

## 2. Methods and Results

### 2.1 Ecological Communities

One endangered ecological community, Lowland Subtropical Rainforest on Floodplain, has the potential to occur in the study area. To identify vegetation that may be commensurate with this community, rainforest vegetation from Comprehensive Regional Assessment Aerial Photograph Interpretation (CRAFTI) maps, prepared by DEC, was overlaid on contour maps to identify rainforest vegetation existing on floodplains, in other words, relatively flat, low lying alluvial areas. The resultant overlay showed that rainforest was associated with steep hillsides and gullies, which is clearly not part of a floodplain and not Lowland Subtropical Rainforest on Floodplain (Figure 2).

It should be noted that the DEC CRAFTI map has not been verified by a detailed field survey, and as such there may be small areas of Lowland Subtropical Rainforest on Floodplain that are not identified on this map. Vegetation communities in the study area differ in terms of their conservation status and distribution (Table 2.1). Communities located on more fertile soils, such as Flooded Gum and Tallowwood, have been extensively cleared and have a high conservation status, whereas communities less amenable to agriculture, such as Blackbutt, have been less extensively cleared and have a lower conservation status. The conservation status and distribution of vegetation communities likely to be impacted by the proposal is shown in Table 2.1 and Figure 2.

<b>Table 2.1: Distribution and Conservation Status of Impacted Vegetation Communities</b>	
<b>Booyong</b>	
<u>Distribution:</u> The footprint of Option IN2 touches the edge of a small area of this community. Tall (12-20 metres) closed forest located on stream banks and narrow floodplain, generally only 10-30 metres wide along the upper reaches of streams in the Coast Range and foothills. In steep, hilly country, sometimes extending to lower hill slopes in deep protected gullies.	
<u>Conservation Priority:</u> <b>High</b>	
<u>Synonyms:</u> Stream bank subtropical rainforest equates with the Black Booyong alliance, sub-alliances 7 or 9 of the rainforest classification of Floyd (1990). This community is common along small streams in the coastal ranges of the Coffs Harbour district. Although these communities are relatively widespread, all rainforests are protected from logging and clearing in NSW and generally considered of high conservation value.	
<b>Flooded Gum</b>	
<u>Distribution:</u> Valleys on all Inner Bypass Options and the Existing upgrade. Tall to very tall (20-40m) open forest. Valley floors and lower slopes throughout the Coast Range and foothills. Sites generally have less topographic protection from fire than those occupied by Brush Box do.	
<u>Conservation Priority:</u> <b>High, poorly conserved, protected or floristic variant</b>	
<u>Synonyms:</u> This community is equivalent with forest type 48 Flooded Gum or EF010a-b of Hager and Benson (1994), considered poorly conserved in upper north eastern NSW. In the forest ecosystem classification this association appears to be equivalent to FE154 Wet Flooded Gum-Tallowwood of which 62% has been cleared with 9317ha remaining. This is a high rate of clearing indicative of lowland distribution and poorer representation in the reserve system.	
<b>Tallowwood</b>	
<u>Distribution and condition:</u> Found along all Inner Bypass Options and a small area along the Existing Highway Option.	



<b>Table 2.1: Distribution and Conservation Status of Impacted Vegetation Communities</b>
<p>Tall to very tall (30 to 45m) open forest. Located on mid to lower slopes between Flooded Gum and Blackbutt communities, where free quartz is less available. Found on a range of aspects and topographic positions, but is best developed on sheltered slopes of moderate to high fertility.</p> <p><u>Conservation Priority:</u> <b>High, inadequately conserved</b></p> <p><u>Synonyms:</u></p> <p>This community is equivalent with forest type 45 Tallowwood or EF0165a of Hager and Benson (1994) considered inadequately conserved in upper north eastern NSW.</p>
<b>Moist Blackbutt</b>
<p><u>Distribution:</u></p> <p>Found along all Inner Bypass Options and the Existing Highway Option, except for the Option IN2.</p> <p>Tall to very tall (40m) open forest. A community of mid to lower hill slopes with a protected south west to south east aspect.</p> <p><u>Conservation Priority:</u> <b>High, inadequately conserved</b></p> <p><u>Synonyms:</u></p> <p>This community is equivalent with forest type 36 Moist Blackbutt or EF0145a-c of Hager and Benson (1994), considered inadequately conserved in upper north eastern NSW. In the forest ecosystem classification this association appears to be equivalent to FE72 Low Relief Coastal Blackbutt or FE153 Wet Coastal Tallowwood-Brushbox (co-dominated by Blackbutt), which are 45% and 47% cleared and have 859ha and 6581 ha remaining, respectively.</p>
<b>Dry Blackbutt</b>
<p><u>Distribution:</u></p> <p>Found along the north and south shared sections of the Inner Bypass Options and small areas along the Existing Highway Option.</p> <p>Tall to very tall (25m) open forest. Steep, hilly country on exposed upper hill slopes, ridges and spurs, and surrounding gently undulating country. Yellow podsolc soil on metasediment.</p> <p><u>Conservation Priority:</u> <b>Low, adequately conserved</b></p> <p><u>Synonyms:</u></p> <p>This community is equivalent with forest type 37 Dry Blackbutt or EF0145a-c of Hager and Benson (1994) considered adequately conserved in upper north eastern NSW. In the forest ecosystem classification this association appears to be equivalent to FE32 Dry Foothills Blackbutt-Turpentine, which is 21% cleared and has 7364ha remaining.</p>
<b>Paperbark</b>
<p><u>Distribution and condition:</u></p> <p>Found on the southern shared section of the Inner Bypass Options and the Existing Highway grade.</p> <p>Tall open forest (15-20m) with a closed mid-stratum. Floodplains of lower Moonee Creek; periodically waterlogged heavy clay soil.</p> <p><u>Conservation Priority:</u> <b>High, poorly conserved, protected or floristic variant</b></p> <p><u>Synonyms:</u></p> <p>This community is equivalent to forest type 31 Paperbark or EF0145a-c of Hager and Benson (1994) considered adequately conserved in upper north eastern NSW. In the forest ecosystem classification this association appears to be equivalent to FE112 Paperbark, which has 28,577ha remaining (extent of clearing not given). While this community is considered adequately conserved, the example of this community on lower Moonee Creek is rare and unusual in having a well developed rainforest understorey, which increase its conservation values.</p>
<b>Swamp Mahogany</b>
<p><u>Distribution and condition:</u></p> <p>Found on the southern shared section of the Inner Bypass Options. Not mapped on the Existing Highway Option.</p> <p>Open forest (to 25m) with a dense mid and lower stratum. Poorly drained saline soils and quaternary deposits of</p>

<b>Table 2.1: Distribution and Conservation Status of Impacted Vegetation Communities</b>
sedimentary clays and deep sandy loams near the coast.
<u>Conservation Priority:</u> <b>High, inadequately conserved</b>
<u>Synonyms:</u>
Of the approximately 2755 hectares of this community or 48% of this community is thought to remain in the region (NPWS 1999).
Hager and Benson (1994) consider this community to be adequately conserved in upper north eastern NSW. However, this may change with continued land clearing (SFNSW 1995).

The level of vegetation directly impacted is highest in Option IS1 / IN1, followed by Option IS1 / IN2, then Option IS2 / IN1 and with Option IS2 / IN2 having the lowest direct impact (Table 2.2). As the difference between the highest and lowest impact is approximately 0.6 ha, the difference between the Options is considered to be negligible. As with vegetation in general, the direct impact from the clearing of high conservation status vegetation is highest in Option IS1 / IN1, followed by Option IS1 / IN2 then Option IS2 / IN1 with Option IS2 / IN2 having the lowest direct impact (Table 2.2). Again, as the difference between the highest and lowest impact is approximately 0.4 ha, the difference between the Options is considered to be negligible concerning the conservation status of vegetation.

With the exception of Swamp Mahogany Forest, the Existing Highway Option passes the same range of vegetation types as the Inner Bypass Options. However, due to the presence of the existing highway corridor, the impact on vegetation of conservation significance is likely to be minimal in comparison with the Inner Bypass Options.

<b>Table 2.2: Vegetation Removal likely with the Road Footprint of each Option</b>				
Vegetation Type	Option IS2 / IN2 (ha)	Option IS2 / IN1 (ha)	Option IS1 / IN2 (ha)	Option IS1 / IN1 (ha)
Blackbutt / Bloodwood Apple	0.6	0.6	0.6	0.6
Flooded Gum	1.9	1.3	2.6	1.9
Moist Blackbutt	2.5	2.7	2.4	2.6
Paperbark	1.3	1.3	1.3	1.3
Swamp Mahogany	0.4	0.4	0.4	0.4
Tallowwood	0.4	0.9	0.3	0.7
Dry Blackbutt	1.1	1.3	1.1	1.3
Booyong	>0.1	-	>0.1	-
<b>Overall Total</b>	<b>8.3</b>	<b>8.5</b>	<b>8.7</b>	<b>8.9</b>
High Conservation Status  (See Table 2.1)	6.6	6.7	6.9	7.0

**Table 2.2: Vegetation Removal likely with the Road Footprint of each Option**

Vegetation Type	Option IS2 / IN2 (ha)	Option IS2 / IN1 (ha)	Option IS1 / IN2 (ha)	Option IS1 / IN1 (ha)
Low Conservation Status (See Table 2.1)	1.7	1.9	1.7	1.9

## 2.2 Terrestrial Species Assessment

### 2.2.1 Threatened Flora Species Known or Likely to Occur

In order to compare the potential impacts of Options on threatened flora, it is necessary to determine which threatened species are likely to occur in the study area. At this level of study, it is only possible to determine the probability of occurrence, as not all of the study area has been surveyed. A review of the habitat preferences of threatened species known to occur in the Coffs Harbour LGA, vegetation maps and location data is used to identify species considered likely to occur (Table 2.3).

**Table 2.3 Threatened Flora Species Habitat Assessment**

Plant Species	Vegetation Associations	Probability of Occurrence
<i>Acronychia littoralis</i> Scented Acronychia TSC – E	Coastal dune and littoral rainforest	<b>Low</b> No suitable habitat; no records
<i>Allocasuarina defungens</i> Dwarf Heath She-oak TSC – E; EPBC - E	Heath on sedimentary substrate	<b>Low</b> No suitable habitat; no records
<i>Amorphospermum whitei</i> Rusty Plum TSC – V; EPBC - E	Gully, littoral or warm temperate rainforests generally below 600 m altitude on the less fertile soils derived from rhyolite or metasediments (Floyd 1989). Occurrences are likely in rainforest and wet sclerophyll forest along drainage lines or on protected lower slopes in the study area.	<b>High</b> A number of records in study area, most likely to occur in the south along highway and common section of Inner Bypass Options.  Suitable habitat exists on all Options in Booyong, Flooded Gum, Moist Blackbutt, Tallowwood vegetation types
<i>Angophora robur</i> Large-fruited Angophora TSC – V; EPBC - V	Forests with a heath understorey on sandstone substrates.	<b>Low</b> No suitable habitat; no records
<i>Arthraxon hispidus</i> TSC – E; EPBC - V	Known from Coffs Harbour district; suitable swamp and streamside seepage habitat present – detectable summer to autumn, after disturbance.	<b>Moderate</b> Habitat along common section of Inner Bypass Options to the south and along the highway, mainly to the south in Paperbark, Swamp Mahogany vegetation types
<i>Boronia umbellata</i> TSC – V; EPBC – V	Known from Conglomerate SF; shrubby, moist open forest present, but preferred sedimentary substrate	<b>Low</b> No suitable habitat; no records

**Table 2.3 Threatened Flora Species Habitat Assessment**

<b>Plant Species</b>	<b>Vegetation Associations</b>	<b>Probability of Occurrence</b>
<i>Eleocharis tetraquetra</i> Square-stemmed Spike Rush TSC – E	Known from Coffs Harbour district; suitable swamp and streamside seepage habitat present – detectable summer to autumn. Very rare.	<b>High</b> There are a number of records close to the highway, 1.5km south of the start of the Inner Bypass Options.  Habitat along common section of Inner Bypass Options to the south and along the highway, mainly to the south, in Paperbark, Swamp Mahogany vegetation types.
<i>Lindsaea incisa</i> TSC – V	Suitable stream bank habitat present in the Little Arwarra Creek area. Recorded from Waihou Flora Reserve.	<b>High</b> Habitat along common section of Inner Bypass Options to the south and along the highway, mainly to the south.
<i>Marsdenia longiloba</i> Slender Marsdenia TSC – E; EPBC – V	Lowland wet sclerophyll forest, often in ecotones between wet sclerophyll and rainforest. Also occurs in sub tropical and warm temperate rainforest.	<b>Moderate</b> The wet sclerophyll - rainforest ecotone is likely to have occurred along all options before clearing. Remnant vegetation is likely to contain such ecotones.  Small number of records indicate a moderate probability of occurring in Booyong, Flooded Gum, Moist Blackbutt, Tallowwood vegetation types
<i>Parsonsia dorrigoensis</i> TSC – V; EPBC - E	Known from Woolgoolga area; preferred wet sclerophyll-rainforest habitat widespread in study area	<b>Low</b> No suitable habitat; no records
<i>Phaius australis</i> Swamp Orchid TSC – E; EPBC - E	Known from Coffs Harbour district; slight chance of being found in Paperbark and damp sub-coastal sites.	<b>High</b> One record in study area, most likely to occur in the south along common section of Inner Bypass Options in Paperbark, Swamp Mahogany vegetation types.  There is a chance of occurrence along highway, due to proximity of local record, however habitats along highway are likely to be highly disturbed.
<i>Quassia</i> sp.1 'Mooney Creek' Quassia TSC – E; EPBC - E	Wet and dry sclerophyll forest. Some records are from heath open forest dominated by <i>E. planchoniana</i> and <i>E. pyrocarpa</i> on poor sandstone soils, while others are from wet sclerophyll forest. A. Floyd regards <i>Quassia</i> sp. 1 as a forest edge species (Quinn et al. 1995). Many locations appear to be in the ecotone between wet and dry sclerophyll forest.	<b>Moderate</b> The wet and dry sclerophyll forest ecotone is likely to have occurred along all options before clearing. Remnant vegetation is likely to contain such ecotones.  Small number of records indicate a moderate probability of occurring in Blackbutt / Bloodwood Apple, Flooded Gum, Moist Blackbutt, Tallowwood, Dry Blackbutt.
<i>Sarcophilus fitzgeraldii</i> Ravine Orchid TSC – V; EPBC – V	Known from Coffs Harbour district; may occur in steep protected gullies on rock faces and outcrops.	<b>Low</b> No suitable habitat; no records

**Table 2.3 Threatened Flora Species Habitat Assessment**

<b>Plant Species</b>	<b>Vegetation Associations</b>	<b>Probability of Occurrence</b>
<i>Senna acclinis</i> TSC – V	Sub-tropical rainforest communities (Harden 1994)	<b>Low</b> No records from the study area; and a very small area of Booyong (rainforest)
<i>Thesium australe</i> Austral Toadflax TSC – V; EPBC - V	Coastal headlands dominated by Kangaroo Grass ( <i>Themeda australis</i> )	<b>Low</b> No suitable habitat; no records
<i>Zieria prostrata</i> Headland Zieria TSC – E; EPBC - E	Coastal headlands	<b>Low</b> No suitable habitat; no records

All vegetation types in the study area (See Section 2.1) have the potential to contain one or a number of threatened species. Some threatened species, such as those associated with suitable stream banks, Paperbark and Swamp Mahogany vegetation types (Table 2.1), are only likely to occur in the low lying areas associated with the common section of Inner Bypass Options to the south and along the Existing Highway Option, mainly to the south. Others, such as those associated with dry, wet sclerophyll eucalypt forests or rainforests have the potential to be located across the study area.

The Existing Highway Option passes through a number of lowland habitats that could potentially contain a number of threatened species (Table 2.1). However, widening of the highway will extend into habitats heavily disturbed by processes such as edge effects, maintenance of the road verge, altered hydrology and weed invasion.

The Inner Bypass Options pass through lowland vegetation such as Paperbark Forests, to a variety of wet and dry Sclerophyll Forests. These habitats are often small areas located in cleared agricultural lands (See Section 2.2). It is likely that these areas are less disturbed than habitats adjacent to the existing Highway. Assuming the Existing Highway Option does not radically depart from its current alignment, it is considered that the widening of the highway is the least likely to impact on threatened flora species.

### **2.2.2 Threatened Fauna Species Known or Likely to Occur**

In order to compare the potential impacts of Options on threatened fauna, it is necessary to determine which threatened species are likely to occur in the study area. A review of the habitat preferences of threatened species known to occur in the Coffs Harbour LGA, vegetation maps and location data is used to identify species considered likely to occur (Table 2.4).

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<b>Amphibians &amp; Reptiles</b>	<b>Habitat Associations</b>	<b>Probability of Occurrence</b>
<i>Assa darlingtoni</i> Pouched Frog TSC – V	Highlands and uplands of the eastern Great Dividing Range (300 to 1180m above sea level MASL). Cool temperate and Subtropical Rainforest (Ehmann 1997).	No suitable habitat, not assessed further
<i>Crinia tinnula</i> Wallum Froglet TSC – V	Wallum swamps and associated low land meandering watercourses on coastal plains (Ehmann 1997).	Suitable habitat
<i>Litoria aurea</i> Green and Golden Bell Frog TSC – E; EPBC – V	Large ephemeral bodies of water exhibiting well-established fringing vegetation adjacent to open grassland areas for foraging (Ehmann 1997).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Litoria olongburensis</i> Wallum Sedge Frog TSC – V; EPBC – V	Wallum and woodlands on costal and swamps . Swamps are typically acidic (Ehmann 1997).	Suitable habitat
<i>Mixophyes balbus</i> TSC – V; EPBC – V	A variety of habitats that are characterised by deep leaf litter or thick cover from understorey vegetation. Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997).	Suitable habitat
<i>Mixophyes iteratus</i> Giant Barred Frog TSC – E; EPBC – E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest and wet sclerophyll forests. This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997).	Suitable habitat
<i>Philoria sphagnicolus</i> Sphagnum Frog TSC – V	Recorded between 640 to 1470 MASL in rainforest and wet sclerophyll forest with more than 1500mm annual rainfall (Ehmann 1997).	No suitable habitat, not assessed further
<i>Coeranoscincus reticulatus</i> Three-toed Snake-tooth Skink TSC – V; EPBC – V	Inhabits rainforests and adjacent wet sclerophyll forests, where it is usually found in rotting logs or under fallen timber (Cogger 1996).	Suitable habitat
<i>Hoplocephalus stephensii</i> Stephen's Banded Snake TSC – V	Wet Sclerophyll and rainforest (Cogger 1996). This species is threatened by fragmentation, with a low reproductive rate and late reproductive age (Shine 1993 in SFNSW 1995) indicates continued occupation of isolated fragments unlikely. Recorded in Orara State Forest (Hugget pers. com.)	Suitable habitat
<b>Avifauna</b>	<b>Habitat Associations</b>	
<i>Burhinus grallarius</i> Bush Stone-curlew TSC – E	Associated with dry open woodland with grassy areas (SFNSW, 1995), dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000, Marchant & Higgins, 1999). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins, 1999). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed to lightly disturbed habitat (in SFNSW 1995).	Suitable habitat
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo TSC – V	Associated with a variety of forest types containing <i>Allocasuarina</i> species (Environment Australia 2000, NPWS 1997 and SFNSW 1995). Nests in large trees with large hollows (Environment Australia, 2000).	Suitable habitat
<i>Coracina lineata</i> Barred Cuckoo-shrike TSC – V	Associated with rainforests and moist forests, often in creek lines located in gullies. Recorded locally in the Woolgoolga Creek Flora Reserve (SFNSW 1995).	Suitable habitat
<i>Cyclopsitta diophthalma</i> Double-eyed Fig-Parrot TSC – E; EPBC – E	Associated with upland (to 1200MASL) to lowland rainforests, tropical semi-deciduous vine thickets and gallery forests, usually containing fig trees. Usually in large tracts of forests, particularly near edges, rarely in partly cleared or fragmented rainforest (Marchant and Higgins 1999).	Suitable habitat



**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Ephippiorhynchus asiaticus</i> Black-necked Stork TSC – E	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands. Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant and Higgins 1999).	Suitable habitat
<i>Erythroriorchis radiatus</i> Red Goshawk TSC – V; EPBC - V	Associated with forests and woodlands with a mosaic of vegetation types, an abundance of birds and permanent water. In NSW, this species is thought to favour mixed subtropical rainforest, Melaleuca Swamp Forest, and open Eucalypt forest along rivers, often in rugged terrain (Marchant and Higgins 1999). Is thought to require contiguous tracts of woodland / forest and a sustainable supply of pesticide free prey (Debus 1993 in SFNSW 1995).	Suitable habitat
<i>Grantiella picta</i> Painted Honeyeater TSC – V	Considered a rare vagrant to the area (SFNSW 1995). Associated with dry woodland / forest habitats. Woodlands, which are laden with Mistletoes (esp. <i>Amyema spp.</i> ), are particularly important as this species feeds almost exclusively on mistletoe nectar and fruit (Environment Australia 2000, SFNSW 1995).	Suitable habitat
<i>Grus rubicundus</i> Brolga TSC – V	During breeding season mostly near shallow freshwater marshes or freshwater meadows. During non-breeding seasons congregates near deep, permanent freshwater marshes, mostly foraging in nearby field, pastures and fallow fields and occasionally foraging in littoral zones of marshes (Marchant and Higgins 1999).	Suitable habitat
<i>Irediparra gallinacea</i> Comb-crested Jacana TSC – V	Freshwater wetlands, such as lagoons, billabongs, swamps, lakes and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1999).	Suitable habitat
<i>Ixobrychus flavicollis</i> Black Bittern TSC – V	Associated with the margins of wetlands and quiet watercourses flowing through coastal forest, woodland, mangroves and Melaleuca swamps (NPWS 1997, SFNSW 1995).	Suitable habitat
<i>Lathamus discolor</i> Swift Parrot TSC – E; EPBC - E	Associated with dry open Eucalypt forests and woodlands with winter flowering Eucalypts (Marchant and Higgins 1999). In the local area, this species has utilised Spotted Gum ( <i>Corymbia maculata</i> ), Banksias ( <i>Banksia integrifolia</i> and <i>B. serrata</i> ) (SFNSW 1995). Winter flowering eucalypts in the study area include Blackbutt ( <i>Eucalyptus pilularis</i> ), Swamp Mahogany ( <i>E. robusta</i> ) and the Forest Red Gum ( <i>E. tereticornis</i> ) (Law et al. 2000). Often located in urban areas and farmlands with remnant Eucalypts.	Suitable habitat
<i>Lophoictinia isura</i> Square-tailed Kite TSC – V	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant and Higgins 1999, NPWS 1999). Likely to require a large area for foraging (Marchant and Higgins 1999).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Monarcha leucotis</i> White-eared Monarch TSC – V	Associated with lowland subtropical rainforest edges and remnants; littoral and floodplain rainforest, swamp sclerophyll with mesomorphic mid storey, coastal wet sclerophyll. Appears to prefer rainforest with edges. Is thought to avoid moving into small remnants; preferring to move through areas of continuous forest cover (Environment Australia 2000).	Suitable habitat
<i>Pachycephala olivacea</i> Olive Whistler TSC - V	Elevated (>500 MASL), cool temperate rainforest and moist eucalypt forest in the northern part of their range. This species appears to favour large tracts of undisturbed and densely vegetated forest (SFNSW 1995).	No suitable habitat, not assessed further
<i>Pandion haliaetus</i> Osprey TSC – V	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	Suitable habitat
<i>Podargus ocellatus</i> Marbled Frogmouth TSC – V	Tropical and subtropical rainforests, usually with luxuriant epiphytic growth. Rarely seen outside of rainforests (Marchant and Higgins 1999).	Suitable habitat
<i>Ptilinopus magnificus</i> Wompoo Fruit-Dove TSC – V	Associated with large, undisturbed patches of tall tropical or subtropical rainforest, at all altitudes. Occasionally located in patches of monsoon rainforest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodland or vine thickets near rainforest (Marchant and Higgins 1999).	Suitable habitat
<i>Ptilinopus regina</i> Rose-crowned Fruit-Dove TSC – V	Tall tropical and subtropical, evergreen or semi-deciduous rainforests, especially with a dense growth of vines. Also located in closed wet sclerophyll forest, gallery forests or sclerophyll woodlands with abundant fruiting trees, near or next to rainforest. Is thought to prefer large areas of vegetation, but has been located in patches and occasionally in parks and gardens with fruiting trees (Marchant and Higgins 1999).	Suitable habitat
<i>Ptilinopus superbus</i> Superb Fruit-Dove TSC – V	Lives mainly within rainforests but will feed in adjacent mangroves or Eucalypt forests (Blakers et al. 1984). Nests are well hidden within the rainforest habitat and are built in trees from 10 to 30m off the ground (Recher et al. 1995).	Suitable habitat
<i>Todiramphus chloris</i> Collared Kingfisher TSC – V	Virtually confined to mangrove lining sheltered coastal embayment, inlets, estuaries and adjacent tidal flats (Marchant and Higgins 1999).	Suitable habitat
<i>Turnix melanogaster</i> Black-breasted Button-quail TSC - E; EPBC - V	Drier rainforests with dense overhead cover and a thick dry litter layer. Observations in Lantana thickets and hoop pine plantations indicate this species may be able to utilise human modified environments (Blakers et al. 1984).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<p><i>Xanthomyza phrygia</i> Regent Honeyeater TSC – E; EPBC - E</p>	<p>Feeds primarily on nectar from box and ironbark eucalypts and occasionally from Banksias and Mistletoes (NPWS 1995). Associated with temperate Eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature Eucalypts, riparian forests of River Oak (<i>Casuarina cunninghamiana</i>) (SFNSW 1995, Garnett 1993). Reliant on locally abundant nectar sources, especially flowering eucalypts that occur mainly in dry open woodland (SFNSW 1995), on richer soil types with different flowering times to provide reliable supply of nectar (Environment Australia 2000). Areas containing Swamp Mahogany (<i>Eucalyptus robusta</i>) in coastal areas have been observed to be utilised (NPWS 1997, SFNSW 1995).</p>	<p>Suitable habitat</p>
<p><i>Ninox connivens</i> Barking Owl TSC – V</p>	<p>Associated with a variety of habitats such as savanna woodland, open Eucalypt forests, wetland and riverine forest. Kavanagh et al. (1995), which suggests that the species is particularly associated with coastal lowland or riparian woodland dominated by various red gum species. The diet of the Barking Owl consists of mammals, birds and insects, the percentage of which depends largely on seasonal availability (Debus 1997). Species rich habitats, such as woodlands and ecotones, are considered to important habitat for this species due to its diverse diet (Environment Australia 2000). Usually nests in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).</p>	<p>Suitable habitat</p>
<p><i>Ninox strenua</i> Powerful Owl TSC – V</p>	<p>Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus &amp; Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).</p>	<p>Suitable habitat</p>

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Tyto capensis</i> Grass Owl TSC – V	In NSW the Grass Owl is rarely recorded and is strictly tied to the occurrence of suitable habitat. Compared with other owls, the Grass Owl is unusual in that it nests on the ground within dense tall grass, sedges, reeds and even sugarcane plantations. Reported habitats include tall grass, swampy, sometimes tidal areas, mangrove fringes, grassy plains, coastal heaths, grassy woodland, cane grass, lignum, sedges, cumbungi, cane fields and grain stubble (Pizzey and Knight, 1997). The Grass Owl primarily feeds on rodents, hunting on the wing over heathland, grassland and sedgeland, as well as along the edge of sugar cane, crops and pastureland.	Suitable habitat
<i>Tyto novaehollandiae</i> Masked Owl TSC – V	Associated with forest with sparse, open, understorey, particularly the ecotone between wet and dry forest, and non forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh and Peake 1993).	Suitable habitat
<i>Tyto tenebricosa</i> Sooty Owl TSC – V	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus, 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus, 1994, Garnett 1993, Hyem 1979).	Suitable habitat
<b>Mammals</b>	<b>Habitat Associations</b>	
<i>Aepyprymnus rufescens</i> Rufous Bettong TSC – V	Associated with grassy open forests and woodland, typically with an absence of shrub layer, but may also occur on grassy ridges with a dense shrub layer (SFNSW, 1995). Has been observed more commonly in forests characterised by the Spotted Gum ( <i>Corymbia maculata</i> ) in northern eastern NSW (SFNSW, 1995). This species has been positively related to high food plant density, moderate topography and grazing (SFNSW, 1995).	Suitable habitat?
<i>Dasyurus maculatus</i> Spotted-tailed Quoll TSC – V; EPBC - V	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests and rainforests (Mansergh, 1984), more frequently recorded near the ecotones of closed and open forest (SFNSW 1995). Maternal den sites include logs with cryptic entrances, rock outcrops, windrows and burrows (Environment Australia 2000).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Phascogale tapoatafa</i> Brush-tailed Phascogale TSC – V; EPBC - V	Preferred habitat is Dry Open forest with a sparse open understorey, however, has been located in heath, swamps and rainforest and wet sclerophyll forest (NPWS 1999).	Suitable habitat
<i>Macropus parma</i> Parma Wallaby TSC - V	Associated with dry and mesic sclerophyll forests and occasionally in rainforest. Optimum habitat appears to be mesic Eucalypt forests with a mosaic of open and closed thick shrubby understorey patches (in SFNSW 1995).	Suitable habitat
<i>Petaurus australis</i> Yellow-bellied Glider TSC – V	Associated with a range of forest types but is more common at ecotone between dry and wet sclerophyll forests. Habitats are characterised by a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984). Large hollows within mature trees are required for nesting and breeding (Henry and Craig 1984).	Suitable habitat
<i>Petaurus norfolcensis</i> Squirrel Glider TSC – V	Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988, Quin 1993, Traill 1991). Habitats typically include gum barked and high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995). Recorded locally in Wedding Bells SF and Moonee Beach Nature Reserve.	Suitable habitat
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby TSC – V; EPBC - V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	No suitable habitat, not assessed further
<i>Potorous tridactylus</i> Long-nosed Potoroo TSC - V; EPBC - V	Associated with dry coastal heath and dry and wet sclerophyll forests with relatively thick ground cover and light sandy soils (Strahan 1995).	No suitable habitat, not assessed further
<i>Phascolarctos cinereus</i> Koala TSC – V	Associated with both wet and dry Eucalypt forests that contain a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees.	Suitable habitat
<i>Thylogale stigmatica</i> Red-legged Pademelon TSC - V	Predominantly a rainforest species, also in wet sclerophyll forest and deciduous vine thickets. Requires a dense understorey for cover (SFNSW, 1995).	Suitable habitat
<i>Pteropus poliocephalus</i> Grey-headed Flying-Fox TSC – V; EPBC - V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Eby, 1998).	Suitable habitat
<i>Syconycteris australis</i> Common Blossom-bat TSC – V	Breeding and sheltering habitats are in subtropical and littoral rainforests. Requires a diverse range of nectar producing plant communities year round. Will occasionally eat some rainforest fruits (Environment Australia, 2000).	Suitable habitat
<i>Chalinolobus dwyeri</i> Large Pied Bat TSC – E; EPBC - V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests. This species roosts in caves (Churchill, 1998).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle TSC – V	This species is associated with forested areas with higher rainfall (Parnaby, 1983), and has been located from the highlands to the coast, appearing to be less common at low altitudes, and tending to favour the cool moist forests of the ranges (Phillips, 1998). While the Eastern False Pipistrelle roosts primarily in tree trunk hollows, individuals have also be found in caves and abandoned buildings (Klippel, 1992).	Suitable habitat
<i>Kerivoula papuensis</i> Golden-tipped Bat TSC – V	The most favoured habitat for this species is moist closed forests often with a rainforest influence, however, some captures have been made in dry forests some distance from any rainforest (Lunney et. al., 1986, Parnaby and Mills, 1994). It has been suggested that the amount of vines and complex tree layers allows for increased numbers of spiders and webs, and such areas are sought by the Golden-tipped Bat (Schulz & Eyre, 2000). This species is often caught over streams within rainforest and is known to frequently roost within the pendulous nests of Yellow-throated and Large-billed Scrub Wrens and Brown Gerygone in such areas. (Schulz, & Eyre, 2000).	Suitable habitat
<i>Miniopterus australis</i> Little Bent-wing Bat TSC – V	Breeding occurs in caves, usually in association with <i>M. schreibersii</i> . This species shelter in a range of structures including culverts, drains, mines and caves. Foraging is associated with forested areas, predominantly moist Eucalypt forests, rainforests, and some dry forest types (Environment Australia 2000).	Suitable habitat
<i>Miniopterus schreibersii</i> Common Bent-wing Bat TSC – V; EPBC - V	Associated with a range of habitats, typically well timbered areas where it forages above and below the tree canopy on small insects (Australian Museum Business Services, 1995; Dwyer, 1995, 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1988). This species has been reported utilising bushland remnants in urban areas and is estimated to forage within a 20km radius in a single night.	Suitable habitat
<i>Nyctophilus bifax</i> Eastern Long-eared Bat TSC - V	In NSW the species is limited to the coastal fringe, south to Iluka and appears to be associated with littoral rainforest.	Suitable habitat
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat TSC – V	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests. Within denser vegetation types, use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1995).	Suitable habitat

**Table 2.4 Threatened Fauna Species Habitat Assessment**

<p><i>Mormopterus norfolkensis</i> East Coast Freetail Bat TSC – V</p>	<p>Although the habitat preferences are unclear, most records of this species have been reported from dry Eucalypt forest and woodland on the eastern side of the Great Dividing Range. Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia, 2000; Allison &amp; Hoyer, 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia, 2000; Allison &amp; Hoyer, 1998). Examination of wing morphology indicate that cleared or open habitats are favoured, such as open habitats (woodlands), cleared forest edges and tracks through forests as well as areas above the forest canopy (Ecotone, 2002).</p>	<p>Suitable habitat</p>
<p><i>Myotis macropus</i> Southern Myotis TSC – V</p>	<p>A variety of foraging habitats are used by this species although it is usually found near large bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to roost sites however movements of up to 20km between roost and foraging site have been recorded (Caddle and Lumsden, 1999). The species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows (Churchill 1998).</p>	<p>Suitable habitat</p>
<p><i>Chalinolobus nigrogriseus</i> Hoary Wattled Bat TSC – V</p>	<p>The preferred habitat of this species appears to be variable, with dry open forest, woodland, vine thickets, coastal scrub, sand dunes, grasslands and floodplains recorded (Churchill, 1998). This species often forages along watercourses, swampy areas and over farm dams. In NSW, this species has been recorded in Spotted Gum (<i>Corymbia maculata</i>), Grey Box (<i>Eucalyptus moluccana</i>) and Northern Ironbark (<i>E. siderophloia</i>) and woodland characterised by Scribbly Gums (<i>E. signata</i>) and Pink Bloodwood (<i>C. intermedia</i>) and sites dominated by the Blackbutt (<i>E. pilularis</i>). Roost sites have been identified as tree hollows, rock crevices and the roofs of buildings (Churchill, 1998).</p>	<p>Suitable habitat</p>
<p><i>Saccolaimus flaviventris</i> Yellow-bellied Sheathtail-bat TSC – V</p>	<p>Associated with open country, mallee, eucalypt forests, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows but may also use caves and has been recorded in a tree hollow in a paddock (Environment Australia 2000). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats.</p>	<p>Suitable habitat</p>
<p><i>Vespadelus troughtoni</i> Eastern Cave Bat TSC - V</p>	<p>Associated with a variety of forest and woodlands, with a preference for mesic vegetation such as wet sclerophyll and rainforest (SFNSW 1995). This species roosts in shallow caves and tunnels (Ecotone 2002, SFNSW 1995).</p>	<p>Suitable habitat</p>

Threatened species considered likely to occur were grouped according to habitat preference, a habitat being based on vegetation types (See Section 2.1). This process identified a number of groups, Coastal Vegetation Species (associated with the Paperbark and Swamp Mahogany vegetation types), species associated with Large Waterbodies, Mesic Community Species (associated with the Moist Blackbutt, Tallowwood, Flooded Gum, Booyong vegetation types) and Forest Fauna (associated with a variety of forests types). The species included in each group are listed in Table 2.4.

**Table 2.5: Threatened Fauna Species Groups and Associated Vegetation**

Grouping of Threatened Species	Vegetation Associations
<p><b>Coastal Vegetation Species</b></p> <p>Wallum Froglet (<i>Crinia tinnula</i>), Wallum Sedge Frog (<i>Litoria olongburensis</i>), Black Bittern (<i>Ixobrychus flavicollis</i>), Collared Kingfisher (<i>Todiramphus chloris</i>), Osprey (<i>Pandion haliaetus</i>).</p>	<p>Paperbark, Swamp Mahogany</p>
<p><b>Aquatic Habitat Species</b></p> <p>Green and Golden Bell Frog (<i>Litoria aurea</i>), Brolga (<i>Grus rubicundus</i>), Comb-crested Jacana (<i>Irediparra gallinacea</i>), Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)</p>	<p>Waterbodies are not defined by a vegetation type in study area</p>
<p><b>Mesic Community Species</b></p> <p>White-eared Monarch (<i>Monarcha leucotis</i>), <i>Mixophyes balbus</i>, Giant Barred Frog (<i>Mixophyes iteratus</i>), Three-toed Snake-tooth Skink (<i>Coeranoscincus reticulatus</i>), Stephen's Banded Snake (<i>Hoplocephalus stephensii</i>), Barred Cuckoo-shrike (<i>Coracina lineata</i>), Wompoo Fruit-Dove (<i>Ptilinopus magnificus</i>), Rose-crowned Fruit-Dove (<i>Ptilinopus regina</i>), Superb Fruit-Dove (<i>Ptilinopus superbus</i>), Sooty Owl (<i>Tyto tenebricosa</i>), Red-legged Pademelon (<i>Thylogale stigmatica</i>), Golden-tipped Bat (<i>Kerivoula papuensis</i>), Double-eyed Fig-Parrot (<i>Cyclopsitta diophthalma</i>), Marbled Frogmouth (<i>Podargus ocellatus</i>), Black-breasted Button-quail (<i>Turnix melanogaster</i>), Common Blossom-bat (<i>Syconycteris australis</i>), Eastern Long-eared Bat (<i>Nyctophilus bifax</i>)</p>	<p>Moist Blackbutt, Tallowwood, Flooded Gum, Booyong</p>
<p><b>Forest Fauna</b></p> <p>Bush Stone-curlew (<i>Burhinus grallarius</i>), Glossy Black-Cockatoo (<i>Calyptorhynchus lathami</i>), Painted Honeyeater (<i>Grantiella picta</i>), Red Goshawk (<i>Erythrotriorchis radiatus</i>), Regent Honeyeater (<i>Xanthomyza phrygia</i>), Square-tailed Kite (<i>Lophoictinia isura</i>), Swift Parrot (<i>Lathamus discolor</i>),</p> <p>Barking Owl (<i>Ninox connivens</i>), Grass Owl (<i>Tyto capensis</i>), Masked Owl (<i>Tyto novaehollandiae</i>), Powerful Owl (<i>Ninox strenua</i>)</p> <p>Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>), Koala (<i>Phascolarctos cinereus</i>), Parma Wallaby (<i>Macropus parma</i>), Rufous Bettong (<i>Aepyprymnus rufescens</i>), Spotted-tailed Quoll (<i>Dasyurus maculatus</i>), Squirrel Glider (<i>Petaurus norfolcensis</i>), Yellow-bellied Glider (<i>Petaurus australis</i>),</p> <p>East Coast Freetail Bat (<i>Mormopterus norfolkensis</i>), Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>), Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>), Grey-headed Flying-Fox (<i>Pteropus poliocephalus</i>), Hoary Wattled Bat (<i>Chalinolobus nigrogriseus</i>), Southern Myotis (<i>Myotis macropus</i>), Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)</p>	<p>Principally eucalypt forests (Blackbutt / Bloodwood Apple, Dry Blackbutt, Moist Blackbutt, Tallowwood, Flooded Gum, Paperbark, Swamp Mahogany) and for some species rainforest (Booyong)</p>



In the case of the Forest Fauna group, the association with a large number of vegetation types, and hence a large area often did not reflect the low numbers of records and the rarity of these species in the locality. It was noted that for many of these species, habitat features critical for their survival are not likely to be evenly spread across the remaining native vegetation. For example, tree hollows are more common in older stands, gullies, vegetation not logged and on flat terrain (Gibbons and Lindenmayer 2002). To account for this, Forest Fauna were associated with critical habitat features (Table 2.6), which in turn can be broadly associated with other landscape features.

**Table 2.6: Critical Habitat Features Forest Fauna**

Species	Large, contiguous habitats	Winter flowering trees	Tree Hollows	Specialist Habitat
<b>Avifauna</b>				
Bush Stone-curlew ( <i>Burhinus grallarius</i> )				
Glossy Black-Cockatoo ( <i>Calyptorhynchus lathamii</i> )			*	<i>Allocasuarina</i> sp.
Painted Honeyeater ( <i>Grantiella picta</i> )				Mistletoes
Red Goshawk ( <i>Erythrorhynchus radiatus</i> )	*			
Regent Honeyeater ( <i>Xanthomyza phrygia</i> )		*		
Square-tailed Kite ( <i>Lophoictinia isura</i> )	*			
Swift Parrot ( <i>Lathamus discolor</i> )		*		
Barking Owl ( <i>Ninox connivens</i> )			*	
Grass Owl ( <i>Tyto capensis</i> )				Grasslands
Masked Owl ( <i>Tyto novaehollandiae</i> )			*	
Powerful Owl ( <i>Ninox strenua</i> )			*	
<b>Mammals</b>				
Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )			*	
Koala ( <i>Phascolarctos cinereus</i> )				Feed Trees
Parma Wallaby ( <i>Macropus parma</i> )				
Rufous Bettong ( <i>Aepyprymnus rufescens</i> ),				
Spotted-tailed Quoll ( <i>Dasyurus maculatus</i> )	*			
Squirrel Glider ( <i>Petaurus norfolcensis</i> )		*	*	
Yellow-bellied Glider ( <i>Petaurus australis</i> )		*	*	
East Coast Freetail Bat ( <i>Mormopterus norfolkensis</i> )			*	
Eastern False Pipistrelle ( <i>Falsistrellus tasmaniensis</i> )			*	
Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )			*	
Grey-headed Flying-Fox ( <i>Pteropus poliocephalus</i> )		*		
Hoary Wattled Bat ( <i>Chalinolobus nigrogriseus</i> )			*	
Southern Myotis ( <i>Myotis macropus</i> )			*	Water bodies
Yellow-bellied Sheath-tail-bat ( <i>Saccolaimus flaviventris</i> )			*	
Common Bent-wing Bat ( <i>Miniopterus schreibersii</i> )				
Eastern Cave Bat ( <i>Vespadelus troughtoni</i> )				
Large Pied Bat ( <i>Chalinolobus dwyeri</i> )				
Little Bent-wing Bat ( <i>Miniopterus australis</i> )				

### 2.2.3 Impacts on the Habitats of Threatened Species

#### Vegetation Clearance

Threatened species have been placed into a number of groups, based on broad habitat preferences (Table 2.6), which are in turn based on vegetation types. In order to compare the broad potential impact of each Option on the habitats of threatened species; the amount of vegetation cleared for each Option was calculated by using a Geographical Information System (Arcview) to intersect the footprint over the DEC CRAFT1 maps (Table 2.7).

<b>Table 2.7: Estimate of Habitat Clearance</b>				
<b>Grouping of Threatened Species</b>	<b>Option IS2 / IN2</b> (ha)	<b>Option IS2 / IN1</b> (ha)	<b>Option IS1 / IN2</b> (ha)	<b>Option IS1 / IN1</b> (ha)
<b>Coastal Vegetation Species</b>	1.7 ha	1.7 ha	1.7 ha	1.7 ha
<b>Aquatic Habitat Species</b>	See Section 2.2.4	See Section 2.2.4	See Section 2.2.4	See Section 2.2.4
<b>Mesic Community Species</b>	4.9 ha	4.9 ha	5.2 ha	5.3 ha
<b>Forest Fauna:</b>				
<i>Total</i>	8.3 ha	8.5 ha	8.7 ha	8.9 ha
<i>Vegetation with winter flowering species</i>	5.9 ha	6.3 ha	5.8 ha	6.2 ha
<b>Total Vegetation Clearance</b>	20.8 ha	21.4 ha	21.4 ha	22.1 ha

The impacts on the habitats of Coastal Vegetation Species are the same impact for all Inner Bypass Options, as the habitat lost is on sections common to each Option (Table 2.7). The impacts on the habitats of Mesic Community Species are slightly higher for Option IS1 / IN2 and Option IS1 / IN1 than in Option IS2 / IN2 and Option IS2 / IN1 (Table 2.7). The differences are no greater than 0.4 ha, which at this level of study is considered a negligible difference.

The impacts on the habitats of Forest Fauna are slightly higher for Option IS1 / IN2, Option IS1 / IN1 than in Option IS2 / IN2 and Option IS2 / IN1 (Table 2.7). The differences are no greater than 0.6 ha, which at this level of study is considered to be a negligible difference. Similarly, the removal of vegetation characterised by winter flowering species did not differ more than 0.5ha, which is considered a negligible difference (See Section below).

The Existing Highway Option passes a number of native vegetation types, which include habitats of Coastal Vegetation Species, Mesic Community Species and Forest Fauna listed in Table 2.5. Due to the presence of the existing highway, the loss of habitats for these species is likely to be minimal, and the provision of impact minimisation measures, such as regeneration and revegetation, is likely to adequately mitigate this impact.

### Koala Habitat

Koala habitats are those identified by Lunney et al. (1998). Habitats are divided into three categories, based on the quality of habitat for the Koala. These are:-

- Primary Koala Habitat:** Areas of Primary Koala Habitat are the most significant, and accord a high level of protection. The objective for these areas is to maintain existing habitat and where appropriate restore it. To achieve this, no further clearing, disturbance, fragmentation or isolation of habitat should be permissible unless adequate and appropriate compensatory measures are provided. The majority of this habitat, and Koala records and activity, occurs in the south east of the LGA from Korora Nature Reserve and Bruxner Park Flora Reserve, which encompasses all areas of the Inner Bypass Options and the Existing Highway Option. The conservation of viable habitat remnants was considered critical to securing the population in the LGA.
- Secondary Koala Habitat:** Secondary Koala Habitat generally has lower levels of activity than Primary Koala Habitat, but supports many Koala populations particularly inland from the coast. Secondary Koala Habitat plays a vital role in supporting Primary Koala Habitat and contributes to the overall habitat available to Koalas. Secondary Koala Habitat is important for the dispersal of Koalas and as support or refuge habitats, such as in drought or fire. Secondary Koala Habitat requires protection with only limited development permitted when it can be shown that it is compatible with Koala conservation.
- Tertiary Koala Habitat:** Tertiary Koala Habitat occurs predominantly in rural areas to the west of the coastal range. This habitat generally contains lower densities of Koalas, however important populations may occur. Tertiary Koala Habitat requires protection, with development being permissible when it can be shown that it will not adversely affect the values of Koala habitat in the locality.

At the southern end of the study area, the Inner Bypass Options and the Existing Highway Option share a common alignment that passes through an area of Primary Koala Habitat (figure 3). (Any loss of Koala Habitat in this area will be minimal, due to the presence of the Existing Highway Corridor. The provision of impact minimisation measures such as fauna overpasses/underpasses and fauna-proof fencing will aid in mitigating these impacts.

The Inner Bypass Options pass through some Primary and Secondary Koala Habitats. The area of Koala Habitat lost under the Inner Bypass Options is detailed in Table 2.8.

Habitat Type	Option IS2 / IN2 (ha)	Option IS2 / IN1 (ha)	Option IS1 / IN2 (ha)	Option IS1 / IN1 (ha)
<b>Primary</b>	7.4	7.4	8.0	8.0
<b>Secondary</b>	1.1	1.1	0.9	0.9
<b>Tertiary</b>	0.8	0.1	0.8	0.1

Options IS2 / IN2 and IS2 / IN1 were considered to have the lowest impact on Primary Koala Habitat, which will result in a loss of 0.6 ha less Habitat than would Options IS1 / IN1 and IS1 / IN2 (Table 2.8). This difference occurs as a result of Option IS1 passing through a number of Primary Koala Habitats (Figure 3). The greatest difference between the impact of the Options on Secondary Koala Habitat is 0.2 ha, which is considered to be a negligible difference. Similarly, the greatest difference between the impact of the Inner Bypass Options on Tertiary Koala Habitat is 0.3 ha, which is considered negligible.