They were not utilising the habitats within the corridor at the time of sighting;
- ▶ Brown Treecreeper (*Climacteris picumnus victoriae*) – (Vulnerable TSC Act). The Brown Treecreeper (two individuals) was observed foraging in the Marulan section of the proposed pipeline corridor close to Red Hills Road;
- ▶ Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) – (Vulnerable TSC Act). The Eastern Bentwing Bat was recorded via Anabat analysis along Jaorimin Creek (Marulan sector) and in the Towrang sector between Rampion Hills Road and Osborns Creek. The species is a cave-dweller and can forage long distances from the roost site;
- ▶ Large-footed Myotis (*Myotis macropus*) – (Vulnerable TSC Act). The Large-footed Myotis was recorded via Anabat analysis in the Goulburn section of the proposed pipeline near to the Old Hume Highway; and
- ▶ Eastern Falsistrellus (*Falsistrellus tasmaniensis*) – (Vulnerable TSC Act). The Eastern Falsistrellus was also recorded via Anabat analysis in the Goulburn section of the proposed pipeline corridor near to the Old Hume Highway.

Two species that are under a preliminary listing (TSC Act) were also recorded. These were the Scarlet Robin (*Petroica boodang*) and Varied Sitella (*Daphoenositta chrysoptera*). The Scarlet Robin was recorded in the Towrang section between Rampion Hills Road and Osborns Creek. The Varied Sitella was recorded in three locations along the proposed pipeline corridor: Goulburn (to the north of the Old Hume Highway), Towrang (between the Wollondilly River and Carrick Road) and Paddy's River (about 500 m east of where the proposed pipeline crosses Uringalla Creek).

The locations of threatened fauna records from field surveys are shown in Figure 10.2.

The preliminary environment assessment and subsequent field habitat assessments indicate the potential presence of a further 26 threatened fauna species listed under the TSC Act and/or EBPC Act. The full list of threatened fauna, including their conservation status, habitat requirements, previous records and likelihood of occurrence is presented in Appendix E. A review of the specific habitat requirements of these species, and the habitat present within the survey corridor allowed a number of these species to be eliminated as having low likelihood of occurrence ('unlikely') along the proposed pipeline route.



A total of seven further threatened species, not recorded during field surveys, were considered to have a high likelihood of occurrence within the survey corridor based on the presence of suitable foraging and roosting habitat and recent records in the local area. A further 18 species may utilise habitats within the survey corridor on an occasional or opportunistic basis (see Appendix E).

Aquatic threatened fauna

A desktop search of aquatic biota listed under the FM Act, TSC Act and EPBC Act revealed that, based on their known distributional ranges, the following threatened freshwater species could occur within the locality:

- ▶ Macquarie Perch (*Macquaria australasica*);
- ▶ Australian Grayling (*Prototroctes maraena*); and
- ▶ Giant Dragonfly (*Petolura gigantea*).

An assessment of their preferred habitats, combined with their current known distributions, revealed that both species of fish (Macquarie Perch and Australian Grayling) are unlikely to occur within the survey corridor. However, the one species of aquatic invertebrate, the Giant Dragonfly is assessed as potentially occurring within the survey corridor (see Appendix E), within freshwater wetlands and swamps.

10.2.11 Threatening processes

A 'key threatening process' (KTP) is defined under the TSC Act as 'a threatening process specified in Schedule 3' of the Act. A 'threatening process' is defined as 'a process that threatens, or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities'.

The following KTPs are known or anticipated to be currently operating within the survey corridor:

- ▶ Predation by the Red Fox (*Vulpes vulpes*);
- ▶ The degradation of native riparian vegetation along New South Wales water courses;
- ▶ Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) and European Hare (*Lepus europeus*); and
- ▶ Invasion of native plant communities by exotic perennial grasses.

The following KTPs would have operated previously, given the modified vegetation communities present within the survey corridor:

- ▶ Clearing of native vegetation;
- ▶ Loss of hollow-bearing trees; and
- ▶ Removal of dead wood and dead trees.

The proposed activity would directly contribute to the operation of six key threatening processes (KTPs):

- ▶ Clearing of native vegetation;



- ▶ Loss of hollow-bearing trees;
- ▶ Removal of dead wood and dead trees;
- ▶ The degradation of native riparian vegetation along New South Wales water courses;
- ▶ Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; and
- ▶ Invasion of native plant communities by exotic perennial grasses.

The likely contribution of the Project to the operation of these processes is described in Section 10.3.

10.2.12 Matters of National Environmental Significance

Matters of national environmental significance (MNES) listed under the EPBC Act that are predicted to occur within the locality were assessed on their habitat requirements and likelihood of occurring in the survey corridor (Appendix E). The assessment concludes that the following MNES are likely to occur in the pipeline easement and hence could be affected by construction and operation of the Project:

- ▶ 28 listed threatened species, comprising 22 flora species and six threatened fauna species; and
- ▶ 11 listed migratory species.

No Threatened Ecological Communities, Ramsar Wetlands, World Heritage properties or other MNES are likely to occur within the survey corridor.

10.3 Impact assessment

10.3.1 Construction footprints

As there are two different routes, one for raw (untreated) water and the other for treated water, there are two corresponding construction footprints. The raw water transfer pipeline would be approximately 83 km long, whereas the pipeline for the treated water transfer scheme would be approximately 75 km long.

The assessment of construction impacts is based on the following assumed construction footprints:

- ▶ A temporary construction easement of 20 m width within areas of 'non-significant vegetation' such as cleared areas, agricultural land (pasture, crops, etc) and disturbed and/or weed infested areas. Within the 20 m-wide easement, 10 m would be disturbed by construction activities including trenching, stockpiling (of trench spoil) and movement of machinery, with the remaining 10m of land to be used for vehicle access, temporary stockpiles and workers compounds.
- ▶ A 6 m wide temporary construction easement within areas of 'significant vegetation', which is defined in this report as areas of intact native terrestrial vegetation and vegetation associated with waterways (i.e. riparian and aquatic vegetation at creek crossings).

- ▶ A permanent 10m wide easement to be established and retained post-construction for the entire pipeline route, which would form an access corridor for maintenance and monitoring activities throughout the operational life of the Project. Within non-significant vegetation, this 10m easement would be rehabilitated with grass cover, with allowance for an unsealed 4WD access track. Within areas of significant vegetation, the 10m easement would comprise a 6m wide grassed access (following revegetation) and 4m of surplus land that would be excluded from construction and operational activities. Where present, native vegetation would be retained in this 4m strip.

The preferred pipeline route corridor would be located mostly adjacent to existing infrastructure easements that have previously been cleared and either remain cleared or have regenerating vegetation present. From Wingecarribee Reservoir, the pipeline route corridor largely runs adjacent to existing power line easements until it crosses the Hume Highway. After crossing the Hume Highway, the pipeline route would be located adjacent to and outside of an existing gas pipeline easement (the Moomba to Sydney Gas Pipeline), which it follows almost the entire way to Goulburn.

For the purposes of the assessment of potential impacts on flora and fauna in this report, 'significant vegetation' includes all of the native vegetation communities recorded, as well as Degraded Riparian Creeklines, Freshwater Swamps and Mixed Dwelling/Patchy Vegetation. It is assumed that the construction corridor can be limited to a maximum width of 6m within the above listed vegetation types.

Non-significant vegetation is defined as the following vegetation communities: Disturbed Agricultural and Grazing Land; Planted / Exotic Vegetation and Acacia Regrowth. The calculation of vegetation clearance in these communities is based on permanent removal and maintenance of a 10 m-wide easement, with temporary disturbance to a 20 m-wide easement during construction. It is assumed that any land within this corridor could theoretically be subject to vegetation removal and soil disturbance.

10.3.2 Vegetation clearing during construction

Construction of the Project would require the removal or modification of vegetation that currently occupies the proposed construction corridor, as follows:

- ▶ Permanent removal or modification of approximately 61ha of vegetation within the construction footprint of the treated water transfer pipe, of which approximately 31 % (19 ha) is native (significant) vegetation and 69 % (42 ha) is non-native vegetation;
- ▶ Permanent removal or modification of approximately 68 ha of vegetation within the construction footprint of the raw water transfer pipe, of which approximately 27 % (19 ha) is native (significant) vegetation and 73 % (50 ha) is non-significant vegetation; and
- ▶ Temporary disturbance to approximately 83 ha of non-native vegetation during construction of the treated water pipeline and 99 ha within the raw water pipeline. The majority of the non-native vegetation is pasture grass and grazing land. The impact would involve minor surface disturbance, including minor compaction, soil removal and localised removal of grass cover associated with parked vehicles, pedestrian traffic and stockpiles within a 10 m strip of the 20



m wide temporary corridor. This 10 m strip would be returned to grazing pasture at the completion of construction.

Table 10.6 summarises the vegetation clearance associated with construction of the Project.

Table 10.6: Total Vegetation Clearance (hectares) During Construction

	Treated Water Pipeline (ha)		Raw Water Pipeline (ha)	
	Permanent Removal (ha)	Temporary Disturbance (ha)	Permanent Removal (ha)	Temporary Disturbance (ha)
Native (significant) Vegetation	18.80 (31%)	0	18.71 (27%)	0
Non-Native Vegetation	41.74 (69%)	83.47	49.55 (73%)	99.11
Total (ha)	59.54	83.47	67.26	99.11

Flora species

The proposed development would have direct impacts within a maximum surface disturbance area of 166 ha for the raw water transfer pipeline, of which 99 ha is temporary disturbance of a 20 m wide corridor within non-native vegetation and 67 ha is permanent removal of native vegetation within a 6 m wide corridor. Vegetation clearing required in these areas would remove a combination of exotic pasture grass, non-threatened native plants and noxious and environmental weeds. A large proportion of this area is disturbed, cleared, subject to severe weed infestation and/or or severely drought affected and contains very little native vegetation cover and has little habitat value for native plants.

Construction for the Project would damage or remove individuals of a number of native canopy, understorey and groundcover species that are within areas of native vegetation within the 6 m-wide construction corridor. However, the non-threatened native plant species recorded are all widespread in distribution and none are restricted to the locality or the survey corridor. Hence, clearing for construction is not likely to cause the local extinction of any native plant populations.

Populations of plants species with restricted distributions would be more vulnerable to negative effects arising from direct removal. One such species, Camden Woollybutt (*Eucalyptus macarthurii*), has been recorded at several locations within the survey corridor and a certain number of individual trees would be required to be felled to create the 6 m-wide construction corridor at these locations. The potential impacts on Camden Woollybutt and on other subject flora species are discussed below in Section 8.5.2.

Vegetation communities

Table 10.7 lists a breakdown of the clearing estimates (in hectares) by vegetation type, for both permanent and temporary impacts and for both the treated water and raw water pipelines.

Of the 19 ha of native vegetation to be permanently removed (within the 6 m construction corridor), the majority (at approximately 8 ha) is mapped as 'Mixed Dwelling/Patchy'. This vegetation type was not comprehensively surveyed (due to access and time constraints) but was observed to contain a mix of planted or landscaped vegetation in residential and rural areas, with individuals or small stands of native trees in isolated stands.

Approximately 10.7 ha of the 19 ha to be cleared is composed of small components of native vegetation communities recorded through the survey corridor. Five of these communities form components of the Southern Highlands Shale Woodlands EEC, the impacts on which are described in the following sections. Permanent removal of vegetation is limited to a few hectares of each community, with estimates of clearing ranging from 0.06 ha to 3.33 ha. These estimates are only a small fraction of the total mapped areas of these communities within the 400 m survey corridor and a minor fraction of the total available area of habitat within the locality and the region.

The only community recorded within the survey corridor that would not be affected by construction is Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands, which is a component of the Robertson Basalt Tall Open Forest EEC.

Clearing of aquatic and riparian vegetation communities would be minimal, with 0.24 ha of Degraded Riparian Creeklines and 0.01 ha of Freshwater Swamp vegetation to be permanently removed for the raw water pipeline (Table 10.7). Clearing of Degraded Riparian Creeklines would be less for the treated water scheme (0.13 ha), which (being shorter) crosses fewer waterways. It should be noted that the estimates of permanent clearing for riparian and swamp vegetation types are based on a conservative assumptions that a 6 m wide corridor would be cleared through the creeklines; whereas in reality, directional drilling (or similar) techniques would be employed to tunnel under many of the creeks and the associated riparian vegetation. Hence, these numbers are likely to be an overestimate of the clearing of aquatic and riparian vegetation for construction.

Table 10.7 demonstrates that, in terms of native vegetation removal, there is very little difference between the raw water and treated water transfer schemes. The key difference in native vegetation clearing is that the shorter treated water pipeline would require clearing of slightly less Degraded Riparian and Mixed Dwelling/Patchy vegetation. The main difference between the schemes is that the raw water construction would permanently remove around 8 ha more (and temporarily disturb around 16 ha more) Disturbed Agricultural and Grazing Land. Given that these grazed areas of exotic pasture have low ecological value, there is likely to be little difference in the ecological significance of impacts between the two scheme options.

Table 10.7: Permanent and Temporary Disturbance (in hectares) of Vegetation Communities during Construction

Vegetation Community	Conservation Status	Treated Pipeline (ha)		Raw Pipeline (ha)	
		Permanent Removal	Temporary Disturbance	Permanent Removal	Temporary Disturbance
Narrow construction corridor – 6m wide in native vegetation					
		6m wide	6m wide	6m wide	6m wide
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills of the South Eastern Highlands	EEC (SHSW ³)	1.24	0.00	1.24	0.00
Inland Scribbly Gum - Brittle Gum low woodland of the eastern tablelands, South Eastern Highlands		2.40	0.00	1.58	0.00
Narrow-leaved Peppermint - Mountain Gum - Brown Barrel moist open forest on high altitude ranges, northern South Eastern Highlands	EEC (RBTO ⁴)	0.00	0.00	0.00	0.00
Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest of the tablelands of the South Eastern Highlands		0.67	0.00	0.67	0.00
Ribbon Gum - Narrow-leaved Peppermint grassy open forest on basalt plateaux of the Sydney Basin and South Eastern Highlands	EEC (SHSW)	0.17	0.00	0.17	0.00
River Peppermint - Narrow-leaved Peppermint open forest on sheltered escarpment slopes, Sydney Basin and South East Corner	EEC (SHSW)	0.95	0.00	0.95	0.00
Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges of the north east South Eastern Highlands		3.33	0.00	3.33	0.00

³ SHSW = Southern Highlands Shale Woodlands EEC (TSC Act)

⁴ RBTO = Robertson Basalt Tall Open Forest EEC (TSC Act)



Vegetation Community	Conservation Status	Treated Pipeline (ha)		Raw Pipeline (ha)	
		Permanent Removal	Temporary Disturbance	Permanent Removal	Temporary Disturbance
Swamp Gum - Ribbon Gum woodland on poorly-drained flats of the South Eastern Highlands	EEC (SHSW)	0.06	0.00	0.06	0.00
Sydney Peppermint – Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin	EEC (SHSW)	1.90	0.00	1.90	0.00
Degraded Riparian Creeklines		0.13	0.00	0.24	0.00
Freshwater Swamps		0.01	0.00	0.01	0.00
Mixed Dwelling/Patchy Vegetation		7.95	0.00	8.58	0.00
<i>Subtotal Native Vegetation</i>		<i>18.81</i>	<i>0</i>	<i>18.73</i>	<i>0</i>
<i>Standard construction corridor – 10m wide in non-native vegetation</i>					
		10m wide	20m wide	10m wide	20m wide
Disturbed Agricultural and Grazing Land		41.17	82.38	48.98	98.02
Planted / Exotic Vegetation		0.34	0.65	0.34	0.65
Acacia regrowth		0.23	0.43	0.23	0.43
<i>Subtotal Non-Native Vegetation</i>		<i>41.74</i>	<i>83.46</i>	<i>49.55</i>	<i>99.1</i>
Total		60.55	83.46	68.26	99.1

10.3.3 Fauna Impacts during Construction

Fauna Species

The project would cause displacement or mortality of fauna that reside or roost within the construction corridor at the time of construction activities. The project may also interrupt or prevent breeding activities for one season if species are breeding within or near disturbance footprints during construction. Given the extent of native vegetation within and adjacent to the survey corridor, it is likely that local fauna populations would persist in alternative habitat outside the construction corridor. The magnitude of likely impacts would vary between types of fauna.

Birds are likely to be affected mostly by the clearing of trees within forest and woodland habitats. Around 18 ha of forest, woodland and mixed/patchy vegetation would be permanently removed within the 6 m construction corridor. However, relatively mobile and so most individuals would be able to avoid vegetation clearing or construction operations. Most individuals directly affected by the Project would be displaced rather than killed. There are approximately 1249 ha of forest (including native and planted), woodland and mixed habitat mapped within the 400 m survey corridor (Table 10.3) that could provide refuge and/or alternative habitat for displaced fauna, with much larger stands of similar habitat throughout the surrounding locality.

Macropods and other large mobile terrestrial mammals are likely to readily avoid vegetation clearing or construction operations and so individuals directly affected by the Project would be displaced rather than killed. There may be some mortality of mammals less able to avoid the disturbance. These would include smaller terrestrial mammals, nocturnal species and especially arboreal mammals and microbats which may be sheltering in felled trees. There may be mortality of individuals sheltering in woody debris, tree hollows, and crevices or under bark. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows). This may result in impacts beyond the disturbance area by favouring aggressive or generalist species.

Displacement or mortality due to construction impacts would affect limited numbers of individuals and would be unlikely to threaten the survival of any local populations of any fauna species.

Terrestrial habitat removal

Construction of the Project would have a direct negative effect on habitat for native flora and fauna through vegetation clearing as described above. Impacts would include permanent removal of foraging habitat and possibly shelter, nesting and roosting resources. This clearing would have additional negative effects on the quality of habitats in the broader locality through edge effects, fragmentation of habitat and the disruption of vegetated habitat corridors, which are discussed below.

The areas (in hectares) of habitat types to be cleared during construction are listed below in Table 10.8. The majority of habitat to be permanently removed is grassland, which exists largely as exotic pasture grass within grazing lands. Approximately 49 ha of grassland would be permanently removed for the raw water pipeline, which represents 71 % of the total area of permanent habitat removal (68 ha). The treated water pipeline, being shorter, would require permanent removal of 41 ha of grassland habitat. The key difference in habitat clearance between the raw water and treated water pipelines is the clearing of grassland, which is the predominant habitat type at the western end of the pipeline route (where the two

pipeline route options diverge near Goulburn). The amount of clearing for other habitat types during construction is similar for both pipeline options, as shown in Table 10.8.

Construction would require the removal of approximately 8.25 ha of forest and 2.46 ha of woodland habitat during construction of the treated water pipeline (Table 10.8). The importance of this impact is discussed below. Only minor clearing of other habitat types is predicted, including approximately 8 ha of mixed/patchy vegetation, 0.13-0.21 ha of riparian scrub and 0.01-0.03 ha of sedgeland (Table 10.8).

Construction of the raw water pipeline would require temporary disturbance to approximately 98 ha of grassland (which would be returned to pasture following construction). The equivalent figure for the treated water pipeline is 82 ha. The vast majority of temporary disturbance would occur within pasture and grazing land within the proposed 20 m-wide temporary corridor. The potential impact on native fauna of this impact is considered to be minor to negligible, given the low habitat value and the temporary nature of the disturbance. However, it is important to note that the grassland habitat type contains widely spaced trees, some of which are mature eucalypts or standing dead trees and are therefore often hollow-bearing. Some of these paddock trees may have to be felled during construction, although on-site adjustments to the location of construction activities should allow most paddock trees to be avoided.

Table 10.8 Permanent and Temporary Disturbance of Habitat Types during Construction

Habitat Type	Treated Pipeline		Raw Pipeline	
	Permanent Removal (ha)	Temporary Disturbance (ha)	Permanent Removal (ha)	Temporary Disturbance (ha)
Forest	8.25	0.00	8.25	0.00
Mixed Dwelling/Patchy Vegetation	7.95	0.00	8.58	0.00
Riparian Scrub	0.13	0.00	0.21	0.00
Sedgeland	0.01	0.00	0.03	0.00
Woodland	2.46	0.00	1.63	0.00
Forest (Planted)	0.34	0.65	0.34	0.65
Grassland	41.17	82.38	48.98	98.02
Shrubland	0.23	0.43	0.23	0.43
Total	60.55	83.46	68.26	99.10

Clearing for construction of the pipeline would permanently remove some foraging resources for native fauna, particularly in forest and woodland habitats, which comprise a canopy of eucalypt trees of varying age classes. Eucalypts and other native canopy species would provide nectar resources as well as foraging substrate for a diverse range of arboreal species, such as birds, reptiles (varanids), arboreal mammals and bats.

Given the construction corridor width of 6 m and the presence of equivalent habitats adjoining the corridor, retained vegetation outside of surface disturbance areas is likely to provide sufficient alternative

foraging resources for local populations of native biota. This magnitude of removal of habitat is unlikely to threaten the persistence of any species within the locality.

Habitat trees

The estimated numbers of hollow-bearing trees to be cleared during construction are presented in Table 10.9. These estimates are presented as a range in recognition of the spatial variation and inaccuracy inherent in the dataset. It is estimated, based on large-scale density classes mapped in GIS, that between 59 and 247 hollow-bearing trees could be removed from within the construction corridor for the treated water pipeline (Table 10.9). Approximately 56 to 257 hollow-bearing trees could be removed from the raw water pipeline.

Table 10.9 Estimated Impacts on Hollow-bearing Trees

Density Class	HBT to be cleared (Treated Pipeline)		HBT to be cleared (Raw Pipeline)	
	<i>Hectares</i>	<i>Estimated number of trees</i>	<i>Hectares</i>	<i>Estimated number of trees</i>
Low (0-2.5 trees/ha)	50.73	0-127	59.78	0-149
Medium (3-10.5 trees/ha)	6.09	18-64	4.95	15-52
High (11-15 trees/ha)	3.72	41-56	3.72	41-56
Total	60.54	59-247	68.45	56-257

Impacts associated with the removal of habitat trees would be minimised as far as possible through adjustments to the alignment of the construction corridor during detailed design, through pre-clearing surveys (to identify active hollows within the construction corridor) and associated micro-realignments or wildlife rescue.

The greatest intensity of habitat tree removal is likely to occur in areas of native vegetation, which generally contain a greater density of large trees, including habitat trees. A higher density of habitat trees was recorded within the Paddy's River sector and impacts on hollow-bearing trees are likely to be greatest in this area.

Modification of habitat

The main effect of the construction works would be to widen an existing easement (of 25 – 35 m width) by an additional 6 m. This would create a new edge between fully structured vegetation (e.g. forest and woodland with canopy, shrub and ground layers) and cleared vegetation that comprises only a ground layer. Following construction the intensity of light at the soil surface and on plants would be greater in the disturbance area than in undisturbed vegetation. These changes would occur in the disturbance area as well as adjacent edges of remnant vegetation and may alter the plant and animal communities which occur there.

There would be both positive and negative effects on native biota, depending on the ecology of individual species. Examples would include:

- Dense growth of annual herbs both native and exotic, as noted in clearings during the field survey;

- ▶ Increased abundance of opportunistic and dry open forest reptile species;
- ▶ Adverse impacts on flight and foraging ability of smaller microbats and birds of closed woodland and forest habitats as a result of alterations to habitat structure and increases in wind speed (Law, 1996);
- ▶ Increased foraging habitat quality for edge-specialists, including open woodland birds and larger microbat species; and
- ▶ Decrease in habitat quality for species that require structurally diverse vegetation and/or a dense understorey, particularly threatened woodland birds.

Fragmentation of habitat

The corridor would adjoin an existing easement and would therefore effectively increase the width of the existing easement, which currently extends from 20 – 35 m wide. This easement would already constitute a barrier to regional movements of migratory fauna species by increasing the area of non-viable habitat that they need to traverse. Migratory species often rely on 'stepping stones' of suitable foraging and roosting habitat during migrations. By widening an existing corridor, the Project would increase the distance between suitable patches.

Conversely, the clearing for construction of the Project, being located adjacent to an existing easement, would not create new gaps in the forest/woodland canopy and hence would not cause the fragmentation of contiguous stands of habitat into small stands. Rather, the habitat clearing is likely to worsen the effects of existing fragmentation along the length of the pipeline corridor. In comparison to the existing easement, which extends to 35 m wide in places, the proposed construction corridor would only be 6 m wide where native vegetation occurs.

Intact native vegetation would be retained outside the construction corridor and is likely to provide connectivity for movement and dispersal of local fauna populations.

Creek crossings and fish passage

There are likely to be localised construction impacts on aquatic biota and habitats where the proposed pipeline crosses rivers, creek, streams and other waterways. As a worst case scenario, it has been assumed that trenching would be used to traverse waterways, although it is recognised that this technique would not be suited to large waterways with permanent pools or flowing water. Flowing water would be temporarily diverted around the trench using coffer dams or other techniques.

The construction of the pipeline would directly disturb a number of intermittent water bodies at the locations of proposed waterway crossings. A total of 138 crossings have been identified, of which the majority (93) are minor unnamed tributaries of larger creeks. This would remove habitat within the construction footprint and modify the form and flow characteristics of the water body. Approximately 0.13 to 0.21 ha of riparian vegetation would be cleared during construction (Table 10.8), assuming a 6 m wide corridor at all crossings where vegetation exists. This is a small fraction of the total area of riparian vegetation present within the locality and the region. Negative effects would be very limited in extent, in the context of the extensive network of intermittent water bodies within the locality, and of short duration, with the trenching of minor waterways expected to take no more than a few days.

Sensitive construction techniques and mitigation measures would be used to minimise direct impacts. In particular, the following would be implemented:

- ▶ Restriction of the construction corridor width to 6 m at creek crossings;

- ▶ Erosion and sedimentation controls;
- ▶ Timing of construction to dry periods, where possible, and avoiding open trenching during rainfall events; and
- ▶ Diversion of flowing water around the trench, thereby maintaining flow and fish passage.

Other mitigation measures are recommended in Appendix E. On the basis of the above considerations, construction would affect a very limited area of aquatic and riparian habitat in the immediate vicinity of the construction footprint. The areas of creekline to be affected are not likely to contain a significant proportion of individuals or habitat for aquatic biota occurring within the locality.

The proposed construction would not interrupt fish passage or otherwise affect migration and dispersal ability of fish species, including listed threatened species. Any silt fences, coffer dams or equivalent required for construction would be located in the immediate vicinity of the excavation area and would not completely obstruct any drainage lines or isolate any important areas of aquatic habitat. Provision for fish passage has been incorporated into the design of the Project infrastructure.

With the employment of direction drilling or equivalent techniques at creek crossings, adverse effects on aquatic and riparian species and their habitats would be minimal to negligible, as the earthworks and other surface disturbance would be removed from the riparian zone of the creek crossings.

Regional Biodiversity Corridors

The proposed pipeline route traverses two regional biodiversity corridors:

- ▶ The Abercrombie River to Morton National Park corridor towards the western end of the pipeline; and
- ▶ The Bargo to Morton National Park corridor around the Penrose State Forest within the eastern section of the pipeline.

Although both are likely to be important wildlife corridors for fauna movement and plant dispersal at the regional scale, neither are comprised of contiguous stands of vegetation and as mentioned above, they are bisected by, amongst other things, the existing easements for the Sydney-Moomba gas pipeline and power line easements.

The Project would extend the existing 25-35 m wide easements that traverse these regional biodiversity corridors by 6 m where native vegetation occurs and by 10 m where non-native vegetation occurs. Such an impact represents a minor reduction in habitat connectivity and would be negligible at a regional scale. The habitat removal is limited in extent relative to the overall width of the corridor and would not isolate or disconnect any vegetation patches. Viable alternative faunal migration routes through the corridor would be maintained in native vegetation surrounding the proposed pipeline corridor. In this context, the Project is unlikely to significantly reduce the potential for fauna movement through the corridor.

Groundwater Dependent Ecosystems

GDEs may be impacted either through outright removal of habitat, or through loss or alteration of groundwater resources. The Project would involve abstraction of water from the existing Wingecarribee Reservoir and does not involve the direct removal of groundwater. Groundwater aquifers and management units may be disturbed by the trenching and excavation activities during construction, however this is considered unlikely given the depth of the watertable in the region. The pipeline traverses Groundwater Management Units (GMUs) within the Sydney basin province, falling mainly within the

Southern Highland GMU, which has an indicative depth to the water table of 15m (DEWHA 2009). Given that the nominal depth of the pipeline trench would be 1.5-2m, the potential for disturbance of the aquifer is regarded as minimal.

Riparian and aquatic vegetation does occur within the pipeline easement and may or may not be groundwater dependent. The potential effect of construction activities, such as clearing construction corridors and creek crossings, are addressed in Section 10.3.3.

10.3.4 Indirect impacts during construction

Indirect effects on flora and fauna during construction could potentially include the following:

- ▶ *Edge effects* in adjoining or adjacent areas of vegetation and habitat related to increased weed growth, increased noise and light, erosion and sedimentation, at the interface of vegetation and cleared areas. Edge effects can result from vegetation clearance, where a new edge is created between vegetation and cleared areas, or from widening or extending of access roads through existing vegetation;
- ▶ *Permanent modification* of native vegetation, related to activities such as revegetation, erosion control, surface water management (e.g. sedimentation ponds) and weed control;
- ▶ *Light and noise*. Disturbance to local fauna could occur if night works are required. The light and noise associated with night-time construction could alter or hinder breeding, foraging and roosting activities where fauna are located close the construction activities;
- ▶ *Erosion and sedimentation* uncontrolled erosion of topsoil from excavated areas and exposed soils (trench, stockpiles etc) and corresponding deposition into native vegetation or freshwater creeks, a process which can cause weed problems, reduce aquatic habitat values and stifle plant growth;
- ▶ *Weeds* – dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation through erosion (wind and water) and through workers shoes and clothing and through construction vehicles;
- ▶ *Pathogens* – potential spread of soil-borne pathogens of native plants (e.g. Phytophthora) spread on machinery;
- ▶ *Groundwater impacts*, through changes to subsoil or hydrogeological conditions with the introduction of a subsurface trench and pipe, which could change local groundwater conditions; and
- ▶ *Fauna injury and mortality*, whereby fauna become trapped in the open trench (usually overnight), or through vegetation clearing (particularly hollow-bearing trees), boulder removal and excavations.

10.3.5 Operational Impacts

The operational activities that could affect flora and fauna are as follows:

- ▶ Planned or emergency releases or leaks of raw (untreated) water into the receiving environment, including watercourses and native vegetation; and
- ▶ Planned or emergency releases or leaks of treated water into the receiving environment, including watercourses and native vegetation, introducing chlorine into the environment.

The potential impacts of such releases on native flora and fauna would include:

- ▶ Increase in erosion of topsoil and downslope or downstream sedimentation of habitats (leading to reduction in aquatic habitat quality);
- ▶ Reduction in aquatic habitats, where releases into waterways cause elevated turbidity;
- ▶ Introduction of chlorinated water into freshwater ecosystems, which in an extreme event, could lead to mortality of aquatic fauna;
- ▶ Introduction of untreated water into aquatic ecosystems, thereby elevating nutrient levels or possibly pathogens such as blue-green algae (albeit highly unlikely);
- ▶ increased water and nutrients introduced to watercourses, leading to the establishment of conditions favourable to weed establishment; and
- ▶ Modification of vegetation composition in the long-term, if releases occur periodically.

The above impacts would be localised, infrequent and in any case, are difficult to predict or quantify. Given that the point of release would not be known, the implementation of suitable surface water controls or erosion controls would not be feasible. In most cases, an uncontrolled release would be at a low point in the landscape and therefore drain to the nearest waterway via overland flow across pasture and riparian vegetation. The impacts of such overland flow on fauna habitat quality are expected to be minimal.

The water to be released from the pipeline would be freshwater from Wingecarribee reservoir and hence is not likely to contain any pollutants that can occur within surface waters of industrial or urban areas. Hence the risk of an uncontrolled release of water to the environment causing adverse effects on flora and fauna or a serious degradation of habitat quality is considered to be very low.

No other operational activities, such as maintenance inspections or monitoring, are expected to have any substantial effects on native flora and fauna or other biodiversity values.

10.3.6 Key Threatening Processes

The proposed activity would directly contribute to the operation of six key threatening processes (KTPs):

- ▶ Clearing of native vegetation;
- ▶ Loss of hollow-bearing trees;
- ▶ Removal of dead wood and dead trees;
- ▶ The degradation of native riparian vegetation along New South Wales water courses;
- ▶ Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; and
- ▶ Invasion of native plant communities by exotic perennial grasses.

A detailed assessment of the effect of the Project on these KTPs is provided in the *Ecological Impact Assessment* in Appendix E. The assessment demonstrates that construction and operation of the Project would contribute to a minor degree to all of the above listed KTPs. However, the small scale and short-duration of the impacts suggests that the effect on KTPs would not threaten the survival or evolutionary development of any threatened biota (threatened species or communities) that are affected by these KTPs.

10.3.7 Impacts on threatened biota

Assessments of Significance

Assessments of Significance have been prepared for all threatened flora species, EECs and threatened fauna species recorded or considered likely to occur within the survey corridor. The Assessments are structured as per the *Guidelines for Threatened Species Assessment* (DEC & DPI, 2005) and are attached in Appendix E. The Assessments determine that construction and operation of the Project is unlikely to impose significant adverse effects on threatened biota, as listed under both the TSC Act and EPBC Act, within the survey corridor for the following reasons:

- ▶ The numbers of individuals of Camden Woollybutt (*Eucalyptus macarthurii*) to be removed are likely to be relatively low in comparison to the total number recorded and to the areas of habitat that would remain unaffected on adjoining lands;
- ▶ The quantity of habitat for threatened species and EECs to be removed is relatively small, with larger areas of habitat to remain unaffected by construction in adjoining areas, some of which is reserved in nearby State Forests and National Parks;
- ▶ The removal of habitat for threatened species and EECs is not likely to lead to the local extinction of any populations of these species or communities; and
- ▶ Impact mitigation, particularly pre-clearing surveys, construction environmental management and local adjustments to the pipeline corridor to avoid significant habitats, would lessen the severity of impacts to minor or negligible levels.

Detailed consideration of impacts on subject species that were recorded within the survey corridor is provided in the following sections.

Threatened Flora Species

The desktop literature review indicates that 27 threatened plant species have the potential to occur within the habitats present within the survey corridor and therefore could be affected by construction activities (Appendix E). Of these, two threatened flora species were recorded within the survey corridor during the current investigations:

- ▶ Camden Woollybutt (*Eucalyptus macarthurii*); and
- ▶ Hoary Sunray (*Leucochrysum albicans* var. *tricolor*).

No other threatened flora species were recorded during targeted surveys; however suitable habitat for a number of listed species does occur within areas of intact native vegetation, riparian and swampy areas and small patches of grassland. Assessments of Significance (Appendix E) conclude that construction of the Project is not likely to impose any significant adverse effects on threatened flora species.

Camden Woollybutt

Camden Woollybutt (*Eucalyptus macarthurii*), which is listed as vulnerable under the TSC Act, was recorded at a number of locations during targeted flora surveys. The majority of individuals to be affected would be at the Paddy's River location. More individuals of this species may occur in areas of vegetation not surveyed due to access restrictions, particularly within the Glenquarry and Weraï – Moss Vale areas; however this species is anticipated to occur in relatively low densities in these areas (if present). It is conservatively estimated that up to 100 trees could be affected although it is likely that stands of this species would be able to be avoided through micro-realignment of the pipeline at the detailed design

phase and the use of sensitive construction techniques. Overall the Project would result in the loss of only a small percentage of the populations of the Camden Woollybutt located within the survey corridor and adjacent areas of vegetation.

An Assessment of Significance for Camden Woollybutt has been prepared and based on the following key factors; the assessment concludes that the Project is not likely to have significant adverse effects on this species:

- ▶ Low numbers of individuals likely to be cleared (even with the inaccuracies in the estimates);
- ▶ The relatively small area of habitat to be permanently removed and the relatively large areas of habitat adjoining the construction corridor that would not be affected by construction; and
- ▶ The implementation of mitigation measures prior to and during construction, particularly pre-clearing surveys, and construction protocols to avoid or minimise impacts on significant stands or individuals of the species.

Hoary Sunray

Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) listed as Endangered under the EPBC Act, was recorded adjacent to the proposed raw water pipeline route at the Goulburn Water Treatment Plant. The individuals recorded do not occur within the proposed pipeline route alignment.

An assessment of the significance of potential impacts on *L. albicans* var. *tricolor*, as a species listed under the EPBC Act, has been prepared according to the DEH (2006) *Significant Impact Guidelines* and is attached in Appendix E. Given that the population of the species recorded within the survey corridor would not be affected by construction, the assessment concludes that the Project is not likely to have 'a significant impact' on this species.

Endangered Ecological Communities

One EEC, Southern Highlands Shale Woodlands, lies within the proposed construction footprint and would be affected by construction activities. Table 10.10 lists the areas of EEC to be cleared during construction. Approximately 4.31 ha of Southern Highlands Shale Woodlands would be cleared during construction.

Table 10.10 Areas of EECs to be cleared during construction (by sector)

Pipeline Sector	EEC	Construction Clearing (6m corridor)
Glenquarry	Southern Highlands Shale Woodlands	0.21
Werai – Moss Vale	Southern Highlands Shale Woodlands	0.03
	Robertson Basalt Tall Open-forest	0
Sutton Forest – Exeter	Southern Highlands Shale Woodlands	0.45
Paddy's River	Southern Highlands Shale Woodlands	2.07
Marulan	Southern Highlands Shale Woodlands	1.55
Towrang	Southern Highlands Shale Woodlands	0
Goulburn – Murray's Flat	Southern Highlands Shale Woodlands	0
Total		4.31

The Assessment of Significance for Southern Highlands Shale Woodlands (Appendix E) concludes that the Project is not likely to have a significant adverse effect based on the following considerations:

- ▶ The proposed construction would permanently remove approximately 4.3 ha of SHSW which is a minor proportion (1.4%) of the total area mapped within the 400 m survey corridor and a small fraction of the total known distribution of this community;
- ▶ Small portions of the community would be retained within the permanent 10 m easement; and
- ▶ The stands of this EEC recorded within the survey corridor form part of much larger tracts of vegetation in adjacent areas that would not be affected by the Project.

The proposed offset strategy described in Section 10.5 would further mitigate negative impacts on local populations of the EEC. The proposed conservation and management of SHSW within the offset sites would compensate for the removal of approximately 4.3 ha of the community and produce a net gain in its regional conservation.

Threatened terrestrial fauna

A total of 30 threatened fauna species have the potential to occur within the habitats present within the proposed corridor and could be affected by construction and operation of the Project. The project has the potential for negative effects on these species or their habitats. The project would involve permanent removal of habitats and resources of potential value to threatened fauna species.

Part 3A Assessments of Significance have been undertaken for these threatened fauna and are provided in Appendix E. The Assessments of Significance conclude that construction and operation of the Project would affect a very minor proportion of individuals and suitable habitats for these species. Hence, the Project is not likely to impose significant adverse effects on local populations of these species.

Threatened fish

Two threatened fish species potentially occur within the survey corridor. An assessment of their preferred habitats and current known distributions reveals that both species are unlikely to occur within the survey corridor (see Appendix E). Given this assessment, it can be concluded that there are not likely to be any adverse effects on threatened fish or aquatic species or their habitats, as listed under the FM Act, TSC Act and EPBC Act.

10.3.8 Critical habitat

There is no recommended or declared critical habitat on the DECCW NSW Critical habitat register (DECCW, 2009e) or the DPI critical habitat register (DPI, 2009b) in the locality or of relevance to the assessment of the Project.

10.3.9 Matters of National Environmental Significance (MNES)

The assessment of the significance of impacts on MNES has been conducted as part of the Assessments of Significance for TSC Act listed species. Given that the Part 3A assessment criteria overlap with or mirror those for MNES under the EPBC Act *Significant Impact Guidelines* (DEH 2006), a separate assessment under the latter has not been conducted.

No MNES were recorded within the construction corridor and hence there are not likely to be any direct impacts on MNES during construction or operation of the Project. However, based on the assessments presented in Appendix E, construction of the Project could affect the some MNES that are predicted to occur within the locality of the site, based on their habitat requirements, distributional range and/or dispersal or migration patterns, including:

- ▶ Listed threatened species (flora and fauna); and
- ▶ Listed migratory species.

A summary of the Assessments of Significance, as they relate to MNES, is provided below.

Potential impacts on nationally listed threatened species

Four of the EPBC Act listed flora potentially affected by the Project are also listed under the TSC Act. In addition, one threatened flora species, Hoary Sunray, is only listed under the EPBC Act, and was recorded outside of the construction corridor. The Assessments of Significance for these species conclude that the Project is not likely to have a significant impact on these threatened flora species or their habitats.

A total of six threatened fauna species and their habitats could be affected by construction of the Project. The Assessments of Significance for these species conclude that the Project is not likely to have a significant impact on these threatened fauna species or their habitats.

A number of other threatened fauna species listed under the EPBC Act are known or predicted to utilise habitat in the locality on an occasional or opportunistic basis. The Project would remove potential habitat for these species. This Assessment of Significance for threatened fauna concludes that the Project is not likely to have a significant negative affect on any mobile threatened fauna.

Potential impacts on migratory species

A total of seven listed migratory species were recorded during the field surveys. A further four listed migratory species may occur within the locality based on the results of the Protected Matters search. Migratory species listed under the EPBC Act are not likely to occur within the pipeline corridor, other than in flight, or on a transient or temporary basis.

Direct negative impacts arising from the Project would affect only small areas of marginal migratory bird habitat compared to the overall area of higher quality habitats available within the region. Based on the above considerations the Project is unlikely to impose 'a significant impact' on any of the listed migratory fauna species predicted to occur within the locality.

10.4 Summary of results

The scope of the current investigation included both a desktop search of available biodiversity information, as well as field surveys. An assessment of the likelihood of occurrence of threatened species, populations and ecological communities listed under the TSC Act, FM Act and EPBC Act was also undertaken.

A total of 27 threatened plant species are considered likely to occur within the habitats present within the proposed corridor. Of these, only two threatened flora species were recorded as occurring along the proposed pipeline route: Camden Woollybutt (*Eucalyptus macarthurii*) is listed as Vulnerable under the TSC Act and Hoary Sunray (*Leucochrysum albicans* var. *tricolor*), listed as endangered under the EPBC Act. One EEC listed under the TSC Act, Southern Highlands Shale Woodlands, was recorded at various locations along the proposed pipeline route, with a total of 314.5 ha mapped within the 400 m survey corridor.

Vegetation clearance calculations for the two options for the proposed pipeline route showed the treated water option would result in the permanent clearing of 18.81 ha of native vegetation and 41.74 ha of non-native vegetation, with temporary disturbance of 83.46 ha of non-native vegetation. The raw water option would result in the permanent removal of 18.73 ha of native vegetation and 49.55 ha of non-native vegetation, with temporary disturbance to 99.10 ha of non-native vegetation.

The native vegetation to be permanently removed during construction includes 4.32 ha of the Southern Highlands Shale Woodlands EEC, as well as potentially up to 100 individuals and associated habitat for the threatened Camden Woollybutt. No individuals of Hoary Sunray would be affected.

A total of 30 threatened fauna species are considered likely to occur within the survey corridor. Field surveys confirmed the presence of six species of threatened fauna including: Gang-gang Cockatoo, Glossy Black Cockatoo, Brown Treecreeper, Eastern Falsistrellus, Large-footed Myotis and Eastern Bentwing Bat, which are all listed as vulnerable under the TSC Act.

Vegetation to be cleared in the construction corridor is likely to provide habitat for the six fauna species identified within the survey corridor and others considered likely to occur at least on occasion. Impacts on fauna would include reduced shelter or roosting sites, foraging habitat and actual food abundance. Clearing would have additional negative effects on the quality of habitats in the broader locality through edge effects and incremental fragmentation of habitat.

10.5 Mitigation measures

The mitigation of adverse effects arising from the proposed pipeline construction has been presented according to the hierarchy of avoidance, mitigation and offsetting of impacts, consistent with the approach outlined in the DEC/DPI (2005) guidelines.

Potential impacts of the Project on native biota and their habitats would be greatest in the construction footprint during the construction phase due to clearing of vegetation and direct habitat loss and modification. Specific mitigation measures have been incorporated into the Project design to avoid or minimise such impacts on the natural environment within the pipeline corridor, and in particular to reduce potential impacts on threatened species and their habitats.

A Biodiversity Management Strategy, incorporating measures to avoid, mitigate and offset biodiversity loss arising from the proposed pipeline construction has been developed in consultation with DECCW and GMC. The Strategy comprises four key actions:

- Additional targeted surveys to obtain comparable baseline data on the biodiversity values of the proposed offset sites and the survey corridor.
- Refinement of the pipeline corridor through the detailed design phase, whereby the design team will make adjustments to the alignment of the pipeline (subject to engineering constraints) in response to data obtained from the additional field surveys, to further avoid or reduce direct impacts on biodiversity values.
- Preparation of a Flora and Fauna Management Plan (FFMP) that will be prepared during the detailed design phase of the Project. The FFMP will identify detailed site-specific/species-specific mitigation measures and environmental management protocols to be implemented before, during and post construction to further avoid or reduce impacts on threatened biodiversity. The FFMP will comprise a sub-plan to the CEMP and OEMP for the Project and will be prepared in consultation with DECCW and finalised before construction.
- Preparation of an Offset Plan, in consultation with DECCW, that will detail the biodiversity values of the proposed offset sites, and provide an assessment of how the offset will compensate for unavoidable impacts on threatened biota.

Further details on proposed mitigation measures to be implemented during construction and during operation of the Project are provided in Appendix E.

10.5.1 Avoidance of impacts

Direct impacts on remnant forest and woodland and fauna habitats have been avoided to a large extent by aligning the proposed pipeline along an existing pipeline easement to the greatest extent possible. The proposed pipeline route follows the route of existing gas pipeline and fibre optic infrastructure for most of its length. The current Project intends widening the current pipeline and cabling easement and hence for the majority of the alignment only small patches of degraded habitat present on the edge of the existing cable infrastructure route would be impacted by the current Project.

In addition, existing tracks are to be used as far as possible to access the pipeline during the construction and operational phases of the Project. Where additional access tracks are required they would be located through existing cleared lands. Directional drilling (or a similar technique) would be used to avoid potential impacts on aquatic environments and associated riparian areas at sensitive waterways.

Avoidance of the requirement to clear native vegetation and fauna habitats as far as possible has significantly reduced the potential for adverse impacts of the pipeline on biodiversity values.

Proposed refinement of the pipeline corridor through the detailed design phase will aim to further avoid direct impacts on biodiversity values. This will involve adjustments to the alignment of the pipeline (subject to engineering constraints) in response to data obtained from field surveys to avoid identified threatened plants, EECs, threatened fauna habitats, including rock outcrops and large hollow-bearing trees, and the Kenmore Creek wetland.

10.5.2 Mitigation of impacts

Construction Environment Management Plan

A Construction Environment Management Plan (CEMP) and Operational Environment Management Plan (OEMP) will be prepared for the Project and would include the environmental impact mitigation measures outlined below as a minimum:

- A Sediment and Erosion Plan;
- measures to minimise the generation of dust and associated impacts on adjacent natural environments; and
- measures to ensure protection of watercourses and the surrounding natural environment during routine scouring events once the pipeline is operational.

Flora and Fauna Management Plan

A Flora and Fauna Management Plan (FFMP) will be prepared as a sub-plan to the CEMP and OEMP for the Project. The FFMP will be prepared in consultation with DECCW prior to the construction phase. It will identify environmental management measures to protect the natural environment (e.g. weed and phytophthora controls) and detailed site-specific and species-specific mitigation measures and management protocols to be implemented before, during and post construction to further avoid or reduce impacts on threatened biodiversity.

Further details on proposed mitigation measures to be implemented during construction and during operation of the Project are provided in Appendix E.

10.5.3 Offsetting of impacts

Overview

There is the potential for a number of direct and indirect impacts to occur on biodiversity values as a consequence of the Project. While many of these impacts can be avoided or minimised, as described in the preceding sections, there are likely to be residual impacts on biodiversity, including threatened biota, that cannot be avoided or mitigated, including:

- A loss of up to 18.8 hectares of native vegetation, including approximately 4.3 hectares of Southern Highlands Shale Woodland, which is listed as an EEC under the TSC Act;
- Removal of Camden Woollybutt, a threatened flora species listed under the TSC Act; and
- Loss of habitat and resources for a variety of native fauna species, including in threatened woodland birds and microchiropteran bat species listed under the TSC Act.

Offset plan

A biodiversity Offset Plan is required in order to address likely residual impacts on biodiversity values associated with the Project in accordance with the guidelines for threatened species assessments on Part 3A projects (DEC and DPI 2005), such that the Project 'maintains or improves' biodiversity. An Offset Plan will be developed through ongoing consultation with DECCW and other relevant stakeholders and will be informed by data collected as part of the current study and during additional targeted surveys. The Plan is underpinned by the offset sites proposed by GMC as described below, but may include alternative or additional offset sites or actions to provide an appropriate offset as determined during the more detailed offset site assessment.

The Offset Plan will contain detailed information to demonstrate how unavoidable impacts on threatened flora and fauna species and ecological communities will be adequately compensated for in the final offset package. The Offset Plan will address the following issues:

- ▶ suitability and condition of the offset sites as habitat for threatened flora and fauna species likely to be affected by the construction works;
- ▶ consideration of representation of endangered ecological communities and over-cleared landscapes within the Hawkesbury-Nepean catchment management area likely to be affected by the construction works;
- ▶ loss of hollow bearing trees with the construction corridor and the hollow resource in the offset sites;
- ▶ vegetation condition within the offset sites;
- ▶ connectivity and linkages within the offset sites to surrounding vegetation;
- ▶ proposed management to improve the condition and biodiversity values of proposed offset sites; and
- ▶ future titling and funding arrangements for the offset sites to ensure their legal protection in perpetuity.

As agreed with DECCW, the preparation of the proposed Offset Plan will be included in the Statement of Commitments for the Project. If project approval is granted, the requirement for preparation and finalisation of the Plan will be written into the Conditions of Consent.

Proposed offset sites

Two potential offset site options have been identified for consideration in development of an appropriate offset package for the Project. A broad description of the biodiversity values of each site, based on the findings of preliminary surveys, is presented in Appendix E.

The DECC (2008) offsetting principals require the improvement of condition and biodiversity values at offset sites through management. Both offset site options have been disturbed and degraded through historical clearing, cultivation and grazing. The Project provides the opportunity to improve the condition of the vegetation and enhance existing biodiversity values through a change in management regime. The offset strategy may include consideration of the following measures in this regard:

- ▶ Maintenance of site boundaries, exclusion of potentially damaging activities and management of threatening processes;
- ▶ Removal of grazing;
- ▶ Management of weeds and pest fauna; and

- ▶ Revegetation in strategic areas (e.g. to improve vegetation connectivity and habitat links) through development and implementation of a vegetation management plan (VMP).

Weeds and pest fauna would be managed within the offset site in accordance with Council's existing programmes and in conjunction with local and regional weed and pest animal management agencies to complement landscape wide control programs.

A monitoring programme would be established to monitor change in vegetation community condition and to inform adaptive management. This monitoring program would report on improvements in the condition of the offset site achieved through management actions.

Council is currently considering appropriate titling options to ensure conservation of the offset site in perpetuity. Funds would be provided to enable implementation of environmental management works on the site.