6. Terrestrial fauna

This section describes the existing environment, potential impacts and mitigation measures for the Project in terms of the terrestrial fauna values. The assessment has been based on a review of existing information and the outcomes of supporting field investigations.

It should be noted that the information regarding legislation is current at the time of writing this section but may be subject to change in the future. Legislation requirements covered in the EIS have been cited from:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Nature Conservation Act 1992 (*NC Act)
- *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation)
- *Vegetation Management Act 1999* (VM Act)
- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Land Protection (Pest and Stock Route Management) Regulation 2003*

The currency of such information will be checked during the detailed design phase of the Project and prior to commencement of construction activities within the project area. Currently the designation of threatened species under the NC Act and NC Regulation is being reviewed to conform with international classification and as such species listed as rare will be reassessed and classified as either least concern, vulnerable, near threatened, endangered or critically endangered.

6.1 Existing environment

6.1.1 Methodology

In March 2007, Connell Hatch prepared a desktop ecological assessment to support the development of an Initial Advice Statement, EPBC Referral for determination of the Project's controlled action status under the EPBC Act and ultimately assist in the EIS process. The Project was deemed a not controlled action under Section 75 of the EPBC Act.

This EPBC referral was supported by a comprehensive fauna survey in August 2007 (dry season) which was undertaken to verify and delineate the desktop assessment. A second round of monitoring was conducted in December 2007 (wet season) to assist in describing any temporal variation within the fauna assemblages.

The desktop fauna study included the identification of the vegetation communities, habitats and the potential fauna assemblage within the project area. A number of ecological databases were referenced to describe the fauna assemblage of the area and the likely occurrence of threatened and/or significant species on a local, state and national scale. The ecological databases consulted included the DEHWA web-based EPBC Act protected matters search, EPA Wildlife Online and the Queensland Museum records (refer Appendix E1). In addition to the database searches, previous environmental and ecological studies within and surrounding the project area were also reviewed. Environmental and anthropogenic factors affecting the biodiversity of the area were also examined.

The survey techniques were based on the EPA Flora and Fauna Survey Guidelines (EPA 1999) and also the New South Wales National Parks and Wildlife Service Comprehensive Regional Assessment Systematic Fauna Survey Guidelines (NPWS 1997). The surveys were conducted in accordance with Connell Wagner's scientific purposes permit (WISP01649604) and animal ethics permit (0099).

Techniques adopted included diurnal and nocturnal searches, trapping (pitfalls and baited traps), hair funnels, spotlighting and call/play back and Anabat II recordings. During each survey round trapping was conducted over five consecutive nights which was dependent on fine weather.

A number of species were identified from hair and skeletal remains. These however can be difficult to confirm unless the species is monotypic (ie genus containing only one species). The majority of species identified in this manner, however, were also positively identified in the field.

Scientific and common names used in the section to describe fauna were obtained from:

- Pizzey and Knight (2002) for birds
- Cogger (2000) and Wilson (2005) for reptiles
- Robinson (2000), Cogger (2000) and Frogs Australia Database for amphibians
- Menkhorst and Knight (2004) and Strahan (1995) for mammals

It is important to note that not all species noted as potentially inhabiting the area were identified during the monitoring programme. Factors include the intensity and resourcing of the programme, cryptic nature and behaviour of some species, resource availability (food, habitat and water), breeding patterns, migration, vagrancy as well as seasonal and spatial variation.

Site description

In total, seven fauna monitoring sites were surveyed over the two monitoring periods (refer Figure 6.1). The selected monitoring sites were established in the major habitat types within the project area, including:

- Riparian habitat along Calliope River
- Open Bluegum *(Eucalyptus tereticornis*) forest
- Open Ironbark (*Eucalyptus crebra*) forest
- *Eucalyptus moluccana* (Box) open forest (adjoining Larcom Creek)
- Vallis Creek floodplain - mixed eucalypt forest
- Corymbia plantation
- Mixed eucalypt forest - Larcom Creek floodplain

In addition, to these sites, targeted searches were conducted in other habitats including ephemeral wetlands and montane environments.

Major habitat types were determined using information gathered from the preliminary surveys, aerial photography, RE mapping and geomorphology of the area (topography, type and size of the vegetation communities and geology). The general vegetation structure and description of the communities are outlined in Section 5.

6.2 Fauna results

A total of 192 species were recorded over the monitoring programme as inhabiting and/or frequenting the area. It included 107 avian species, 18 species of amphibians, 30 reptilian species and 37 mammalian species, including bats (refer Appendix E2).

The majority of the species recorded during the monitoring programme are listed as least concern under the NC Act and are common and widespread within the region. Four species, which are considered threatened[1] under Commonwealth and/or State legislation, were encountered during the monitoring programme. These species and their status are listed in Table 6.1.

[1] Threatened species are those that are listed as endangered, vulnerable or rare (EVR) under the NC Act and/or near threatened, vulnerable, endangered under the EPBC Act.

Table 6.1 Threatened species pursuant to the NC Act recorded within the project area

Species Name	Common Name	NC Act Status
Adelotus brevis	Tusked frog	Vulnerable
Ephippiorhynchus asiaticus	Black-necked stork	Rare
Geophaps scripta scripta	Squatter pigeon^	Vulnerable
Chalinolobus picatus	Little pied bat	Vulnerable

Table note:
^ Listed as vulnerable under the EPBC Act

Consultation with local landowners also identified the presence of the Common death adder (*Acanthophis antarcticus*) within the dry sclerophyll woodland/forests while the Estuarine crocodile (*Crocodlyus porosus*) was described as inhabiting the Calliope River downstream of the Moura Link Eastern Option (*pers comm* local landowner). In addition, to the threatened species, a number of avian species subject to international treaties were also recorded from the project area and surrounds (refer Section 6.2.2 and Appendix E2).

6.2.1 Regional context of study

The results of the survey are generally consistent with previous ecological surveys conducted in the region. A summary of the results from these studies with reference to the data collected during the MLARP ecological assessment is provided in Table 6.2.

Findings of the 1994 Curtis Coast Study conducted by the Queensland Department of Environment and Heritage established that there are 422 species present within the Curtis Coast area. Based on these results, the project area has been observed to support at least 44% of fauna species known to occur within the Curtis Coast region.

The rich biodiversity within the project area can be associated with the varied habitats and the overall size of the project area. The project area is located in the Brigalow Belt bioregion (as determined by Sattler and Williams 1999) which provides habitat for a distinctive array of threatened fauna species as well as significant vegetation communities, a large percentage of which have and are still being cleared for agricultural purposes.

Table 6.2 Comparison of the Terrestrial Fauna Results with other Ecological Studies within the Port Curtis Region

Study	Region	Amphibians	Reptiles	Mammals	Birds
MLARP EIS (this study)	Moura Link - Aldoga	18	30	24 + 13 bats	107
EPA Wildlife Online (2007)	Yarwun – Calliope River	7	29 (2 marine species)	18 + 8 bats	119
WetlandInfo (2008)	Calliope River catchment	26	70	44 + 22 bats	264
QDEH (1994)	Curtis Coast	22	60	38 + 14 bats	288
Wiggins Island Coal Terminal (2005)	Yarwun - Calliope River	14	39	34 + 10 bats	142
Connell Wagner (2004)	Calliope River to Larcom Creek	5	15	12	54
URS (2003)	Targinie Industrial Estate	7	18	13 + 4 bats	93
Dames & Moore (1998)	Yarwun Industrial Estate to Aldoga	14	36	24 + 14 bats	140
Connell Wagner (1992)	Aldoga	9	25	12	108

Study	Region	Amphibians	Reptiles	Mammals	Birds
Connell Wagner (1992)	Carrara	9	17	9	74
Connell Wagner (2002)	Aldoga	1	3	8 + 0 bats	35
CQU – Meltzer *et al* (1999a)	Calliope River	14	22	12 + 8 bats	109
CQU – Meltzer *et al* (1999b)	Targinie	19	38	21 + 13 bats	141
Dames and Moore (1998)	Aldoga	12	25	17 + 13 bats	95
Houston *et al* (1999)	Targinie	13	35	20 + 6 bats	105

Variability between the current and previous surveys, with particular reference to bird species, can be attributed to a number of factors, including:

- The size of the study area
- Temporal variation – the time of year in which the survey was undertaken
- Difference in habitat types
- Absence/reduction in the availability of freshwater and a reduction in available food resources due to dry conditions within the area
- Vagrancy and migration of species within the localised area (ie avian species are highly mobile and can be present at one site at one time and not the next)

A summary of terrestrial fauna species recorded during the monitoring programme is provided below.

6.2.2 Birds

A total of 107 bird species were observed from habitats within and surrounding the project area (refer species list Appendix E2). The project area provides habitat for at least 43% of the species recorded within the Gladstone region, with the potential for many more (ie a search of the Bird Australia database (January 2008) indicated that 245 species have been recorded from the Gladstone region).

The species richness is to be expected and is a reflection of the various habitat types present within the area, including open eucalypt woodlands and forests, riparian habitats, open grasslands, freshwater wetlands and immature plantation forests. The majority of the species identified from the project area are associated with two dominant terrestrial habitats which are open woodland and grassland communities.

Many raptor species such as the Wedge-tailed eagle (*Aquila audax*), Pacific baza (*Aviceda subcristata),* Nankeen kestrel (*Falco cenchroides*) and Whistling kite (*Milvus sphrenurus*) were also common throughout the project area. Four species of owls were also recorded from the area suggesting a plentiful food resource, with their stable diet consisting of arboreal and ground dwelling mammals.

The distribution and variation within the avian population can be attributed to a range of factors including:

- Habitat type and structure
- Degree of disturbance
- Sedentary nature of some species
- Localised migration for breeding purpose (summer migration species include Cuckoos, Plumed whistling ducks, Satin flycatcher and Spangled drongo)
- To exploit unpredictable food resources (such as Honeyeaters, Welcome swallows)

Suitable habitat (eg notophyll vine thicket and SEVT) is also present within and adjoining the project area for fugivorous bird species such as the Wompoo dove (*Ptilinopus magnificus*) and the Knob-crested dove. This includes the Mount Larcom Ranges, the Calliope River, Scrubby Creek and the montane environment of Wycheproof. These species play an important role in seed dispersal for a number of rainforest species.

During the field investigations two threatened species were identified from the project area.

The Squatter pigeon (southern subspecies) is listed as vulnerable under the EPBC Act as well as the NC Act and was common throughout the area (ie observed at several sites within the project area) (refer Figure 6.2). During the field activities groups (between two (2) and fine (5)) were recorded from grassy woodlands dominated by *E. Molucccana* and *E. crebra* and from more disturbed habitats, including grasslands with scattered remnants and along road corridors.

The species is common in heavily grazed country to the north of its southern range, almost always in a habitat close to a water source. During the survey, this species was observed predominantly in grazed eucalypt open woodland, often at the edges of tracks and roads. The Project poses a potential threat through the loss and degradation of habitat, in addition the species is ground-dwelling and is susceptible to vehicle movement (nesting sites and direct mortality).

The Black-necked stork, listed as rare under the NC Act, was observed foraging within Farmer Creek. Suitable habitat occurs throughout the project area as the species is also associated within floodplain habitats as well as wetlands.

It is likely this species is transient within the area and utilises resources depending on availability (ie foraging for prey). The Black-necked stork feeds on aquatic vertebrate and invertebrate species in relatively shallow wetland areas. The Black-necked stork nests in large live or dead trees with a nest constructed from sticks, rushes and/or grasses (Pizzey & Knight 1999). There was no evidence of nests observed within the project area.

Previous studies within the area have also identified the Black-chinned honeyeater (*Melithreptus gularis*) and the Glossy black-cockatoo (*Calyptorhynchus lathami*) from the riparian zone of the Calliope River. These species were not recorded during the field investigations, however the riparian zone of the Calliope River and Larcom Creek has the potential to support these species.

The Black-chinned honeyeater is widespread in central and eastern Queensland. This species inhabits upper levels of open eucalypt forests and woodlands dominated by Box and Ironback eucalypts. Open *E. moluccana* (Box) and *E. crebra* (Ironbark) woodlands were dominant communities within and adjoining the project area and it is likely that this species inhabits the area. This species is nectivorous and insectivorous and is usually seen foraging in groups in the upper canopy on the outermost flowers and foliage. The absence of flowering of food-plants such as during the field surveys may explain the species absence during the field activities.

The Glossy black-cockatoo is widespread in eastern Australia and is highly dependent on the distribution of *Allocasuarina* spp. and is found in woodland dominated by *Allocasuarina* and in open forests where it forms a substantial middle layer. This type of habitat was limited within the project area and surrounds with *Allocasuarina littoralis* recorded from the riparian zone of the Calliope River. This species is also hollow dependent requiring tree hollows for breeding.

An additional three threatened species have been identified from similar habitats within the local area (refer Table 6.3). The absence of the rest of these species may be attributed to a lack of preferred habitat within the project area or seasonal variation, cryptic nature, resource availability vagrancy and climatic patterns.

Table 6.3 Potential EPBC Act Listed Species

Species	Common Name	Conservation Status
Erythrotriorchis radiatus	Red goshawk	Endangered (NC Act) Vulnerable (EPBC Act)
Rostratula australis	Australian painted snipe	Vulnerable (NC Act, EPBC Act)
Turnix melanogaster	Black-breasted button-quail	Vulnerable (NC Act, EPBC Act)

The Red goshawk inhabits a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses, woodlands, the edges of rainforest and gallery forests along watercourses, and wetlands that include Melaleuca and Casuarina species. The home range of the Red goshawk is extremely large, ranging from 50 to 220 km^2 and are generally a sedentary species, keeping the same territory and often reusing the same nest.

The species has been recorded within the Calliope area, however no roosting/nesting sites were identified in close proximity to the project area (*pers comm* EPA). The species is also often associated with REs found within the project area (ie vegetation communities along the Calliope River).

The Australian painted snipe inhabits shallow inland wetlands. The absence of the species from the project area may be attributed to the drought conditions leading up to the surveys (ie wetland ecosystems were limited during the field surveys to small agricultural dams and permanent pools along the Calliope River, Larcom Creek and Farmer Creek).

The Black-breasted button-quail was not observed during the survey, however this species has been recorded within the GSDA (ie an essential habitat area to the south of Gladstone-Mount Larcom Road (refer Figure 6.2)). Suitable habitat is limited within the project area with vine thicket and rainforest communities restricted to drainage lines adjoining montane environments such as Mount Larcom Range and Scrubby Creek (refer Figure 5.5).

Migratory species

The Australian Government is actively involved in the conservation of migratory species and habitats through its involvement with a number of international agreements. They include the Ramsar Convention and the Convention on Migratory Species (CMS/Bonn Convention), the China-Australia Migratory Bird Agreement (CAMBA) and the Japan-Australia Migratory Bird Agreement (JAMBA) throughout the East Asian-Australasian Flyway.

The EPBC Act provides for protection of migratory species as a matter of national environmental significance (NES). An EPBC protected matters search (refer Appendix E1) for the area identified 10 species as potentially inhabiting the area, of which five were identified from habitats within the project area. With the exception of the Rainbow bee-eater, the migratory species were observed from Farmer Creek and adjoining floodplain vegetation, and palustrine wetlands, upstream of the project area. Species included:

- Rainbow bee-eater (*Merops ornatus*), a solitary specimen was observed foraging within the Calliope River riparian zone. It is unclear as to whether the individual is a resident of the area or has migrated from southern Australia (survey was within normal migration period for the southern population). No nests were evident within the area.
- Cattle egret (*Ardea ibis*), a flock were observed in association with cattle on the Fairview property near Farmer Creek. This species has been identified from the area and is likely to frequent the region (ie suitable habitat occurs within the project area primarily near Aldoga on Larcom Creek and Farmer Creek). No breeding sites were evident with the project area.

- Cotton pygmy-goose *(Nettapus coromandelianus*), a pair were observed within a permanent wetland located on Farmer Creek. The riparian zone and adjoining habitats have been significantly cleared, however isolated hollow bearing trees were intermittently present along the watercourse. These trees may be used during the breeding season (December-April) (Morecombe 2006). The wetland is likely not to be critical habitat for the species and is unlikely to support a large population.
- White-bellied sea eagle (*Haliaeetus leucogaster*), a pair nest in an *E. tereticornis* aligning Framer Creek near Fairview homestead, approximately 2 km upstream of the project area (*pers comm* local landowner). This species was also observed overflying the Larcom Creek floodplain upstream of the Bruce Highway.

  The Project has the potential to degrade the environmental values of Farmer Creek, however the low density of individuals within the area, the location of the nest in relation to the works and the type of management measures will effectively reduce any potential impacts.
- Spectacled monarch (*Monarcha trivirgatus)* was observed at the Bluegum habitat. This species typically forages within thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. The habitat association where this species was observed does not match its characteristic habitat and as such it is not anticipated that the Project will have a significant impact on the species as this habitat is not generally found within the project area.

6.2.3 Amphibians

A total of 18 species of amphibians were recorded during the monitoring programme (refer Appendix E2). Thus the project area provides habitat for at least 69% of the species known to occur within the Calliope River catchment.

Frog species richness was greatest within an ephemeral wetland of Larcom Creek, permanent pools of the Calliope River and an ephemeral wetland and watercourse of Farmer Creek within the Bluegum forest. Species richness and abundance coincided with a significant rainfall event during the December period, with 11 additional frog species recorded.

It is important to note that on a local scale, species richness and abundance was greatest at the wetland on Larcom Creek. The most common species were the Green tree frog (*Litoria caerulea*), Eastern sedgefrog (*Litoria fallax*), Floodplain frog (*Litoria inermis*) and Desert tree frog (*Litoria rubella*) as well as the introduced Cane toad.

All observed amphibian species except for the Tusked frog (vulnerable under the NC Act) and Cane toad (non-declared introduced animal) are listed as least concern under the NC Act and are considered common and widespread within the region.

Tusked frog

The Tusked frog is classed as vulnerable under the NC Act. This species was observed in high abundance (greater than 100 individuals) at an ephemeral wetland on Larcom Creek. The high abundance can be attributed to suitable breeding conditions at the time of the survey (ie a significant rainfall event (approximately 100 mm in 24 hours) creating a wetland ecosystem on Larcom Creek).

The species' preferred habitat consists of rainforest and wet sclerophyll but also includes open grazing country, the dominant habitat surrounding the wetland. The Tusked frog is also thought to be dependent on patches of undisturbed forest, although this was not the case within the project area (ie individuals migrated to the wetland from disturbed open woodlands and grazing land to the west of Larcom Creek).

This species has suffered a reduction in population numbers due to loss and degradation of habitat through agriculture and development (DEH Biodiversity Group 1999). The Project will potentially threaten this species on a local scale through the further loss of habitat.

It has also been suggested that introduced fish such as *Gambusia holbrooki* (Mosquitofish) may play a role in the threatened status of the species. The Tusked frog is a facultative stream breeder who lay their eggs in a foam nest in the water, and predation of eggs may be a limiting process for this population (DEH Biodiversity Group 1999). Mosquitofish have been recorded from the Calliope River catchment and within pool habitats on Larcom Creek directly downstream of the proposed Aldoga Rail Yard (Houston *et al* 2000).

An additional three threatened species have been recorded from the Calliope area (refer Table 6.4). It is important to note that the EPA WetlandInfo (2007) database does not describe any threatened species from the Calliope River catchment.

Table 6.4 Threatened frog species potentially inhabiting the project area

Species	Common Name	Conservation Status
Litoria pearsoniana	Cascade treefrog	Vulnerable (NC Act)
Litoria pearsoniana (Kroombit Tops)	Cascade treefrog (Kroombit treefrog)	Endangered (NC Act)
Taudactylus pleione	Kroombit tinkerfrog	Endangered (NC Act) Vulnerable (EPBC Act)

Both the Kroombit treefrog and Kroombit tinkerfrog are restricted to Kroombit Tops National Park located approximately 100 km west of the project area. The Cascade treefrog is also unlikely to inhabit the project area given that the preferred habitat consists of rainforest gullies and wet sclerophyll forests which do not occur within the area.

6.2.4 Reptiles

A total of 30 reptile species, all of which are listed as least concern under the NC Act, were identified during the monitoring programme. Thus the survey area provides suitable habitat for at least 42% of species recorded from the Calliope River catchment.

The reptile abundance within the project area was somewhat limited, with most species observed in low abundance. The most abundant reptile guild were diurnal littoral skinks such as *Carlia foliorum* and *Carlia munda* which are terrestrial ground-dwelling species generally found amongst leaf litter. The most obvious guild of skinks that was missing from the field observations was the burrowing skinks with absent or greatly reduced limbs.

The nocturnal Narrow-banded sand-swimmer (*Eremiascincus fasciolatus*) (refer Photo 6.1) was recorded from a single specimen. This species was identified from an ecotone of a Moluccana open woodland and open grassland. This species is known to inhabit arid and desert areas as well as dry woodlands. Aside from the WICT EIS field surveys, this species had not been previously recorded in the area (according to ecological database searches), with the Broad-banded sand-swimmer (*Eremiascincus richardsonii*) more common within the Port Curtis region.

Photo 6.1 Narrow-banded sand-swimmer (*Eremiascincus fasciolatus*)

Four different gecko species were identified, with the terrestrial *Heteronotia binoei* and the arboreal *Gehyra dubia* the most prevalent species. Geckos are cryptic species with the majority of the species identified from a single specimen. It is likely that the open forests within the project area support a greater diversity/abundance of species than indicated.

The Eastern water dragon (*Physignathus lesueurii*) was abundant within the riparian zone of Larcom Creek and Calliope River. Other dragon species were generally depauperate with the Bearded dragon (*Pogona barbata*) recorded from the Bluegum forest.

Varanids were also under-represented with one species observed *Varanus tristis* (solitary specimen). However, other previous ecological studies have identified other species within the area, including the Lace monitor (*Varanus varius*).

Snakes that were most frequently recorded from the area included the Yellow-faced whipsnake (*Demansia psammophis*), Red-naped snake (*Furina diadema*), Brown tree snake (*Boiga irregularis*) and Carpentarian whipsnake (*Rhinocephalus boschmai*). Local landowners also confirmed the presence of large elapid species including the Common death adder, the Coastal taipan (*Oxyuranus scutellatus*) and the Eastern brown (*Pseudonaja textillis*).

Photo 6.2 Carpentarian whipsnake from mixed eucalypt forest near Larcom Creek

A solitary carpet snake (*Morelia spilota*), ingesting a Brown hare (*Lepus capensis*), was observed during the survey at the mixed eucalypt forest near Larcom Creek (refer Photo 6.3). However, anecdotal and incidental evidence (ie scats and skins) suggested that large pythons are widespread within the project area. The most obvious guilds absent from the project area during the survey were the fossorial (burrowing) elapids, *Simoselaps* genus.

Photo 6.3 Carpet snake swallowing a Brown hare

No threatened species were recorded from the project area, however anecdotal evidence indicated the presence of the Common death adder and Estuarine crocodile from the local area. Suitable habitat, dry sclerophyll woodlands, is present throughout the project area for the Common death adder.

The Common death adders inhabit a wide variety of habitats, in association with deep leaf litter. Habitats include those present within project area such as dry rainforest, woodland and grasslands. The current grazing activities and the proliferation of Cane toads within the area may have already impacted on local distribution and abundance.

Estuarine crocodiles have been recorded from the estuarine reach of the Calliope River. However, the recordings indicate a limited and restricted population and it is unlikely that the species has migrated into the freshwater reaches of the Calliope River.

The habitats of the Brigalow Belt bioregion are also known to support a number of threatened reptilian species. Essential habitat mapping identified two threatened reptile species, the Rusty monitor and the *Ophioscincus cooloolensis* from the local area (refer Figure 6.2).

Habitat within the project area is unlikely to support the Rusty monitor which is known to inhabit the coastal/mangrove environments of Port Curtis to the north east of the project area. *Ophioscincus cooloolensis* is a fossorial species that burrows in wallum and rainforest habitat, which are not represented or are limited within the project area (ie dry rainforest was associated with riparian zone of Scrubby Creek and drainage lines coming off Mount Larcom Range and other montane environments).

Other species which potentially inhabit the region but have not been previously described from the area are discussed below. The absence of these species can be attributed to the individual species habitat association (ie there is limited or no preferred habitat within the project area) and species known distribution (ie the species had not been recorded from the area and/or Calliope River catchment).

The Ornamental snake (*Denisonia maculata*) is restricted the Dawson and Fitzroy River drainage system. This species inhabits riparian woodland and open forest growing on natural levees. The species has been recorded from complex flooded gilgai which is the dominant landform within the project area. The gilgai had an abundance of frog prey (DEWHA 2008). Suitable habitat occurs within the project area in addition there is a high abundance of food as the Ornamental snake feeds almost primarily on frogs. However, the species is unlikely to inhabit the project area.

Dunmall's snake (*Furina dunmalli*) is predominantly restricted to the Brigalow Belt South and inhabits open forest woodland growing on floodplains of deep-cracking black clay and clay loam soils. With a similar habitat to the Red-naped snake which was observed in high numbers in the area, it is likely that this species may occur within the project area, particularly within the woodlands on the Calliope River and Larcom Creek floodplain such as the Bluegum open forest. Observations have been recorded for the Gladstone region.

The Yakka skink (*Egernia rugosa*), inhabits open dry sclerophyll forest or woodland such as that identified within the project area and local area. The skink often takes refuge among dense ground vegetation, hollow logs, cavities in soil-bound root systems of fallen trees and beneath rocks. Suitable habitat occurs within the region and project area, however this species has not been identified from the local area.

The Brigalow scaly-foot (*Paradelma oreintalis*) is restricted to the Brigalow Belt and is known to occur within the Gladstone region (Boyne Island) and EPA database from the Calliope area (EPA 2007). This species is known to occur within a number of habitats on several soil types, including open woodlands, particularly Ironbark forests that are prominent within the project area. Suitable habitat occurs within the project area, however this species has not been identified from the local area.

Other factors influencing species distribution include seasonal variation, cryptic nature, resource availability vagrancy and climatic patterns. The main threat from the Project to these species is the further loss of habitat and fragmentation.

6.2.5 Mammals

A total of 37 mammalian species were identified during the monitoring programme. This included 13 microchiropteran bats and six introduced species. Thus the project area has the capacity to support 56% of the species recorded from the Calliope River catchment.

A total of 11 native ground-dwelling mammals were recorded from the project area, including the Rufous bettong (*Aepyprmnus rufescens*), Eastern grey kangaroo (*Macropus giganteus*), Long-nosed bandicoot (*Perameles nasuta*), Short-beaked echidna (*Tachyglossus aculeatus*) and Swamp wallaby (*Wallabia bicolor*) which were the most abundant.

Small ground-dwelling mammals such as *Melomys* sp. were depauperate within the project area. Only two species, the Common planigale (*Planigale maculate*) and the Common dunnart (*Sminthopsis murina*), were recorded from project area (caught in pitfall traps). No mammals were trapped in any elliott or cage traps.

Four arboreal species were identified from the project area, including the Common brush-tail possum (*Trichosurus vulpecula*), Greater glider (*Petauroides volans*), Squirrel glider (*Petaurus norfolcensis*) and the Yellow-bellied glider (*Petuarus australis*). The latter two species illustrate the potential impacts human activity can have with both species identified from specimens caught on a barbed wire fence near Larcom Creek.

All of the arboreal species recorded are hollow-dependent and the age of the woodlands within the project area would influence local distribution and abundance. The greatest richness and abundance of arboreal species was observed within the Bluegum forest where a locally significant population of Greater gliders were identified and along Larcom Creek. Other factors, including the fragmentation of habitats and the clearing of vegetation also impact on their distribution.

A semi-aquatic species, the Water rat (*Hydromys chrysogaster*) was identified from incidental evidence (tracks and feeding behaviour) from Larcom Creek and Farmer Creek. The Platypus (*Ornithorhynchus anatinus*) has also been recorded from the Calliope River catchment (refer Section 7).

Exotic mammal species observed included the Feral cat (*Felis catus*), Rabbit (*Oryctolagus cuniculus*), Hare (*Lepus capensis*), Pig (*Sus scrofa*), Feral dog (*Canis familiaris familiaris*) and Dingo (*Canis lupis dingo*).

With the exception of the Little pied bat (*Chalinolobus picatus*) and the introduced species all of the mammals encountered during the survey are classified as least concern under the NC Act and are considered locally common and widespread within the region.

The Little pied bat occurs most frequently in dry, open woodland communities, including communities dominated by *Eucalyptus moluccana, E. tereticornis* and ironbark species such as those present in the project area. This species was identified foraging in open woodland adjoining the Calliope River and Larcom Creek (Aldoga Rail Yard). It is also thought that the species may be locally common near permanent or semi-permanent water in semi-arid environments (Environment Australia 1999).

This species predominantly roosts in hollow bearing trees and the removal of large potential roost trees such as the *E. tereticornis* on Larcom Creek, will be a major local threat. Other risks will be the general loss of foraging habitat.

In addition to this species, an additional 12 species of micropteran bats were recorded from the project area. This include cave roosting species such as the Eastern bent-winged bat (*Miniopterus schreibersii*), hollow dependent species such as the White-striped freetail bat (*Tadarioda australis*) and Large-footed myotis (*Myotis adverus*) which feed predominantly over open water.

An additional six threatened species were identified as potentially inhabiting the project area (refer Table 6.5).

Table 6.5 Threatened mammalian species potentially inhabiting the project area

Species	Common Name	Conservation Status
Chalinolobus dwyeri	Large-eared pied-bat	Vulnerable (NC Act, EPBC Act)
Dasyurus hallucatus	Northern quoll	Vulnerable (NC Act, EPBC Act)
Nyctophilus timoriensis (South-eastern form)	Eastern long-eared bat	Vulnerable (NC Act, EPBC Act)
Kerivoula papuensis	Golden-tipped bat	Rare (NC Act)
Hipposideros semoni	Semon's leaf-nosed bat	Endangered (NC Act)
Phascolarctos cinereus (SEQ bioregion)	Koala (southeast Queensland V 3 bioregion) bioregion)	Vulnerable (NC Act)

Of these species only the Eastern long-eared bat and the Koala (South East Queensland (SEQ) bioregion) have been recorded from the Calliope River catchment (EPA WetlandInfo 2007).

The Eastern long-eared bat inhabits River Red Gum forest, semi-arid woodlands and savannahs. It has also been recorded from box/ironbark/Callitris open forests in SEQ. This species has been recorded from the Calliope River catchment (Wetland Info 2007) and there is suitable habitat in the form of open *E. moluccana* (box) and *E. crebra* (ironbark) woodlands, dominant habitats within the project area. A species of *Nyctophilus* was identified within the open woodland forests of the project area.

Clearing and, in the remaining uncleared areas, timber harvesting, grazing and altered fire regimes are suspected threats.

The Northern quoll may potentially inhabit the project area and/or the surrounding habitats, in particular the Mount Larcom Range. Northern quolls prefer rocky habitat, often within Eucalypt forest and shelters in rocky crevices, hollow logs, tree hollows and caves.

The Large-eared pied bat is predominantly a cave-dwelling species and suitable habitat is generally associated with the Mount Larcom Ranges and montane environments surrounding the project area. These areas will not be directly impact by the Project, however there will be a loss of foraging habitat (ie dry sclerophyll forest).

Semon's leaf nosed bat forages within a range of habitats, including grassland and open woodlands, which are the dominant habitats within the project area. This species roosts in caves or mine shafts which are absent within the project area, but do occur within the surrounding montane environments such as Mount Larcom Range. This species was not identified during the field activities.

6.2.6 Essential habitats

Within the vicinity of the project area essential habitat areas occur for:

- Black-breasted button quail
- *Ophioscincus colloolensis*
- Rusty Monitor
- Little pied bat
- Koala (*Phascolarctos cinereus*) SEQ bioregion
- Wallum froglet (*Crinia tinnula*)

With the exception of the Koala, these species have been discussed in the lead up sections.

The project area is predominantly within the Brigalow Belt South bioregion, however the eastern extent of the project area does encroach into the SEQ bioregion. Within the SEQ bioregion essential habitat mapping defines the sub-dominant and dominant Endangered REs within the project area as essential habitat for Koala Southeast bioregion. The mapping is based on habitat modelling rather than species records (refer Figure 6.2).

No koalas were identified during the survey and from database searches from the area. In 2006, the Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016 (the 'Koala Plan') were implemented. Conservation plans are made under the NCA and prevail over existing planning schemes. The Nature Conservation (Koala) Conservation Plan 2006 is the subordinate legislation component of the Koala Plan made under the NC Act. The Koala Plan directs designation of koala districts and associated objectives.

Prescribes outcomes for Koala Habitat Areas and criteria against which development in these areas must be assessed:

- Prescribes sequential clearing and koala spotting requirements
- Includes additional wildlife permit restrictions for koalas

It is important to note that the project area is located within District C as described in the Koala Plan. Within this district there is evidence of decline, however koalas are classified as of least concern wildlife under the NC Act due to a generally lower perceived threat to their survival (EPA 2006). This is despite the area being within the SEQ bioregion, in which, koalas are listed as vulnerable under the NC Act.

An essential habitat for the Wallum froglet (*Crinia tinnula*) listed as under the NC Act was identified within the vicinity of the proposed WICT Project. As with the Koala habitat modelling has been used to define the essential habitat. The area is classified as RE11.3.29/12.3.12 (*Eucalyptuscrebra, E. exserta,* and *Melaleuca* spp. woodland on alluvial plains + *E. latisinensis or E. exserta* and *Melaleuca viridiflora* on alluvial plains) with the species restricted to freshwater swamps in lowland coastal areas of SEQ. The Gladstone Pacific Nickel EIS did not identify this species from the site (URS 2007).

Based on the species known distribution and habitat association it is unlikely to inhabit the project area.

6.2.7 Pest species

Pest species can impact on the biodiversity of an area through increased competition for resources, habitat destruction, weed distribution, increased risk of diseases and predation. Analysis of scats identified the diet of cats and dogs/dingos inhabiting the area was primarily rabbits, bandicoots and possums. It is likely that other native fauna such as small marsupials is also a common food source for these predators.

Of the 72 fauna species (excluding birds and bats) recorded from the surveys, approximately 10% are introduced and/or pest species. All of the exotic species encountered during this monitoring programme, with the exception of the Cane toads and cattle (which are listed as 'non-declared') are listed under the LP Act as 'declared' species. Other 'non-declared' animals were also present within the project area, including cattle and horses, and are primarily the result of land use activities within the area.

The distribution of pest species was generally confined to edge and/or disturbed environments and close to anthropogenic activities. Most of the project area is utilised as grazing land and is therefore highly disturbed and contains pest species.

The most common and abundant pest species were cane toads, rabbits and hares. However, there was strong evidence (tracks and scats) that feral dogs/dingos are also common throughout the area. Some of this evidence is likely to be due to domesticated dogs frequenting the area as the local landowners have dogs as pets and/or for work and recreational purposes (eg mustering and pigging).

A wild dog was observed along the Calliope River and at the mixed eucalypt forest adjoining Vallis Creek. Local landowners reported that feral dogs are an issue in the area, along with dingoes. The landowners have therefore undertaken baiting and trapping to control dog populations and reduce the risk of stock loss.

Species listed as Class 2 declared pest species[2] are cats, European foxes, European rabbits, feral pigs, feral dogs and dingoes. Landowners must take reasonable steps to keep land free of Class 2 pests (http://www.nrm.qld.gov.au/pests/pest_animals/declared/index.html). Local landholders were observed to have control measures in place for pigs, wild dogs and dingoes, with hunting and baiting the two main control measures in practice.

The impacts from the introduction of feral cats, foxes, feral pigs, rabbits and the cane toad are listed under the EPBC Act as Key Threatening Processes. A key threatening process is one that threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community (http://www.deh.gov.au/biodiversity/threatened/ktp/index.html). As a result, a number of corresponding threat abatement plans have been compiled to mitigate and reduce potential impacts.

Red imported fire ants (RIFA) *(Solenopsis invicta*) have been recorded from the Yarwun area, outside the project area (refer Figure 4.9). Fire ants are a notifiable pest under the *Plant Protection Act 1989* and landholders who think or know they have Fire ants are legally obliged to inform the DPIF of the infestation.

Fire ants are considered to be the greatest ecological threat to Australia since the introduction of the rabbit and are potentially worse than the Cane toad (http://www2.dpi.qld.gov.au/fireants/). This species is also listed under the EPBC Act as a Key Threatening Process.

6.3 Existing habitat values

The rich biodiversity within the project area is a reflection of the location of the area. This is because the project area encompasses an area of approximately 600 ha, including a diverse array of terrestrial and aquatic habitat types.

The major habitat types identified within the project area include dry sclerophyll forests, open grasslands, riverine/riparian communities and freshwater wetlands. Key habitats within the project area, including essential habitats and the habitats within which the Squatter pigeon was recorded have been mapped (refer Figure 6.2). Other important habitats within the project area were dry rainforest, vine thicket, floodplain communities and palustrine wetlands.

Although the habitat integrity is low, the overall habitat value of the project area could be assessed as being moderate due to the limited amount of connectivity remaining within the project area, placing more value on the remaining habitats. As a result of historic and current anthropogenic activities regional and localised impacts have resulted in fragmentation and further loss of habitat integrity.

Some of the current disturbances include linear disturbances (ie powerlines, gas and water pipelines, roads and railway lines), grazing, clearing/thinning and industrial activities. These activities and the resultant impacts affect an area's biodiversity, distribution and population dynamics. Natural processes (ie rivers) have also impacted on areas, causing fragmentation and limiting/restricting the movement of some species.

[2] A Class 2 pest is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. The management of these pests requires coordination. They are subject to programmes led by local government, community or landowners.

On a localised scale, habitat structure and subsequent value varies depending on anthropogenic and natural processes. The habitat value of the project area was largely dependent on microhabitat complexity, including:

- Groundcover type and density (ie grasses (native vs introduced) and leaf litter)
- Understorey composition and density
- Presence of rocky outcrops
- Presence of hollows
- Dead stags and exfoliating bark
- Soil type (ie cracking clays, sandy)

The microhabitats varied significantly within and between monitoring areas, providing many niche habitats for native and exotic species. The characteristics of the monitoring areas have been discussed further in Appendix E4.

The presence of many exotic plant species (particularly grasses) has altered the habitat significantly. Because much of the project area is maintained by slashing and/or fire, the assemblages of fauna existing within them changes depending on the microhabitat that the grasses provide.

Constant internal (maintenance and clearing) and external (noise and land use) disturbance have provided habitats for relatively disturbance-tolerant species as were found throughout the monitoring period (refer Appendix E2).

6.4 Potential impacts

6.4.1 Construction

The proposed infrastructure proposes to clear approximately 600 ha of vegetation within an already disturbed and fragmented landscape. From a holistic perspective, reducing the area of vegetation within an area already struggling to retain biodiversity and ecological function could result in long term effects due to a chain of events such as the following:

- Removal of vegetation reduces habitat for many significant, keystone species such as birds and bats
- This results in the disappearance of these species from within the local area
- The disappearance of such species will greatly reduce/eliminate the processes of seed dispersal and pollination of further flora species
- Ultimately this can cause a cascade effect that can have significant impacts on the continuation of ecosystems within an area

The proposed clearing of vegetation may have a direct impact on the fauna assemblages through:

- Loss of habitat and displacement of species
- Mortality as a result of vehicle strikes and destruction of hollows (eg hollow dependant species)
- Increased fragmentation
- Increase risk of ‘edge effects’
- Disruption of species behaviour
- Potential increased pressure from exotic and pest species
- Change in the fauna assemblages – the loss of some species as a result of Project activities may adversely impact on the ecosystem (potential collapse of a population). Alternatively another species may occupy the former species’ ecological niche.
- Potential reduction in stands of vegetation that serve as important buffer systems

In order to reduce the effects that such broadscale clearing and fragmentation can have on local ecosystems, habitat connectivity can be incorporated into design by:

- Considering measures to facilitate fauna movement
- Consideration of maintaining habitat adjoining creek and drainage lines (ie maximise vegetation retention within the project area)
- Consideration rehabilitation locations with respect to habitat links

Retaining vegetation along creek lines and maximising bridge spans can increase riparian zones and add value to remaining, tenuous habitat connections. Also incorporating endemic, low growing flora species under rail bridges will incorporate QR safety specifications as well as assist with continuing fauna corridors.

Protected areas

There are no protected areas under Commonwealth and State legislation within the project area (refer to Figure 3.3). However, there are a number of protected areas within the region which are discussed below.

Mount Stowe State Forest

Mount Stowe State Forest is located approximately 0.2 km to the south east of the project area (refer Figure 3.3). The Project will not have a direct impact on the environmental values of Mount Stowe State Forest if probably managed. However, there may be some indirect impacts (eg noise, dust and visual disturbances) on the fauna assemblage inhabiting this area.

Port Curtis

Port Curtis is located approximately 40 km downstream of the project area. This area is recognised under the EPBC Act as part of the Great Barrier Reef World Heritage Area. Port Curtis is also part of the Rodd's Bay Dugong Protection Area and is recognised under the Directory of Important Wetlands of Australia as a wetland of national significance.

There is the potential for the Project to impact indirectly on the ecological values this area. This includes changes to water quality (eg toxicants, nutrients) and environmental flows (local hydrology and reduced catchments), which will have flow on effects to the fauna assemblages inhabiting and/or frequenting Port Curtis.

Through the implementation of relevant mitigation measures and procedures during construction and operation the potential impacts of the Project on Port Curtis environmental values are likely to be minimal. Other factors which will reduce the potential impact include the ephemeral nature of the Larcom Creek catchment, the nature and type of works, and the location of the project area with respect to the Calliope River.

Essential habitats

Essential habitat for four fauna species were identified within close proximity to the project area (refer to Figure 6.2). An essential habitat is created based on actual recordings and/or habitat modelling for significant species pursuant to the NC Act. The essential habitats identified in the project region are for the following species:

- Black-breasted button quail (*Turnix melanogaster*) – Vulnerable status (NC Act and EPBC Act)
- *Ophioscincus colloolensis* – Rare status (NC Act)
- Rusty Monitor (*Varanus semiremex*) – Rare status (NC Act)

- Koala (*Phascolarctos cinereus*)
- Little pied bat (*Chalinolobus picatus*) – Rare status (NC Act)

The project area does not intersect these habitats, however suitable habitat is present within the project area for some of the species, including the Little pied bat which was recorded from a number of locations within the project area.

The risk of indirect impacts on protected areas within the region as a result of the Project's construction phase is considered to be low.

Fauna population

A total of 164 species were recorded during the monitoring programme as inhabiting and/or frequenting the project area. Grazing activities and pressures within the project area have impacted on the area's biodiversity and habitat complexity (ie the area has been significantly cleared and is predominantly native pastoral grasslands). Linear disturbances (eg roads, pipelines and railway lines) and other anthropogenic activities such as clearing for industrial development within the GSDA have also impacted on the areas biodiversity and composition.

Under the NC Act all native plants and native animals area protected and cannot be harmed without appropriate licensing and permits. Construction activities associated with the Project may have an adverse impact on the local fauna population. Potential impacts may include:

- Translocation and/or displacement of species
- Loss/disturbance of habitat
- Removal of hollow bearing trees
- Loss of microhabitats (rocky outcrops, hollow logs)
- Increased edge environment
- Changes in soil composition
- Increased pressure for resources
- Linear disturbances, isolating previously contiguous habitats

Invertebrate species were not targeted during the monitoring programme, however some species of invertebrates (eg butterfly) are listed under the State legislation. The Project may have an adverse impact on the microbial and invertebrate assemblages associated with the project area including the loss of a particular group or a keystone species within the food web. For example, native bees are important in the pollination of plant species and also possess cultural heritage value. Many birds are also significant seed dispersers and without this mechanism of dispersal, vegetation communities may become isolated.

The extent to which construction activities produce long-term adverse impacts upon local fauna assemblages will be dependant upon the resilience/tolerance of the affected species and the viability of the habitat retained.

Threatened species

During the field activities four species listed under Commonwealth and/or State legislation were identified from the project area. In addition, a previous ecological study of the riparian zone of the Calliope River identified an additional two threatened species. The potential impact of the Project's construction phase on these species has been discussed below.

Black-necked stork

The Black-necked stork was observed foraging within Farmer Creek. The primary threat associated with this species is the loss, degradation and fragmentation of its habitat, including the modification of floodplain habitats.

The construction phase of the Project has the potential to impact on this species due to the reduction and/or modification of the Calliope River and Larcom Creek floodplain (including stags which may be used as nest trees), changes in ecosystem dynamics and reduction in ecosystem health (eg degradation in water quality due to sedimentation or the introduction of toxicants). Other impacts include disturbance to species behaviour due to noise, dust and visual movement.

Potential impacts are likely to be short-term (duration of construction) due to the linear disturbance and implementation of appropriate mitigation measures (refer Section 6.5).

Squatter pigeon

The Squatter pigeon is listed as a vulnerable species under the NC Act and the EPBC Act. This species was common throughout the project area. It was generally associated with open grasslands adjoining fragmented remnant vegetation.

The main risk to individuals is vehicle and equipment movement during construction. This species is predominately a ground-dwelling species which when disturbed remains still and adopts a low profile to avoid detection. In addition, this species nests on the ground, usually laying two eggs in sheltered positions (Morecombe 2006).

This risk can be mitigated through an inspection of the alignment prior to any clearing activities and mapping nest sites with an appropriate buffer created during the breeding season. Other mitigation measures have also been outlined in Section 6.5.

In the long-term the further loss of habitat due to development in the GSDA could potentially threaten this species.

The proposed development will result in the loss of habitat and/or further fragmentation of existing habitat within areas in which the Squatter pigeon was observed (ie Moluccana forest near Larcom Creek and *E. crebra* near Farmer Creek). The impact of fragmentation on this species is still unknown, but it is likely that the species has shown a degree of resilience to previous linear disturbances and loss of habitat in a local scale. From records taken during the survey the species has displayed behaviour suggesting it has adapted to linear disturbances within its habitat, with the species foraging along the sides of road and rail lines.

Unlike some other bird species the Squatter pigeon has poor mobility and the linear disturbance will further exasperate movement (ie the Moura Link will server existing habitat and obstruct species movement).

Although the Central Queensland population appears to be stable the species is still at risk from loss of habitat (Houston *et al* 1999). Through the implementation of specific mitigation measures it is anticipated that the level of impact on this species will be low.

Under the EPBC Act a nationally vulnerable species is considered significantly impacted upon if a Project will or is likely to:

- Lead to a long-term decrease in the size of an important population of a species
- Reduce the area of occupancy of an important population
- Fragment an existing important population into two or more populations
- Adversely affect habitat critical to the survival of a species

- Disrupt the breeding cycle of an important population
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- Result in invasive species that may impact on a vulnerable species becoming established in a suitable habitat
- Interfere substantially with the recovery of a species

Under these conditions it is unlikely that the Project will have a significant impact on this species and/or other vulnerably listed species under the EPBC Act.

Tusked frog

The Tusked frog is listed as a vulnerable species under the NC Act. This species was observed in high abundance at an ephemeral wetland on Larcom Creek.

Habitat degradation is considered one of the major threatening processes affecting the survival of this species. The Tusked frog is at risk of local extinction when populations become small and scattered, a process which is intensified due to habitat fragmentation. Subsequently the construction phase of the Project could potentially impact on the Tusked frog through the modification of the species' habitat through vegetation clearing and potential weed proliferation.

Additionally vegetation clearing can reduce the buffering capacity of an area. This may result in an adverse impact to the species as an increase in exposure to ultra-violet radiation is thought to shorten the species' life-span. Construction activities may also potentially impact the species' habitat through changes in hydrological regimes and water quality. These effects could be long term if viable habitat is destroyed as a result of construction activities therefore reducing habitat resources for any existing or future populations.

Several studies have been conducted to determine the effects of habitat disturbance on the Tusked frog and a study by Frances Lemckert (1999) established that the species appeared to be dependent on undisturbed patches of vegetation, therefore further confirming that disturbance within known habitats should be limited wherever practically possible.

Donna Hazell (2003) also discusses that altered hydrological regimes as well as increased nutrient and sediment loads are considerable threats to the survival of this species. This is a risk associated with the Project as it will result in the disturbance of approximately 600 ha including floodplain and wetland habitats and a number of watercourses. Hence, there will be a need for strict adherence to suitable erosion and sediment controls during construction and until disturbed sites have been reconsolidated.

If vegetation clearing, earthworks and other anthropogenic activities are limited adjacent to watercourses, pond and wetland habitats the Project's impact upon the Tusked frog can be reduced significantly. Specific mitigation measures for this species are discussed in Section 6.5.

Little pied bat

The main threat to this species is the loss of habitat which will impact on species roosting (eg hollow-bearing trees) and foraging (open woodlands) behaviour. Suitable roosting and foraging habitat is present throughout the area and the proposed construction activities could result in the loss of this habitat. A direct threat to the species is the removal of current roosts, which may result in the direct loss of individuals. Other impacts are associated with the increase activity within the area which may disrupt roosting behaviour.

Common death adder

The main risk to this species is associated with the clearing of vegetation which may remove habitat including woody debris and rocks that provide refuge.

During the construction activities there will be a significant increase in the number of people occupying the project area increases the risk of encountering this species. Therefore, there is a risk to individuals due to the vehicle and equipment movement and also through human nature and misunderstanding of snakes ecological importance. Other potential impacts include changes to predator-prey interaction (ie loss of prey species) and the proliferation of feral species including Cane toads.

Glossy-black cockatoo

The main risk to this species is associated with the clearing of vegetation which may remove *Allocasurina* spp. and hollow-bearing trees suitable for nesting.

Allocasurina was recorded within riparian zone of the Calliope River and a previous study recorded Glossy-black cockatoos as utilising this feeding resource. The high water banks of the Calliope River have been thinned and cleared, however suitable hollow-bearing trees are present within the project area (ie hollow-bearing *E. tereticornis* were identified along the property boundary between Farmer Creek and Calliope River).

The Moura Link Eastern Option intersects an area of the Calliope River which has already been disturbed (ie 50 m section of the high water bank vegetation and the riparian zone has been removed to allow cattle movement). The construction activities associated with the Moura Link Western Option will disturb a larger area of vegetation (ie the area is relatively intact compared to the other sections of the Calliope River).

The loss of riparian vegetation should be minimal due to the high banks of the Calliope River. Also the strategic location of the pilings should also assist in minimising any impacts.

Black-chinned honeyeater

The main threat is the loss and/or degradation of *E. Moluccana* and *E. crebra* woodland within the project area. With the exception of the introduced grassland this was the dominant vegetation community within the project area. The construction of the Moura Link will result in the loss of this habitat (refer Section 5.4) and increase fragmentation especially within the Ironbark community.

This species is highly mobile and the potential impacts associated with the construction activities are likely to be short-term and include disturbance to local movement and feeding behaviour.

Estuarine crocodile

The Estuarine crocodile is listed as a vulnerable species under the NC Act and as a migratory species under the EPBC Act. The species has been recorded within close proximity of the project area (*pers comm* Local landowner).

Habitat destruction is considered a major threat to the survival of this species in Queensland. The works within the Calliope River will be short-term (construction of bridge structure) and suitable habitat is limited adjacent the proposed alignment options (ie large pool habitats). However, the species may potentially migrate upstream during high flows within the catchment. Other impacts are associated with changes to the water quality and environmental flows due to the construction works. These impacts and relevant mitigation measures have been discussed further in Section 8.

The construction phase of the Project is not anticipated to adversely impact the behaviour or habitats of the Estuarine crocodile.

Other species

The desktop studies also identified an additional 16 threatened species which potentially inhabit the project area. These species were not identified within the project area within the project area during the monitoring programme. However, the Project may impact on these species, if present, the reduction and/or degradation of suitable habitat required for foraging and roosting purposes and the movement of construction equipment and vehicles. Other potential adverse impacts may include increased pressure as a result of microclimate changes, pressure from exotic/pest species and changes in web dynamics.

Migratory species

An EPBC Act protected matters report (refer Appendix E1) identified 10 migratory species that may inhabit the project area. Five of these species were identified within the project area during the monitoring programme, these included:

- Cattle egret
- Spectacled monarch
- White-bellied sea eagle
- Rainbow bee-eater
- Cotton pygmy-goose

Within the project region, the woodlands, forests and wetlands associated with Port Curtis area and the intertidal wetlands associated with the Calliope River are considered important habitats for migratory species. The rainforest habitat associated with the Mount Larcom Range situated to the east of the project area is also considered vital habitat for migratory species such as the Rainbow bee-eater. Suitable habitat for migratory species within the project area is thought to be limited.

Construction activities may adversely impact upon migratory species in the project area through:

- Loss/degradation of habitat
- Reduction in the buffering capacity of the project area
- Generation of dust, noise and light
- Changes in food web dynamics through anthropogenic activities (ie loss of certain species, change in behaviour of species)

The construction activities associated with the Project may alter the movement, roosting and feeding behaviour of those species identified within the project area. However the Project is unlikely to have a significant impact on these species.

Under the EPBC Act, a migratory species is significantly impacted on if a project will or is likely to:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species.
- Result in invasive species that impact on the migratory species becoming established in an area of important habitat of the migratory species.
- Seriously disrupt the life cycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Vegetation clearing

Vegetation clearing is the principal impact of the Project that is likely to have an impact on the biodiversity of the area. Vegetation clearing activities may impact on the fauna assemblages through:

- Mortality as a result of construction activities (eg vehicle strikes, removal and/or disturbance of nests, hollows and burrows)
- Loss of important habitats and habitat complexity
- Increase fragmentation and linear disturbances
- Reduction and loss of wildlife corridors
- Increased the potential risk of "edge effects"
- Disturb species behaviour (ie some species are more susceptible to anthropogenic activity)
- Increase pressure from exotic and/or pest species
- Change in the fauna assemblages – the displacement/loss of some species as a result of the activities and/or a species occupying the "vacant" ecological niche. Such changes may potentially impact on the dynamics of the ecosystem (potential collapse of a population).
- Removal of stands of vegetation which act as important buffer systems (noise and visual)

Anthropogenic activities within the area have impacted on the ecological integrity of the habitat within the project area. This includes the loss of biodiversity through land clearing fragmentation, invasion of weeds/introduced species (eg Giant rats tail grass) and changes to habitat complexity and structure.

The loss of habitat within an area will influence fauna densities and distributions, and potentially result in localised species reduction. This may occur through:

- Hollow dependant fauna is likely to be impacted by vegetation clearing. The removal of large hollow bearing trees may result in the displacement/loss of species, increased competition for resources and susceptibility to predation.
- Loss of important feeding resources (flowering species are important for a range of species).
- Impact on invertebrate biodiversity which would impact on higher trophic organisms (insectivorous birds and bats).
- Plant-animal interaction and symbiotic relationships (eg the Mistletoebird is found wherever mistletoe grows and is important in the dispersal of this plant species).
- Reduces the core habitat for some species and increases the pressure from "edge effects".
- Reduces the capacity of a habitat to support some species.
- The loss of vegetation reduces the microhabitats available within an area (leaf litter, loss of rocky outcrops).
- Reduces the capacity of some species to move through the landscape (small ground dwelling mammals prefer denser ground/under storeys).
- Change to understorey and groundstorey reduces resources (nesting feeding) and changes fire regimes.
- Increase the pressure from other processes, including erosion, exotic/pest species, and water quality degradation.
- The loss of habitat also increases the importance of existing habitats and wildlife corridors.

The loss of vegetation and changes in habitat structure will also impact on the recovery/re-colonisation of an area (limits diversity within the fauna assemblages). This is due to the size and structure of the habitats, absence of wildlife linkages, increased pressure from "edge effects" and anthropogenic activities.

Clearing for construction and other land use activities within the region is likely to increase the reliance of resident fauna on remaining corridors. Many of these species displaced by activities are likely to persist in areas adjacent to the project area despite further anthropogenic activities. This will increase the competition for resources, however it is unlikely to have a significant impact on the faunal biodiversity of the area.

Vegetation clearing and linear disturbances associated with the Project will impact on the size and integrity of the wildlife corridors within the project region. Wildlife corridors are important in fauna movement and population viability. Although there are limited wildlife corridors within the project area the removal of remnant vegetation will increase fragmentation and linear disturbances in the project area, resulting in edge effects and thus potentially impacting and/or impeding fauna movement and dispersal.

The proposed construction activities have the potential to impact on the movement and migration of species locally and regionally. Impacts may include temporary and permanent linear disturbances, removal of wildlife corridors, change in drainage patterns, gullies and cuttings, culverts, stockpiles, trenching, fencing, noise and dust generation, lighting and pollution.

Existing vegetation not only provides important habitat, but also allows species movement and dispersal. The loss or reduction in the size of wildlife corridors will impact on the movement and dispersal of some species. The faunal groups most likely to be affected by reduced habitat linkages are:

- Gliders and possums that may inhabit small patches of vegetation communities as well as larger areas of vegetation
- Some forest-dependent birds
- Small reptiles (especially skinks) that do not venture into open habitats
- Small skulking or forest dependent birds that prefer to travel across the landscape close to the shelter of thick vegetation
- Small marsupials that do not venture far from, or are dependent on the shelter of thickets and/or dense vegetation

Exotic/pest wildlife species

During construction activities there is a risk of introducing and/or translocating pest/exotic species. Approximately 8% of the fauna species identified inhabiting the project area are introduced and/or pest species.

Pest species can impact on the biodiversity of an area through increased competition for resources, habitat destruction, weed distribution, increase risk of diseases and predation. Alternatively the changes to the habitat structure as a result of exotic/invasive flora species can also have an impact on the fauna assemblages (ie some native species are susceptible to change and maybe displaced by exotic/disturbance tolerant species).

Recent investigations (2006/2007) identified Fire ants within the Yarwun Industrial area, adjacent the project area. Construction activities associated with the Project may potentially result in the reintroduction and/or translocation of the Fire ants within the project area. Subsequently, the mitigation measures outlined in Section 20 (ie Soil handling and management sub plan) will need to be implemented to minimise the risk of translocation from the Yarwun Industrial area to the project area.

Bushfire

Fires are an important factor in shaping the dynamics and health of an ecosystem. Many species have developed specific mechanisms to survive periodic fire, while some species depend on fire regimes for critical life stages. Fires may be the result of natural and/or anthropogenic processes.

The impact of fire on a given ecosystem will vary depending upon its intensity, season and the time since the last fire, as well as the species involved. Activities within the area will increase the risk of fires occurring more frequently. Potential sources of concern are human activity (eg smoking and littering) and the operation of equipment (eg sparks associated with trains and heavy machinery).

Fuel load will affect fire intensity and the speed with which a fire spreads. The current land use practices within the area have already influenced fuel loads and reduced the mosaic structure of the area (eg significant areas of grasslands). The proposed construction activities associated with the Project are likely to have an impact on the fuel loads within the project area this includes the short term reduction in fuel loads and increase buffers zones (due to the removal of vegetation).

This risk in conjunction with isolated/fragmented communities can have a detrimental impact on the survival of a population. Changes in bushfire regimes can also have an impact on the dynamics of the ecosystem, which may ultimately impact on the biodiversity and ecosystem health.

Mitigation measures

Construction activities have the potential to adversely impact on the fauna assemblages inhabiting the project area. This includes a number of significant species under the NC Act and EPBC Act. However, the implementation of environmental management and mitigation measures during the construction and operational phases of the Project will minimise these potential impacts to an acceptable level. The mitigation measures are outlined in Section 20.

6.4.2 Operation

In conjunction with increased traffic (rail and road) within the project area, there will be a larger area of habitat exposed to anthropogenic activity. This increases the potential risk of environmental impact through:

- Frequency and intensity of fires (increased fuel loads, coal combustion, train, vehicle and machinery activity, littering and smoking)
- Hazardous substances entering the environment (fuels and chemicals)
- Air emissions (dust and gases)
- Noise and light sources
- Maintenance activities
- Exotic/pest species
- Mortality as a result of vehicles and machinery
- Waste generation (refer Section 12)
- Waste water/stormwater (refer Sections 8 and 12)

The subsequent loss of vegetation also reduces the buffering capacity of the area (ie vegetation communities act as important habitats but are also useful in buffering anthropogenic impacts (visual, noise, vibration, dust and lighting)). Consequently the impacts from operational activities may extend beyond the project area.

Protected areas

Operational activities within the project area increase the risk of environmental impact within the project region and consequently increase the risk of degrading the ecological and conservational values of the area. As the project area does not encroach into any protected areas this risk is considered to be minimal and subsequently the Project is not anticipated to have an adverse impact on significant environmental areas within the project region.

However, indirect risks may impact on the values of these areas. The main risks are through the introduction of pollutants into the aquatic systems which may ultimately impact on the environmental values of Port Curtis, and bushfires. Section 8 describes the potential impacts on water quality during the construction and operational phases. Other impacts include increase traffic along the NCL which may influence the distribution and composition of the faunal assemblages of the edge environment of Mount Larcom Range and Mount Stowe State Forest.

Fauna population

Operational activities associated with the Project may have an adverse impact on the local fauna assemblages. Potential impacts may include:

- Vehicle and train strikes
- Noise and dust generation
- Artificial lighting on habitats
- Air emissions
- Degradation of water quality

Vegetation clearing activities associated with the construction phase of the Project may reduce the project areas buffering capacity and thus increases the risk of operational impacts such as noise, dust generation and lighting adversely impacting the local fauna assemblages.

The operational phase of the Project may also have an adverse impact on the microbial and invertebrate assemblages associated with the project area and adjoining areas. This could negatively impact on the dynamics, biodiversity and health of the ecosystem (ie loss of a particular group or a keystone species within the food web such as pollinating species).

The frequency and care by which the rail and road infrastructure will be used will be a key contributing factor by which local fauna assemblages are adversely impacted upon by the operational phase of this Project.

The proposed development has the potential to further restrict fauna movement and dispersal (excluding mobile bird species). The current design does follow existing linear disturbance which have already impacted, to a degree, on fauna movement and dispersal. Areas at greatest risk include the riparian zone of Larcom Creek and the Calliope River, and vegetation along the Moura Link which will be further fragmented, including the Blue gum forest and remnant vegetation along the Bruce Highway.

This will also increase the impact from operational activities as the natural buffering capacity of the vegetation will be reduced (ie the clearing of vegetation will reduce the core habitat area).

Threatened species

The potential impact of the Project's operational activities upon threatened species identified within the project area has been discussed below.

Black-necked stork

Whilst the behavioural and distributional patterns displayed by the species suggests it is resilient to anthropogenic threats (eg vegetation clearing), indirect impacts associated with the operational phase of the Project may impact on the species behaviour. A change in ecosystem health through influences such as degradation in water quality or the proliferation of weed/exotic species can impact on the species foraging and roosting behaviour in the area. Operational impacts such as the generation of dust, noise and artificial light may also influence the foraging and roosting behaviour of the species.

The Black-necked stork is considered a transient species of the project area, with coastal wetlands, mangrove communities and floodplain areas in the project region providing for the preferred habitat of the species. Subsequently the operational phase of the Project is not considered to adversely impact the species or areas of significant habitat.

Squatter pigeon

During the operation the main risk is the degradation of habitats due to the vegetation clearing, bushfire and the proliferation of invasive flora species such as Lantana and Giant rats tail grass. Other potential impacts include predation by feral species, localised impacts associated with the operation of the Aldoga Rail Yard (artificial lighting, noise and visual disturbances) and changes to water quality and hydrology of the area (eg this species is commonly associated with permanent water).

Maintenance activities especially along the Moura Link will also pose a risk to individuals. This species was identified in relatively high abundance within the southern section of the project area, and it is known to inhabit and/or frequent rail corridors. Therefore, vehicle movement along access tracks and general maintenance activities (eg slashing of grasses) may pose a risk to individuals.

Excessive predation from pest species presents a significant risk to the survival of the Squatter pigeon. The operational phase of the Project may influence the population of pest species within the project region thus impacting upon the viability of Squatter pigeon populations within the project region.

The proliferation of weeds (eg Giant rats tail grass) which may be a result of the operational phase of the Project can also adversely impact the species. In Central Queensland the establishment of Buffel grass pastures and the associated management practices (eg blade-ploughing) is considered a potential threatening process to the Squatter pigeon as the species tends to avoid treeless pastures which provide little food. Buffel grass does not provide a food source for the Squatter pigeon. Although the Project will not involve the sowing of Buffel grass pastures the example illustrates the potential impact weed proliferation within the project area may have upon the behaviour of the Squatter pigeon.

The generation of dust, noise, vibration and artificial light from the Project may impact on the species feeding and roosting behaviour. These impacts are anticipated to be minimal due to the expected intermittent nature of rail and road traffic.

Squatter pigeon communities within the project region are considered to have adapted to a degree of disturbance with the species recorded foraging at the edges of rail tracks and roads. Through the implementation of appropriate mitigation measures and procedures such as fencing the rail infrastructure is anticipated to have a minimal impact upon the species.

Tusked frog

The operational phase of the Project may have an adverse impact on the Tusked frog populations of the project area. The viability of the population may be affected by decreases in ecosystem health resulting from degraded water quality and localised changes to hydrology and overland flow.

Maintenance activities may potentially result in severe reductions in the Tusked frog's population size. The use of herbicides to control weeds on the project area can harm the Tusked frog. Additionally a reduction in moisture levels as a result of road works, vegetation clearing and altered fire regimes can also severely reduce the species populations.

The predation of eggs and tadpoles by introduced fish species such as the Mosquito fish (*Gambusia holbrooki*) and competition with the Cane toad is a threatening process associated with the Tusked frog. The operational phase of the Project may potentially increase the presence of such pest species.

Changes to the hydrology of habitat areas of the species may result in population decreases. This is something that can be remedied during the detailed design phase, however if not appropriately mitigated it could have serious detrimental effects on local populations.

Disturbances associated with the general operational activities of the Project, such as noise, vibration, dust and artificial light may impact upon the species feeding, resting and calling behaviours. If appropriate mitigation measures are employed (refer Section 6.5) the Project is unlikely to severely impact on the Tusked frog. If these measures are implemented it is considered unlikely that the operational phase of the Project will result in the species displacement or significant decreases in population size.

Little pied bat

During operation the artificial lighting may impact on species behaviour (ie the lights will attract insects the primary food source for this species). Other impacts may be associated with this species utilising hollow-bearing trees along Larcom Creek for roosting.

Common death adder

During operation the activities associated with the proposed Aldoga Rail Yard may impact on this species behaviour (ie artificial lighting may impact on species as it is diurnal and nocturnal). There is also a risk to individuals due to human activities and people's misunderstanding of snakes ecological value. Other potential impacts include changes to predator-prey interaction (ie loss of prey species) and changes to local fire regimes.

Black-chinned honeyeater

The proposed Aldoga Rail Yard may impact on the local movement and behaviour of this species (eg noise, dust and visual disturbances). It is unlikely that the operation of the trains along the Moura Link will impact this species due to it high mobility and it behaviour (ie this species is known to move around local movement based on food resources).

Other risks include changes to existing habitat values as a result of bush fires, the proliferation of weeds, changes to water quality and hydrological regimes.

Glossy-black cockatoo

The proposed Aldoga Rail Yard may impact on the local movement and behaviour of this species (eg noise, dust and visual disturbances). However, no feeding resources (*Allocasurina* spp.) were identified within this area. There was suitable breeding habitat in the form of hollow-bearing trees along Larcom Creek, which may be used by this species.

It is unlikely that the operation of the trains along the Moura Link will impact this species due to the species high mobility and behaviour. Other risks include changes to existing habitat values as a result of bush fires, the proliferation of weeds, changes to water quality and hydrological regimes.

Estuarine crocodile

The main impact associated with the operational phase of the Project is changes to the environmental values (hydrology and water quality) of the Calliope River and Port Curtis. These potential impacts have been discussed in Section 8.

The operational phase of the Project is anticipated to have a negligible impact upon the Estuarine crocodile.

Other species

Desktop studies also identified a number of other threatened species which potentially inhabit the project area. Operational activities may impact on the feeding and nesting behaviour of these species utilising areas adjoining the project area through increased lighting and the generation of dust, noise and vibration. This will be enhanced through the removal of buffering vegetation between the infrastructure and suitable habitat. Other risks include changes to existing habitat values as a result of bush fires, the proliferation of weeds, changes to water quality and hydrological regimes.

Migratory species

Impacts such as the generation of dust, noise, vibration and artificial light associated with the operational phase of the Project may impact upon the behaviour of those migratory species which frequent areas adjoining the project area. Operational activities may also impact upon the complexity and health of habitats through the introduction of pest/exotic species, contamination/pollution, degradation in water quality and edge effects.

Comprehensive information on breeding ranges, migration routes, important staging areas, non-breeding sites, feeding requirements, population changes and the quality, carrying capacity and seasonal/annual usage of habitat is not available for many waterbirds. This gap in information can limit the understanding of the importance of habitats and the potential impacts associated with the project activities. Additionally data relating to impacts of historical operations on species behaviour within the project area is limited.

Whilst the operational activities of the Project may impact upon the behaviour of those migratory species which frequent the areas adjoining the project area, the Project is not considered to have a significant impact upon migratory species within the Calliope region as the Project's operations are unlikely to directly impact on any areas identified as significant migratory species habitat.

Habitat values

The extent to which construction activities impact upon the habitat values of the area will influence the degree by which those affected species are resilient to operational impacts. The majority of the fauna species identified within the project area are considered common and widespread within the Calliope region and have exhibited a degree of tolerance to habitat fragmentation and anthropogenic activities in the region.

The Project will create a linear disturbance on the project area. Linear disturbances can impede and/or impact local fauna movements. Impacts upon fauna movement can result in increased competition for resources, loss of genetic diversity and subsequent changes in the area's biodiversity.

The operational activities associated with the Project may adversely impact upon the habitat values of the area through the generation of dust, noise and artificial light. Contamination of local watercourses and soil resources through oil, chemical and rubber residues on the access road and maintenance areas, litter, air emissions and introduction of pest/exotic species can also adversely impact the habitat values of the area.

The Project may also improve the habitat values of the area through the implementation of weed and pest management practices, and rehabilitation and revegetation activities in areas which have reduced habitat value. The revegetation activities may increase linkage between existing habitats and/or increase the size, over time, of core habitats. Other benefits may include improved hydrology, construction of artificial wetlands and fauna movement along existing linear disturbances.

Exotic/pest wildlife species

The introduction and/or translocation of a declared pest/exotic species is a potential impact associated with the operational phase of the Project. Pest species can adversely impact on the biodiversity of an area and have a subsequent detrimental impact on fauna assemblages through increased competition for resources, habitat destruction, weed distribution, native species displacement, increase risk of diseases and predation. This impact is further exasperated if the core habitat of an area has been reduced (eg fragmented due to clearing) limiting the habitats carrying capacity.

Weed species are already prevalent in some areas of the Project, in particular Giant rats tail grass within the Larcom Creek subcatchment. The further disturbance of vegetation and topsoil has the potential to increase the local and regional proliferation of this species which can have an adverse impact on biodiversity.

This may also result in the introduction and/or proliferation of introduced and/or disturbance tolerant species, including rabbits, hares and the Common brushtail possum. This may disrupt the equilibrium of the area due to competition for resources and predation resulting in displacement and/or loss of less tolerant species.

Rail and road traffic

An increase in the rail and road traffic from the Project may have an impact on the local fauna assemblages. The increased train and vehicle traffic may result in vehicle strikes leading to serious injuries and fatalities to native fauna. The risk of vehicle strikes to native fauna is considered low due to the intermittent nature of the expected train and vehicle traffic.

The Project can also have an adverse impact upon fauna movements. The steep nature of rail embankment can impede the movement of some native species, effectively creating a long consistent barrier for the length of the rail line.

Artificial lighting

Artificial lighting associated with the rail and road infrastructure may have an adverse impact on the local fauna assemblages. It is anticipated that the proposed Aldoga Rail Yard will operate 24 hours a day, seven days week and therefore will have significant lighting requirements.

Artificial light is thought to adversely impact fauna assemblages through:

- Altering species foraging and resting behaviours
- Exposing species to predation

In the United States, research on a particular species of nocturnal frog has shown that sudden exposure to artificial light reduced the ability of that species to detect and thus consume prey (Buchanan 1993). Frog habitat was prevalent throughout the project area, however the area most at risk is associated with the proposed Aldoga Rail Yard (ie Larcom Creek, including the adjoining floodplain Gilgai and ephemeral wetlands). Consequently frogs, including the NC Act listed Tusked frog, may be affected by the artificial lighting associated with the proposed works in these areas.

Vehicle and train traffic is anticipated to be intermittent, resulting in an intermittent directional point source of artificial light. Lighting associated with other rail infrastructure such as the rail yard and associated offices is expected to be minimal. Consequently the increased level of artificial lighting is likely to have minimal impact on local fauna assemblages.

Bushfire

Fires are important in forming the Australian landscape, however communities may be more susceptible to damage due to changes in habitat structure (increased fuel loads) which results in increased intensity of fires. This includes sensitive habitats and/or important refuges such Dry rainforest, Semi-Evergreen Vine Thicket and Squatter pigeon habitat.

Changes in bushfire regimes can have an impact on biodiversity and ecosystem health. The changes to the landscape due to the construction activities may also increase the adjacent fuel loads and reduce the areas buffering capacity (ie remove and/or reduce mosaic structure of the landscape).

The increased fuel load, in addition to increased activity within the area will potentially increase the risk and frequency of fires occurring. Potential sources are human activity (eg smoking and littering), coal combustion and the operation of equipment (eg sparks associated with trains).

Mitigation measures

Rail and road operational activities have the potential to impact on the fauna assemblages inhabiting the areas adjacent to the Project. This includes a number of species listed under the NC Act and/or the EPBC Act. However, the implementation of environmental mitigation measures during the operational phase of the Project will limit the impacts to an acceptable level. The mitigation measures are detailed in Section 20.

6.5 Mitigation measures

The measures proposed to mitigate potential impacts on terrestrial fauna for the Project are discussed in Section 20.

6.6 Conclusions

During the field surveys 192 fauna species were recorded from the project area. Generally, the fauna species encountered within the project area are common and widespread within the project region and are associated dry sclerophyll woodlands and forests. However, four threatened species were identified from habitats within the project area.

The project area is located within the Larcom Creek subcatchment which has been heavily cleared or modified for grazing activities. This has impacted on the area's biodiversity and habitat value with the landscape predominantly introduced grasslands. This increases the importance of remaining habitats and wildlife corridors to the area's faunal assemblage.

Habitat destruction and modification as a result of vegetation clearing and associated edge effects is anticipated to be the main impact to native fauna as a result of the Project's activities. This will result in the displacement of some fauna species to surrounding habitats.

The implementation of mitigation and management measures during the construction and operation of the Project will assist to minimise potential adverse impacts to terrestrial fauna and habitat value within and adjacent the project area.

6.7 Commitments

The terrestrial fauna commitments relevant to the Project include:

- Measures in the CEMP and OEMP to address fauna and pest management issues and mitigate the loss of ecological value.