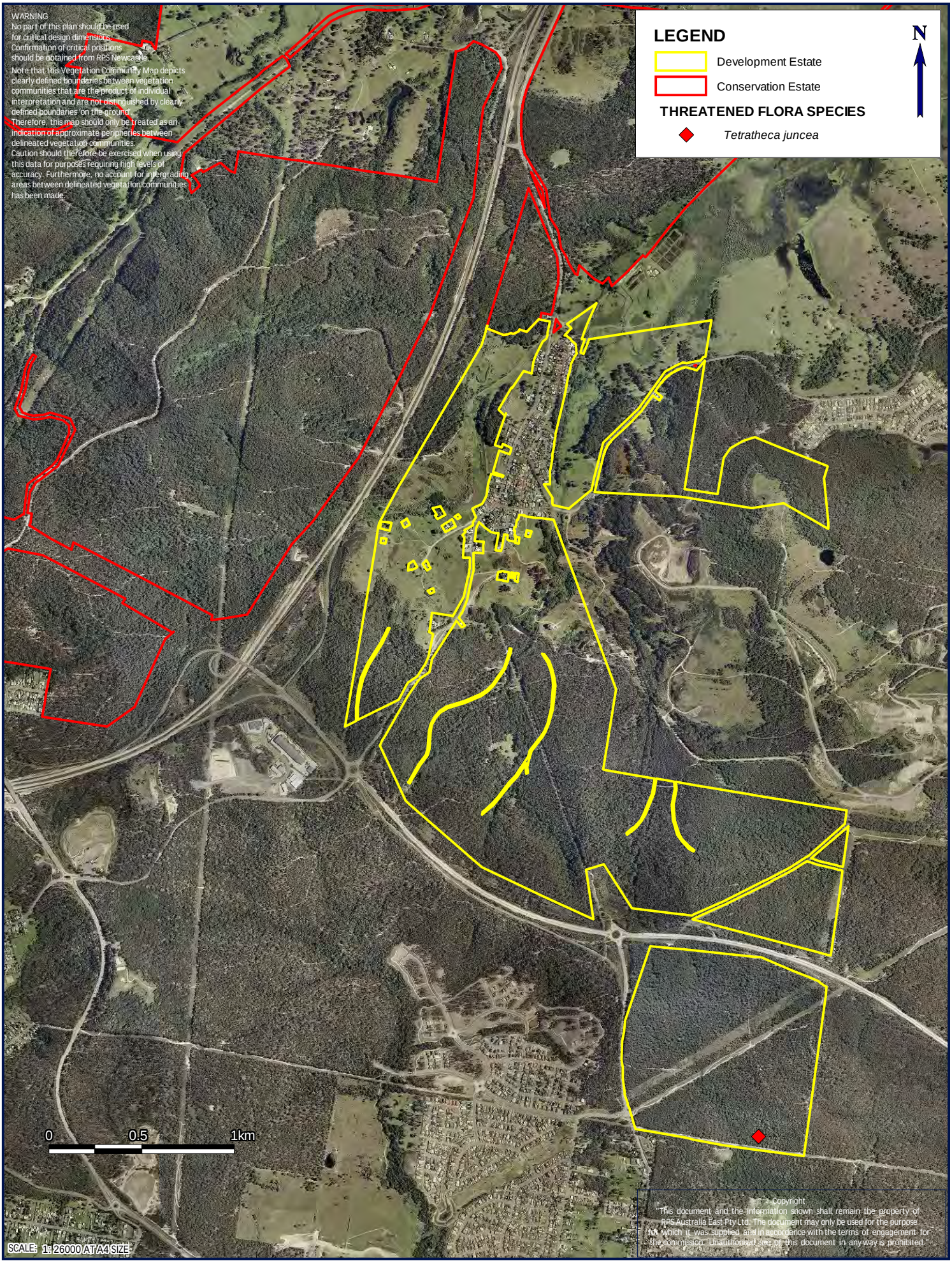

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TITLE:	FIGURE 4-5 DISTRIBUTION OF *Tetratheca juncea*	LOCATION:	MINMI-LINK ROAD	DATUM:	N/A	DATE:	19/10/2010
				PROJECTION:	MGA ZONE 56 (GDA 94)	PURPOSE:	EAR

J:\JOB\24k\24530 Hunter Valley\2010 Works\Draft..\Ecology\Northern Lands\MLR\24530-2 Figure 4-4 Distribution of TJ B A4
LAYOUT REF:
VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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4.1.9 Groundwater Dependent Ecosystems

GDEs is a broad definition covering all ecosystems which are dependent upon groundwater either permanently or occasionally to survive (DLWC, 2002). Several of the vegetation communities on the Minmi - Link Road Development Estate have been identified as GDE's, and these include Freshwater Wetland Complex, HLRF and ATMF (Refer to Figure 4-5). Identification of GDE's depends upon the location of the vegetation communities in relation to groundwater. GDE's are typically the communities which are located in drainage depressions, swamps and creeklines, where groundwater comes up to the surface.

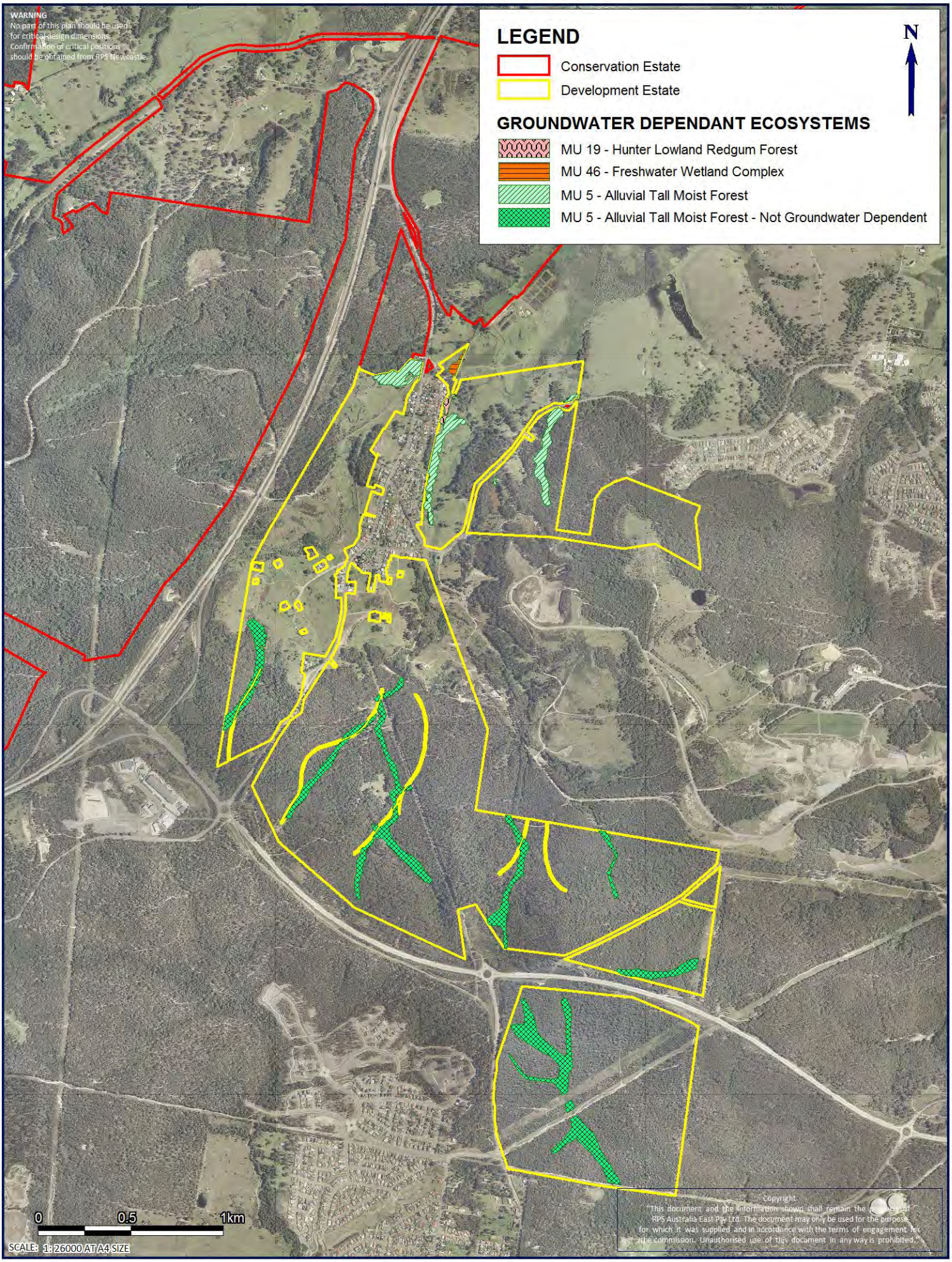
Matthei (1995) has mapped several soil landscapes within the Link Road Minmi Development Estate and these include Killingworth (erosional), Beresfield (residual) and Bobs Farm (Estuarine). The erosional soils of Killingworth are mapped at the higher elevations and are likely to be comprised of clay soil overlying weathered rock. The soil landscape of Beresfield has been mapped in the northern portion of the Development Estate at the high elevations adjoining Hexham Swamp. This soil landscape is similar to Killingworth in that residual clay loams occur over weather rock. However, lower lying areas in the north of the Development Estate are likely to have regular inundation due to the close proximity to Hexham Swamp where the groundwater table is often on the surface. Hexham Swamp is part of the floodplain of the Hunter River. The estuarine soils of Bobs Farm are subject to waterlogging and have permanently high watertables, this soil landscape is mapped in the northern portion of the Development Estate and adjoining Hexham Swamp.

There are three vegetation communities which occur within the Development Estate are classified as GDE's and these include, HLRF, ATMF and Freshwater Wetland Complex. These vegetation communities occur on the estuarine soils of Bob's Farm and within the northern portion of the Development Estate. The ATMF which occurs to the south of Minmi occur on residual soils and the presence of this community is most likely to be a result of surface runoff rather than groundwater dependence. Therefore, southern occurrences of ATMF have not been mapped as GDEs.

GDE's have been classified into several different types according to DLWC (2006). These classes take into consideration aquifer, ecological and geomorphic types. Table 4-2 below outlines the GDE types, classes and sub-classes as per DLWC (2006) which occur within the Minmi Link Road Development Estate.

Table 4-2: GDE's Types and Classes for Link Road Minmi Development Estate

Vegetation Community at Minmi - Link Road	GDE TYPE	Class	Description of Class	Habitat
Alluvial Tall Moist Forest (northern occurrences)	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Hunter Lowland Redgum Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Redgum Roughbarked Apple Forest	Riparian & Terrestrial Vegetation (T)	T1	Riparian Vegetation Community	Terrestrial
Freshwater Wetland Complex	Wetlands (W)	W2	Coastal Floodplain Freshwater Forested Wetland	Epigean



TITLE: FIGURE 4-6 GROUNDWATER DEPENDENT ECOSYSTEMS	LOCATION: MINMI-LINK ROAD	DATUM: N/A PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 19/10/2010 PURPOSE: EAR	LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Draft..\Ecology\Northern Lands\MLR\24530-2 Figure 4-5 Groundwater Dependent Ecosystems B A4 VERSION (PLAN BY): B (A.P-M.D-N.W)	

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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4.2 Fauna

The results of fauna survey work carried out on the site are presented in the following section. A comprehensive list of species expected and recorded during the survey period is presented in Appendix 4

4.2.1 NPWS Threatened Species Database Search Results

The results of the above search indicated that 59 threatened fauna species have been previously recorded within 10km (DECCW Wildlife Atlas 2010) of the Development Estate. A total of 20 of these species are highly unlikely to occur within the Development Estate due to the absence of suitable habitat. From the remaining 39 species, five were recorded during fauna surveys (indicated by an asterisk '*' in the following list). For a number of these species no suitable habitat occurs within the site, but discussion is added below with regard to the potential for these species to occur in line with the precautionary approach incorporated into this EAR assessment process.

Litoria aurea	Green and Golden Bell Frog
Litoria brevipalmata	Green-thighed Frog
Varanus rosenbergi	Heath Monitor
Botaurus poiciloptilus	Australasian Bittern
Lophoictinia isura	Square-tailed Kite
Callocephalon fimbriatum	Gang-Gang Cockatoo
Calyptorhynchus lathami	Glossy Black-Cockatoo
Melanodryas cucullata	Hooded Robin
Stagonopleura guttata	Diamond Firetail
Pomatostomus temporalis	Grey-crowned Babbler
Chthonicola sagittatus	Speckled Warbler
Climacteris picumnus	Brown Treecreeper
Melithreptus gularis	Black-chinned Honeyeater
Anthochaera phrygia	Regent Honeyeater
Lathamus discolor	Swift Parrot
Neophema pulchella	Turquoise Parrot
Glossopsitta pusilla	Little Lorikeet*
Ninox connivens	Barking Owl
Ninox strenua	Powerful Owl
Tyto novaehollandiae	Masked Owl
Tyto tenebricosa	Sooty Owl
Ptilinopus magnificus	Wompoo Fruit-Dove
Ptilinopus regina	Rose-crowned Fruit-Dove
Ptilinopus superbus	Superb Fruit-Dove
Dasyurus maculatus	Spotted-tailed Quoll
Phascogale tapoatafa	Brush-tailed Phascogale
Petaurus australis	Yellow-bellied Glider
Petaurus norfolcensis	Squirrel Glider
Phascolarctos cinereus	Koala*

Pteropus poliocephalus	Grey-headed Flying-fox*
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat
Miniopterus australis	Little Bentwing-bat*
Mormopterus norfolkensis	Eastern Freetail-bat*
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Falsistrellus tasmaniensis	Eastern False Pipistrelle
Chalinolobus dwyeri	Large-eared Pied Bat
*Myotis macropus (*previously *adversus)*	Large-footed Myotis
Scoteanax rueppellii	Greater Broad-nosed Bat
Vespadelus troughtoni	Eastern Cave Bat

In addition to the above threatened species a further 20 threatened wetland, estuarine and inland fauna species have been recorded within a 10 km radius of the site. These species have appeared in wider locality searches as consequence of the site's proximity to estuarine and wetland habitats and rare local records of inland species. These species have not been included within the above 10 km threatened species list, as potential impacts within the site will not include the inland, wetland and estuarine habitats in which they occur and these habitats do not occur on site.

Anseranas semipalmata	Magpie Goose
Stictonetta naevosa	Freckled Duck
Charadrius leschenaultia	Greater Sand-plover
Calidris tenuirostris	Great Knot
Chelodina mydas	Green Turtle
Charadrius mongolus	Lesser Sand-plover
Pterodroma leucoptera	Gould's Petrel
Pterodroma solandri	Providence Petrel
Sterna albifrons	Little Tern
Haematopus longirostris	Pied Oystercatcher
Irediparra gallinaceae	Comb-crested Jacana
Pandion cristatus	Osprey
Hamirostra melanosternon	Black-breasted Buzzard
Ephippiorhynchus asiaticus	Black-necked Stork
Ixobrychus flavicollis	Black Bittern
Limicola falcinellus	Broad-billed Sandpiper
Limosa limosa	Black-tailed Godwit
Oxyura australis	Blue-billed Duck
Rostratula australis	Australian Painted Snipe
Xenus cinerius	Terek Sandpiper

The southern portion of the Minmi - Link Road Development Estate is characterised by open forest habitat offering opportunities for local fauna species including a number of threatened species as listed above. Hollow-bearing trees within these forest habitats may be used by hollow-dwelling Microchiropteran bats for roosting purposes, and the canopy would provide foraging habitat for threatened insectivorous species during the warmer months. There are hollows within the forest habitats of sufficient size to represent potential nesting sites for Glossy Black-Cockatoos and there are areas containing

Allocasuarina torulosa or *A. littoralis*, which are feed tree species for these cockatoos.

The forested areas of the Development Estates also contain hollows that are of sufficient size to represent nesting and roosting sites for forest owl species and these habitats provide suitable foraging habitat for both *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl) potentially occurring in the area. The record of a *Ninox connivens* (Barking Owl) in the wider locality is considered to be a rare occurrence as this species is not common in coastal areas and this is supported by a general lack of records from the region.

Petaurus norfolcensis (Squirrel Gliders) have been recorded within the site to the south of Link Road. This species appears to favour open forest habitats within the Link Road – Minmi Development Estate. Although *Petaurus norfolcensis* (Squirrel Glider) was not recorded within habitat north of Link Road, this species has potential to utilise the habitat within this area.

An individual *Phascolarctos cinereus* (Koala) was observed within the site during nocturnal surveys. Due to a lack of evidence to suggest that the site supports a local population, the individual was identified as a probable immature male travelling between populations. This species favours forested habitats containing high densities of preferred Koala feed trees. Despite the occurrence of the SEPP 44 listed Koala feed tree *Eucalyptus punctata* and the closely related *E. propinqua* within the site there are no previous records of this species within the site or within the locality of the site. The records of a *Phascolarctos cinereus* (Koala) in the wider region include high densities to the north of the Hunter River within the Port Stephens – Medowie area and sparse records in the Watagan Mountains area.

Winter-flowering sclerophyllous tree species within the site include *Corymbia maculata* (Spotted Gum). This species is widespread across the site within the identified Ironbark-Spotted Gum Open Forest. Through winter these stands would potentially provide foraging resources for Flying-foxes, *Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater) which may periodically occur in the local area – though these species were not recorded during the survey period despite targeted surveys.

A record of the *Dasyurus maculatus* (Spotted-tailed Quoll) occurs within 10 km of the Development Estate and is located east of Lake Macquarie. This record is considered somewhat unusual as it occurs in an area that is isolated from extensive high quality habitat in relatively close proximity to residential areas. Nevertheless, this record does not occur within habitat continuous with the Development Estate and the next nearest record occurs some 18 km away in the Watagan Mountains, although there may be potential habitat for this species within land to be retained for conservation purposes at Stockrington. The site's habitats are unlikely to contain an adequate combination of sufficient remoteness, quality or extent for this species.

There are no wetland habitats within the site of sufficient extent or of the open nature that is suited to *Ephippiorhynchus asiaticus* (Black-necked Stork). Furthermore, there is no suitable habitat within the site for a range of other wetland bird species, including

Irediparra gallinaceae (Comb-crested Jacana), *Rostratula australis* (Australian Painted Snipe), *Stictonetta naevosa* (Freckled Duck), *Anseranas semipalmata* (Magpie Goose) and *Oxyura australis* (Blue-billed Duck) despite their occurrence in the wider locality and in some instances, records within the site (Atlas of NSW Wildlife data 2008). The occurrence of records for some threatened waterbird species within dry forests of the site is likely due to the proximity of wetlands on the Hexham flood plain and the inherent inaccuracy within some spatial data supplied to the NSW NPWS.

The site does not contain extensive estuarine habitats for *Ixobrychus flavicollis* (Black Bittern). Furthermore, there is no suitable habitat within the site for a range of other estuarine or oceanic bird species, such as *Sterna albifrons* (Little Tern) and *Charadrius mongolus* (Lesser Sand Plover) despite their occurrence in the wider locality within the Lower Hunter River estuary.

4.2.2 Regionally Significant Fauna Species

Lake Macquarie Flora and Fauna Guidelines (2001) contain a list of regionally significant fauna species occurring across Lower Hunter LGA's, of which nine were identified within the site during surveys and are listed as follows:

Amphibolurus muricatus	Jacky Lizard
Calyptrohynchus funereus	Yellow-tailed Black-Cockatoo
Turnix varia	Painted Button-quail
Haliaeetus leucogaster	White-bellied Sea-Eagle
Petaurus breviceps	Sugar Glider
Acrobates pygmaeus	Feather-tailed Glider
Demansia psammophis	Yellow-faced Whip Snake
Limnodynastes tasmaniensis	Spotted Grass Frog
Pseudophryne coriacea	Red-backed Toadlet

4.2.3 Terrestrial Mammals

Mammals recorded within the site encompassed species from terrestrial, arboreal and aerial guilds. Terrestrial fauna survey captures were dominated by *Antechinus stuartii* (Brown Antechinus), particularly where understorey vegetation densities were higher within open forest habitats. *Rattus fuscipes* (Bush Rat) was found to occur across the site within terrestrial fauna surveys. *Rattus rattus* (Black Rat) was found south of link road situated within drainage lines and likely to be associated with the adjacent residential and industrial areas of West Wallsend and Northlakes. In addition to these small terrestrial mammals, foxes or secondary fox indications, such as scent marking and scats, were encountered throughout the site, but generally along track lines.

Wallabia bicolour (Swamp Wallaby) and *Macropus rufogriseus* (Red-necked Wallaby) were observed across the site during diurnal and nocturnal surveys. Grazing opportunities occur across the site for these species.

4.2.4 Arboreal Mammals

Petaurus breviceps (Sugar Glider) was identified during arboreal fauna surveys, through captures of both males and females in arboreal traps both to the north and south of the Link Road and was heard to call within several locations within the Development Estate. This species was identified to be utilising open forest habitat with a moderate to closed understorey. *Petaurus norfolcensis* (Squirrel Glider) was identified during arboreal fauna trapping within open forest associated with a drainage line within the portion of the site south of Link Road. Two female and one male *Petaurus norfolcensis* were captured at this location. The two female captures were on different nights and may have been the same individual, since marking was not undertaken and weights were similar.

Pseudocheirus peregrinus (Ring-tail Possum), *Acrobates pygmaeus* (Feathertail Glider) and *Trichosurus vulpecula* (Common Brush-tail Possum) were observed during nocturnal spotlighting surveys on several occasions within open forest habitat with moderate understorey complexity in the Development Estate.

Trichosurus vulpecula (Common Brush-tail Possum) and *Petaurus* sp. (Sugar/Squirrel Glider) were recorded via hair tube sampling within the Development Estates.

4.2.5 Bats

A number of Microchiropteran bat species were detected within the site during nocturnal bat call recording surveys with a definite – probable confidence, including *Tadarida australis* (White-striped Freetail Bat), *Miniopterus australis* (Little Bentwing-bat), *Mormopterus norfolkensis* (East-coast Freetail Bat), *Mormopterus* species 2 (Eastern Freetail Bat), *Chalinolobus gouldii* (Gould's Wattled Bat), *Chalinolobus morio* (Chocolate Wattled Bat), *Vespadelus* darlingtonia (Large Forest Bat) *Vespadelus* vulturnus (Little Forest Bat) and *Rhinolophus megaphyllus* (Eastern Horseshoe Bat). Note: *Miniopterus australis* and *Mormopterus norfolkensis* are listed as Vulnerable under the *TSC Act*.

Pteropus poliocephalus (Grey-headed Flying Fox) was observed foraging and was heard calling within the site during nocturnal survey work. Habitat occurs across the site in the form of flowering sclerophyllous tree species with the winter-flowering species *Corymbia maculata* (Spotted Gum) being of note during the survey period.

4.2.6 Avifauna

There are a range of habitat opportunities for different avifauna guilds within the Minmi - Link Road Development Estate encompassing highly disturbed cleared areas through dry sclerophyll woodlands and open forests to wet sclerophyll forests. Large areas of the Development Estate are wooded, particularly in the southern areas surrounding the Newcastle Link Road and a range of common forest bird species were noted during fauna surveys.

Observed forest bird species encompassed a number of groups with those species recorded including, Whistlers and Thrushes, Robins, Flycatchers, Fairy-wrens, Scrub-wrens, Thornbills, Whipbirds, Cuckoos, Finches, Butcherbirds and birds of prey amongst others. Within these bird groups, species with specific preferences for wet or dry forest

habitats were often encompassed, such as Golden Whistler and Rufous Whistler, Rufous Fantail and Grey Fantail and Grey Goshawk and Brown Goshawk.

The canopies of wooded habitats within the site contain a diversity of tree species that together offer a year round continuity in blossom resources for a range of nectivorous bird species such as honeyeaters and lorikeets. The canopy also represents abundant foraging opportunities for those birds that hunt the invertebrate fauna that foliage and flowering trees attract. Understorey strata density varies across the wooded habitats with the greatest complexity occurring within the gullies. This gully habitat provides cover, foraging and nesting opportunities for small bird species occurring within these habitats and adjacent wooded ridges and slopes. Understorey strata within dry forest habitats include patchy shrub layers that provide foraging and a range of nesting opportunities for small forest bird species such as Thornbills, Scrub-wrens, Finches and Fairy-wrens.

Despite the presence of mesic flora species in the site's gullies, this vegetation only occurs as understorey elements. These wet sclerophyll understorey strata have not developed into extensive closed canopy communities. Therefore, these habitats do not provide a significant range of fruiting plant species as required by strictly frugivorous bird species, including those threatened Fruit-dove species that occur on rare occasions within the Lower Hunter Region. CPSBAW understoreys also include nectar producing plant species, such as banksias and Gymea Lilies, which provide additional foraging for nectivorous bird species, including Spinebills and Yellow-faced Honeyeaters and shelter for small understorey species.

Dams within the site provide only marginal habitat for wetland bird species, due to the general lack of extensive wetland vegetation, as such only a small number of common waterbirds species (Little Black Cormorant, Pacific Black Duck and White-faced Heron) were noted within these habitats.

Open cleared areas within the Development Estate offer little opportunity for avifauna apart from those common pasture and open space birds, which are suited to modified habitats, including, Australian Magpie, Welcome Swallow, Masked Lapwings and Crested Pigeons. Where open areas contain remnant stands of canopy trees common open forest birds such as Eastern Rosellas, Noisy Miners, Grey and Pied Butcherbirds occur, but the lack of understorey vegetation compromises the capacity for these habitats to support small bird species other than canopy specialists like the White-throated Gerygone, Spotted and Striated Pardalotes and Mistletoebirds.

Throughout the open forest habitats there is a sparse presence of *Allocasuarina* sp. (She Oaks), which are the source of the dominant food resource for *Calyptorhynchus lathami* (Glossy Black-Cockatoo). No chewed *Allocasuarina littoralis* (Black She-oak) nuts were noted within the site to indicate the recent presence of Glossy Black-Cockatoos.

Extensive wooded habitats within the site, containing moderate to high levels of understorey structural diversity and low to moderately-high hollow-bearing tree resources, support populations of terrestrial and arboreal mammal species. These habitat attributes are important features for forest owl species, particularly *Ninox strenua* (Powerful Owl)

and *Tyto novaehollandiae* (Masked Owl). A Masked Owl record occurs within the north-eastern section of the Development Estate (Atlas of NSW Wildlife) and a Powerful Owl was observed roosting in wet sclerophyll forest within Tank Paddock Conservation Estate to the north of the site during associated fauna surveys. Although neither the Masked Owl or Powerful Owl were recorded within the Development Estate during fauna surveys, the presence of potential habitat and records within the locality suggests that their use of the Development Estate as part of local distributions and movements cannot be discounted. There are hollows of sufficient size within the Development Estate to represent potential breeding opportunities for this species.

Swift Parrot Target Survey Results

The widespread occurrence of *Corymbia maculata* (Spotted Gum) across large areas of both proposed Development and Conservation Estates suggests that these lands have the potential to attract Swift Parrots during those seasons when Spotted Gum is an important winter flowering species within the central to lower Hunter Valley. However targeted survey during 2008 over the Development Estate did not result in any Swift Parrot observations.

4.2.7 Amphibians

A total of 10 common species of frog were identified within the Development Estate including *Crinia signifera* (Common Froglet), *Litoria fallax* (Eastern Dwarf Tree Frog), *Litoria latopalmata* (Broad-palmed Frog), *Pseudophryne coriacea* (Red-backed Toadlet) and *Lymnodynastes peronii* (Striped Marsh Frog).

Although a number of threatened frog species are known to occur within the region, in particular those belonging to the Genus *Crinia*, *Mixophyes*, *Pseudophryne*, *Litoria* and *Heleioporus*, habitat within the site is not suited to these threatened species. *Mixophyes* spp. occur in montane creeklines, *Pseudophryne australis* and *Heleioporus australiacus* occur within Sydney Sandstone habitats to the south of the Hunter and regionally *Crinia tinnula* occurs in swamp woodland and swamp forest communities around Port Stephens and Lake Macquarie. *Litoria brevipalmata* has been recorded on the valley floor in the Cessnock LGA, but onsite habitat is inconsistent with those areas where it has been regionally recorded.

In a historical context habitat attributes that occur within the site, such as creekline and dam edge vegetation, were once recognised as suitable habitat for *Litoria aurea* (Green and Golden Bell Frog). During the 1960's and early 1970's this species was a common frog species frequently encountered in association with *Typha orientalis* (Cumbungi) (RPS ecologist pers. obs.). However, this species was not observed within these habitat types onsite and this species is now more reliably observed within the Lower Hunter River floodplain in association with near estuarine wetland habitats.

4.2.8 Reptiles

The most commonly encountered reptiles within the Development Estate were common skink species occurring within ground debris, particularly *Lampropholis delicata* (Grass Skink), which was observed across all wooded habitats within the site. *Saiphos equalis*

(Three-toed Skink) was found sheltering under dead vegetation in open forest habitats. *Ctenotus robustus* (Striped Skink) was found sheltering below dead vegetation within open forest habitat.

Two species of dragon lizard were observed within the site. *Amphibolurus muricatus* (Jacky Lizard) was observed in open forest habitat and *Physignathus lesuerii* (Eastern Water Dragon) was observed in wet sclerophyll forest at the northern end of Minmi. *Varanus varius* (Lace Monitor) was also observed in open forest habitat within the site.

One snake species was observed within open forest habitat, being *Demansia psammophis* (Yellow-faced Whip Snake) and *Chelodina longicollis* (Long-necked Tortoise) was observed in dams within the site.

4.3 Habitat Survey

4.3.1 Flora Habitat

The vegetation communities present throughout the site offer a number of suitable habitat types for an array of native flora species. A number of geomorphological factors contribute to the diversity of vegetation communities present within the Minmi - Link Road Development Estate. These factors include the geology, soils, elevation, topography and rainfall patterns. This range of geomorphological influences has produced a number of different vegetation communities. The condition of the vegetation communities varies across the site and generally corresponds to the proximity to urban development, tracks, infrastructure easements and previous long history of underground mining, grazing and other associated land-use practices within the site.

The main disturbances within areas away from proximate development generally entail unformed tracks and infrastructure easements and associated access tracks and the associated erosion across the sites. These tracks are regularly used by unauthorised motorbike riders and to a lesser extent four-wheel drive vehicles. Soil erosion is present throughout and within close proximity to the majority of the tracks, with pasture weed incursions and rubbish dumping also occurring in close proximity to tracks. In addition to the aforementioned disturbances, the tracks also fragment the vegetation communities across the site.

A number of threatened flora species are known to occur locally within LHSGIF, CPSBAW, CFSGIF and ATMF. LHSGIF elsewhere within the region is known to contain *Grevillea parviflora* subsp. *parviflora*, *Callistemon linearifolius*, *Rutidosis heterogama* and in some cases *Tetratheca juncea*. Threatened flora species known to be associated with CPSBAW are *Tetratheca juncea, Grevillea parviflora* subsp. *parviflora*, *Angophora inopina* and *Cryptostylis hunteriana*. A threatened flora species known to be associated with CFHSGIF is *Tetratheca juncea*. Threatened flora species known to be associated with ATMF are *Melaleuca biconvexa*, *Dendrobium melaleucaphilum* and *Syzygium paniculatum*.

A number of ROTAP listed flora are known to occur within LHSGIF, including *Grevillea montana*, *Macrozamia flexuosa* and *Eucalyptus fergusonii* ssp. *fergusonii.* *Macrozamia flexuosa* is also known to occur within CPSBAW. ATMF in the region is known to contain the ROTAP listed *Callistemon shiressii*. Furthermore, at least one Regionally Significant plant species, being *Grevillea humilis* has been noted as occurring within the vicinity of the site in CPSBAW.

ATMF lying within the riparian corridors traversing the site on the northern and southern sides of the Newcastle Link Road, in the east and the far north of the site offer opportunities for mesic vegetation, including serious introduced weeds like *Lantana camara* (Lantana).

Other than opportunities for weeds within cleared easements, vegetation community disturbances within the site are limited to edge effects associated with access tracks and occasional incidences of rubbish dumping. Rubbish dumping is confined to access tracks, with the greatest occurrences proximate to main roads.

4.3.2 Fauna Habitat

Fauna recorded within the site varies with respect to vegetation quality, density and community form. The site encompasses vegetation communities ranging from dry and wet sclerophyll vegetation associations with dams and ephemeral creek lines attracting streamside vegetation and denser understorey habitats. The variation in vegetation within the site provides habitat for a diversity of common fauna species and opportunities for a low to moderate number of threatened fauna species.

The flowering times of Eucalypts and other dominant trees have potential to supply nectar and foraging opportunities for a diversity of species throughout the majority of the year. Dominant tree species and flowering period are contained in Table 4-3 below.

Table 4-3: Dominant Tree Species and Flowering Period

Flora Species	TSC listed	EPBC listed	Habitats (But not confined to) Map units REMS	Potential Threatened Fauna Species that May be attracted by Blossom	Flowering Period (Best time to Survey) in Months of the Year
					J F M A M J J A S O N D
Angophora costata	NA	NA	17	Micro bats (insects), gliders.	
Corymbia maculata	NA	NA	15 &17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	
Corymbia gummifera	NA	NA	15, 30	Micro bats (insects), Flying Foxes, Gliders	

Flora Species	TSC listed	EPBC listed	Habitats (But not confined to) Map units REMS	Potential Threatened Fauna Species that May be attracted by Blossom	Flowering Period (Best time to Survey) in Months of the Year
					J F M A M J J A S O N D
Eucalyptus acmenoides	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders	
Eucalyptus fergusonii subsp. *dorsiventralis**	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	
Eucalyptus fibrosa	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater	
Eucalyptus globoidea	NA	NA	17	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	
Eucalyptus grandis	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	
Eucalyptus paniculata / propinqua	NA	NA	5	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater, Swift Parrot	
Eucalyptus punctata	NA	NA	5 & 15	Micro bats (insects), Flying Foxes, Gliders, Regent Honeyeater	
Eucalyptus resinifera	NA	NA	15, 30, 31, 34 37, 39, 42, 51	Micro bats (insects), Flying Foxes, Gliders	

Dark shading represents core flowering times for canopy trees as reported in the literature and light shading represents those times when flowering has been noted by RPS ecologists outside these core flowering periods.

* The flowering period for *Eucalyptus fergusonii* is not reported within the literature, but RPS ecologists have noted it flowering during March and April in the Bulahdelah area.

Note: The cleared areas occurring within the site are considered to be insignificant in terms of providing habitat for native fauna species aside from providing foraging habitat along the ecotone between cleared and forested areas (such as for hunting bats).

Terrestrial Mammals

Open Forest communities provide moderately suitable habitat for a number of terrestrial mammals. Habitat quality for terrestrial fauna is dependent upon the amount of available groundcover, density and floristic diversity of shrubs and grasses and land use history

(e.g. selective logging, clearing, grazing and understorey management practices).

The cleared areas with open understorey, sparse trees and occurrence of grasses and exotic species within the site provide limited suitable habitat for common native browsers, such as various Macropod species. These areas also provide habitat for pest species such as *Lepus capensis* (Brown Hare), *Oryctolagus cuniculus* (Rabbit) and *Vulpes vulpes* (Fox).

Trends observed from the trapping surveys indicate that small mammals such as *Antechinus stuartii* (Brown Antechinus) and Native Rats were of low to moderate abundances throughout the site, due to the relatively open nature of most understorey strata within vegetation communities across the site.

Arboreal Mammals

Open Forest communities contain abundant foraging resources such as foliage, pollen, nectar and invertebrates for Possums, Gliders and potentially, Koalas. The dominant tree species have potential to supply nectar for the majority of the year. However, most areas are characterised by trees of limited maturity, which limits the incidence of hollow-bearing trees across the site. Generally those areas where greatest opportunities for hollow-bearing trees occur within CPSBAW and ATMF. CFSGIF and LHSGIF exhibited a lower incidence of hollow-bearing trees, due to the presence of tree species that are less likely to develop hollows before higher levels of maturity.

Cleared, open and disturbed areas with a low diversity and density of Eucalypt species hold limited habitat for arboreal species.

Bats

The wooded and adjacent open areas within the site provide extensive insectivorous foraging habitat for microchiropteran bat species. The mix of dominant tree species has the potential to provide a continuous supply of nectar throughout the year, thus attracting insect populations for a range of microchiropteran bats that occur within the locality. Although there is a relatively low incidence of hollow bearing trees within the site, it is likely that canopy trees would contain at least a sparse incidence of small hollows, which are utilised by some Microchiropteran bats. Furthermore, the site is continuous with habitat to the west and there are unbroken linkages to forests spilling off the Sugarloaf Range to the south, which would enable species occurring in the wider locality to utilise foraging habitat within the site without having to traverse vast areas of cleared land. Rocky outcrops and other cave like built form structures are present within the site. These may provide roosting and denning habitat for cave dwelling species.

Canopy trees within the site also offer blossom foraging opportunities for Grey-headed Flying-foxes. This species travels widely to access foraging resources and there are abundant blossom resources within the site for this species to utilise.

Frogs

Where remnant wetland habitats, dams and creeklines with ephemeral pools that would persist after significant rain occur within the site there are habitat opportunities for a

variety of frog species. Adjacent wooded habitats are likely to provide foraging and shelter opportunities for a variety of tree-dwelling and terrestrial frog species. The site occurs on coastal foothills, which do not develop the permanent rocky creeklines that suit *Mixophyes* species, and the geology of the site is not consistent with the sandstone plateau habitats that occur in the Watagan Mountains that support a range of threatened frog species. *Litoria aurea* historically occurred around the edges of the Hexham floodplain, which occurs to the northeast of the site, but recent records occurring in the Lower Hunter Region are from areas exhibiting a saline influence in proximity to the lower reaches of the Hunter River. With these habitat constraints in mind it is unlikely that the site would provide significant habitat for more than common frog species.

Reptiles

Habitat within the site has moderate shelter and foraging opportunities for a diversity of common reptile species. The majority of understorey strata across the site contains only moderately diverse habitat, which is unlikely to provide abundant opportunities for habitat specific reptile species. Those areas of greatest habitat complexity occur on south facing slopes, within riparian corridors containing ATMF and vegetated edges of dams and watercourses.

Semi-permanent to permanent wetlands are likely to provide year-round habitat, whereas creeklines and drainage lines with ephemeral ponds within the site provide intermittent foraging opportunities for common snake and turtle species. Wooded areas are likely to represent habitat for common lizard and snake species.

Avifauna

The wooded areas provide suitable foraging resources (e.g. invertebrate habitat and blossom) and nesting and roosting opportunities for a variety of sedentary and breeding-migrant bird species. Hollow-bearing trees may provide nesting habitat for hollow dependant birds such as Forest Owls, Treecreepers, Parrots, Kingfishers and Woodswallows.

The site is represented by an undulating topography, encompassing ridges, which are colonised by dry forest communities, with intervening gullies that provide moist and sheltered conditions for wet sclerophyll plant communities. This diversity of forest habitat provides an extensive mosaic of habitat providing abundant habitat for a wide range of common forest avifauna. The site has areas containing *Allocasuarina* tree species, which are the favoured food source of *Calyptorhynchus lathami* (Glossy Black-Cockatoo), but there are only limited occurrences of hollow-bearing trees of sufficient size to provide this species with breeding opportunities within the Development Estate.

ATMF occurring within the site's gullies provide roosting habitat for Forest Owl species and the low to moderate incidence of hollow-bearing trees within the site suggest that the site is capable of supporting sufficient arboreal mammals to provide *Ninox strenua* (Powerful Owl) with foraging opportunities. Terrestrial mammal species are present within the site and may be present in sufficient numbers to provide hunting opportunities for *Tyto novaehollandiae* (Masked Owl). However, the site has only limited occurrences of hollow-bearing trees of sufficient size to provide these species with breeding opportunities,

species abundant hunting opportunities within open forest and woodland areas.

4.4 Habitat Mapping

Habitat condition mapping (Figure 4-6) has been undertaken based on the results of field assessment coupled with the results of floristic investigations and RPS Ecology staff combined observations and experience. To optimise the habitat mapping for display and analysis, habitat quality has been divided into the five categories outlined below, based on the habitat assessment elements discussed previously. The habitat assessment elements are; hollow bearing tree density, Eucalypt diversity, Allocasuarina species density, Proteaceae species density, structural diversity and fallen timber density.

Note: The habitat quality has been delineated with reference to but does not follow the delineated vegetation community boundaries.

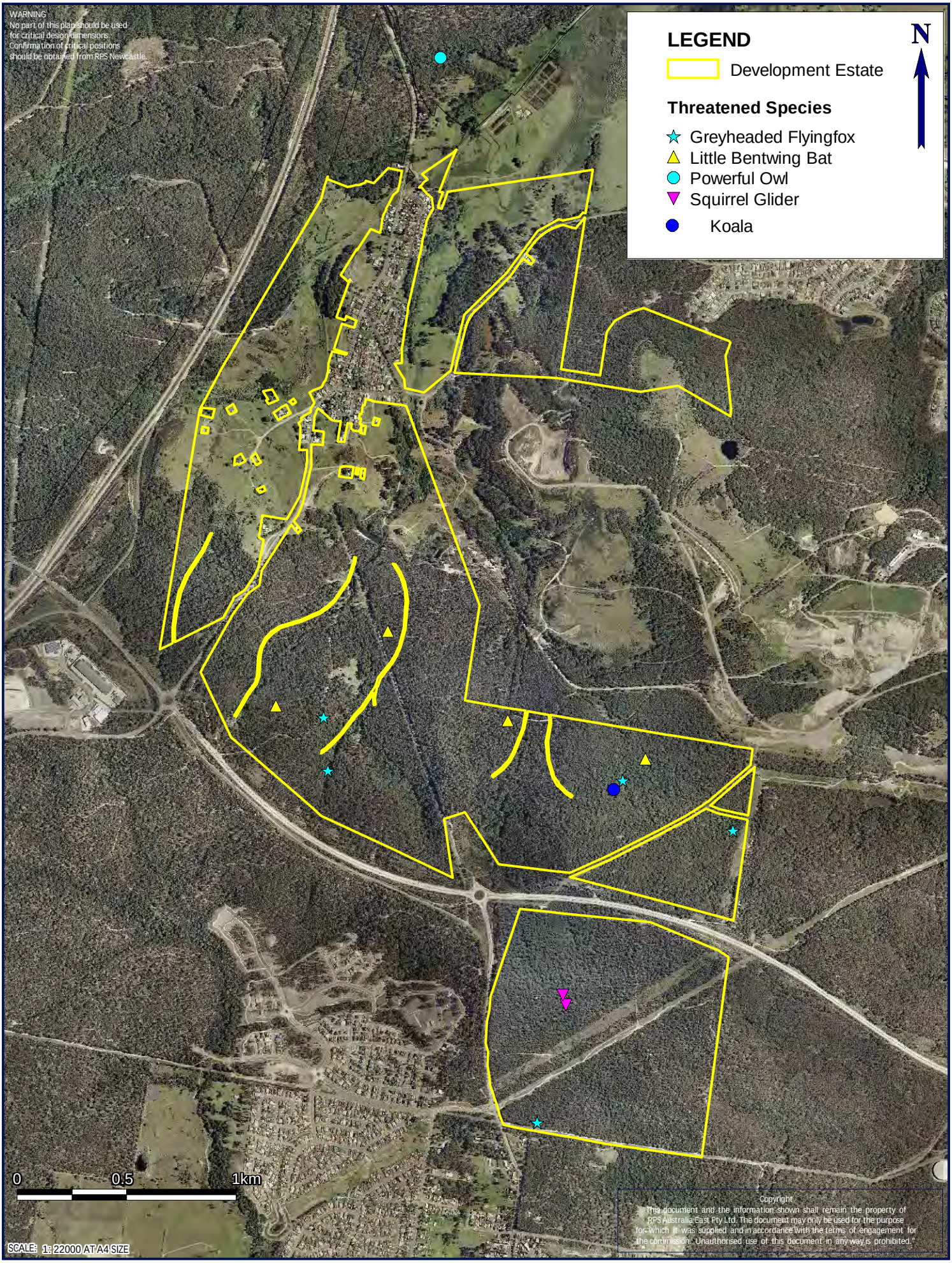
High – Quality habitat with native flora showing no significant disturbance with old growth elements, intact understorey and year round foraging opportunities preferable to significant and threatened fauna species that includes forest owls, arboreal mammals, avifauna (includes EEC with no weed incursion and areas perceived to have regionally unique floristic representations or fauna habitat).

Above average – Quality habitat with native flora showing little to no disturbance with moderate level of key elements. These areas are likely to be utilised by native fauna species, including threatened species, as part of a larger home range (includes EEC with minor weed incursion).

Average quality – Habitat with dominant native community with low – moderate disturbance levels within elements, and includes areas of recent fire disturbance where understorey diversity is low with long term natural regeneration likely (also includes EEC with moderate weed incursion).

Below average – Habitat representing a native vegetation community with high weed incursion and other disturbances and low level of foraging opportunities (includes EEC with severe weed incursion and disused tracks with signs of native regeneration).

Low – Cleared land dominated by exotic flora species and representing preferred habitat for exotic fauna species (includes highly disturbed and frequently used tracks).



TITLE: FIGURE 4-6 THREATENED FAUNA SPECIES RECORDS

LOCATION: MINMI-LINK ROAD

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 19/10/2010
PURPOSE: EAR

LAYOUT REF: J:\JOBS\24k\24530 Hunter Valley\2010 Works\Draft..\Ecology\Northern Lands\MLR\24530-2 Figure 4-6 Threatened Fauna species records B A4
VERSION (PLAN BY): B (A.P-M.D-N.W)

CLIENT: Coal & Allied Industries Ltd
JOB REF: 24530-2

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RPS

5 Development & Conservation Outcomes

The Lower Hunter Region's vegetation is of bio-geographic significance as it supports a transition between the northern and southern plant and animal assemblages. This north-south link is not evident elsewhere in the Hunter Valley. The Region also forms an east-west migratory pathway and a drought refuge for inland species.

The preservation of large vegetated areas that are linked to other similar areas has been recognised as fundamentally important to achieving long term regional biodiversity outcomes in the Lower Hunter region. The two most valued of these areas in the Lower Hunter contain large land areas owned and controlled by Coal & Allied. Firstly, is the green corridor that links the Watagans and Yengo National Parks with the coastal plains of the Tomago Sandbeds, Stockton Bight and Port Stephens. Secondly, the Wallarah Peninsula lands provide a regionally significant break between urban areas, and contain areas of high biodiversity, scenic amenity and heritage value.

The Coal & Allied lands to be dedicated for conservation purposes form both large vegetated areas in their own right, and complete linkage of identified regional corridors in key areas.

In addition to their important strategic location in a wider landscape context, the Conservation Estates contain valuable biodiversity resources. They contain and will conserve a range of important vegetation communities, including areas of Endangered Ecological Communities (EEC) and other vegetation types that have been depleted in the region. Several threatened plant species have been recorded within the Conservation Estates, including *Arthropteris palisotii, Tetratheca juncea* (Black-eyed Susan), *Eucalyptus nicholii, Rutidosis heterogama, Syzygium paniculatum* and *Callistemon linearifolius*. Two of the threatened flora species recorded in the Conservation Estates are considered to be planted specimens and not naturally occurring, being *Eucalyptus nicholii* and *Syzygium paniculatum*, although *S. paniculatum* may have been transported to its position in a disturbed area by natural means. In addition to these threatened species two rare (ROTAP) species *Callistemon shiressii* and *Eucalyptus fergusonii* subsp. *dorsiventralis* were also identified within the Conservation Estates. Refer to Table 5-1: Vegetation Removal / Retention for a complete breakdown of the vegetation retention and removal within both the Development Estates and the Conservation Estates.

The diverse nature of both the landform settings, varying from coastal ranges forests and woodlands to coastal heath to wetlands, provides a diverse array of habitats and resources for native fauna. The Conservation Estates are known to contain important populations of numerous threatened fauna species, including birds, mammals and herpetofauna. The conservation of these lands will provide secure regional biodiversity gene pools, and also through linkages facilitate valuable genetic material exchange and other key processes associated with sustainable ecological population dynamics. Refer to Table 5-2: Habitat Removal / Retention.

In summary, the Coal & Allied conservation dedications provide outcomes that contribute

to meeting the Environmental Protection goals outlined in the Sustainability Criteria contained within the Lower Hunter Regional Strategy. Such includes:

- Outcomes consistent with the Lower Hunter Regional Conservation Plan;
- Maintains / improves areas of regionally significant biodiversity;Maintains environmental areas for air & water quality; and
- Protects areas of Aboriginal cultural heritage value and historical heritage value.

These outcomes:

- Conserve in perpetuity key strategic parcels of land that complete long sought after regional biodiversity conservation corridors and buffer areas;
- Provide large intact areas of conserved habitat that will function as regional biodiversity gene pools;
- Protect an important array of vegetation communities, flora and fauna species, and natural landscape assets, including threatened species and EEC's;
- Contribute significantly to the successful implementation of the Lower Hunter Regional Conservation Plan; and
- Achieve additional conservation benefits within Development Estates via appropriate urban design and management practices.

The following Table 5-1 depicts the vegetation removal and retention associated with the proposal. The following headings have been utilised within the Vegetation Removal Tables.

'Vegetation Community' – Name of Vegetation Community which may be impacted upon by the proposal.

'TSC Act' – Provides the status of the species / community / population described with relation to the *TSC Act.*

'Potential KTP' – Lists the Key Threatening Processes (KTP), which are listed within the *TSC Act*, that have the potential to occur as a consequence of the proposal. Descriptions of potential KTP's and the likelihood of their occurrence within the proposal are presented in Section 6. These are as follows:

1. Loss of Hollow-bearing trees;
2. Clearing of native vegetation;
3. Human-caused climate change;
4. Infection of native plants by *Phytophthora cinnomomi*;
5. Invasion of native plant communities by exotic perennial grasses;
6. Removal of dead wood and dead trees;
7. Predation by the Feral Cat
8. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;

9. *Lantana camara*; and
10. Predation by the European Fox.

'Area in Development Estate (Ha / %)' – Displays the area of vegetation that will be removed as part of the Development Estate.

'Area Conservation Estate (Ha / %)' – Displays the area of vegetation that will be conserved for each of the delineated vegetation communities.

'Total Area' – Represents the total area of each vegetation community within the both the Development Estate and the Conservation Estates, thus the sum of the preceding two columns.

'Comments' – Provides a brief discussion on the key characteristic of the vegetation where relevant.

Table 5-1: Vegetation Removal / Retention

Vegetation Community	1. TSC Act 2. EPBC Act 3. Other	Potential KTP	Vegetation Outcome (ha)			
			Area in Minmi Link Rd Development Estate	Area in Minmi Link Rd Conservation Estate	Area in Black Hill Development Estate	Area in Black Hill Conservation Estate
Alluvial Tall Moist Forest		1-10	30.83	129.88	17.61	36.22
Coastal Foothills Spotted Gum-Ironbark Forest		1-7, 9, 10	169.42	859.01	0	188.39
Coastal Plains Smooth-Barked Apple Woodland		1-7, 9, 10	22.98	160.58	0	44.03
Dam		8	1.30	0.43	0	0
Freshwater Wetland Complex	***1. EEC - FRESHWATER WETLANDS***	1-7, 9	0.37	0	0	11.89
Hunter Lowland Redgum Forest	***1. EEC - HLRF***	1-10	0.39	11.80	0	2.28
Hunter Valley Moist Forest		1-10	21.94	66.87	0	62.54
Lower Hunter Spotted Gum Ironbark Forest	***1. EEC - LHSGIF***	1-7, 9, 10	136.80	181.66	132.92	131.46
Sub-tropical Rainforest	***1.EEC - LOWLAND RAINFOREST***	1-10	0	11.53	0	9.99
Swamp Mahogany – Paperbark Forest	***1. EEC - SSF***	1-10	0	0	0	0.23
Swamp Oak Rushland Forest	***1. EEC - SOFF***	5, 7-9, 10	0	0	0	0.57
Weeds And Cleared Areas		3-10	140.37	139.24	32.97	56.76

Table 5-2: Habitat Removal / Retention

Habitat	Habitat Outcome (ha)			
	Area in Minmi Link Rd Development Estate	Area in Minmi Link Rd Conservation Estate	Area in Black Hill Development Estate	Area in Black Hill Conservation Estate
1 – High	84	211.15	0	174.87
2 – Above Ave	230	1133.18	147	265.74
3 – Average	67.4	82.91	3.5	47.69
4 – Below Ave	13	1.88	33	0.32
5 – Low	130	131.88	0	55.82

6 Environmental Impact Assessment

6.1 Identification of Threatened Species, Populations and Ecological Communities

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the vicinity of the site have been considered within this assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the overall proposal. This assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the overall proposal.

Those species / communities that have been identified as having either a moderate level of impact (or greater) as a result of the proposed Development Estate or that have been recorded within the site during field investigations have been subject to further assessment within Section 6.2 herewith.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat Description and Known Populations' or **'Habitat Description and Known Stands / Populations'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Chance of Occurrence within Site'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impact within Development Estate'– Assesses the likely level / significance of impacts to each species / community / population that would result from the proposed Development Estate, taking into account both short and long-term impacts. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of construction works, proposed remediation works etc. All impact assessment is undertaken with due consideration to the offset related to the Conservation Estates forming part of the proposal.

Table 6-1: Threatened Species Assessment

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
Plants			
Acacia bynoeana Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to the Southern Highlands. Within the Hunter Sub-bioregion it has been found in several locations within the Cessnock LGA where it has been found growing in Kurri Sand Swamp Woodland (KSSW). Has also been recently recorded as isolated populations within Yellow Bloodwood Woodland and Blue-leaved Stringybark Woodland near Ellalong. Locally, it is known to occur with Coastal Plains Scribbly Gum Woodland.	**Low** The survey did not record this species within the proposed development area. Habitat within the Development Estate can be considered sub-optimal at best, as this species prefers woodland habitats. Thus it is unlikely that this species will occur due to the lack of suitable habitat.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat within the Development Estate and thus unlikely to be effected by the proposal.
Arthropteris palisotii Lesser Creeping Fern (E)	Occurs in North-eastern NSW and also in Queensland. The Lesser Creeping Fern grows on trees. Its creeping stem is branched and wiry and covered with dark scales. Spores are borne on the underside of the leaflets in circular clumps. Occurs in rainforest, mainly on tree trunks.	**Low** The survey did not record this species within the proposed development area. The Development Estate lacks potential habitat (rainforest) suitable for this species.	**Low** It is considered that better habitat is present within the Subtropical Rainforest which will be conserved as part of the Conservation Estates at Stockrington to the south west of the Development Estate will be conserved within the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat of open woodland and swamp woodland which is suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Callistemon linearifolius (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Significant populations recently found within the Lower Hunter, including Werakata National Park. Re-sprouting/juvenile specimens difficult to distinguish from other *Callistemon* species such as *C. rigidus* or *C. linearis* without the aid of flowering parts. Locally this species has been recorded where dry forest habitats interface with salt tolerant vegetation communities, such as Swamp Oak Rushland Forest and Riparian Melaleuca forest.	**Moderate** The survey did not record this species within the proposed development area. However, a large area potential habitat is present within the Development Estate in the form of Lower Hunter Spotted Gum Ironbark Forest. A large population of at least 200 specimens were located within the Conservation Estates to the west of the Development Estate.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of a large population of this species and large areas of potential habitat for this species within the Tank Paddock and proposed Conservation Estates. Furthermore, the species was not recorded within the Development Estate during targeted surveys.
Caladenia tessellata Tessellated Spider Orchid (E, V*)	A small terrestrial orchid, which regrows its single leaf on an annual basis. It is known to occur in grassy woodland and locally it has potential to occur within Coastal Plains Scribbly Gum Woodland. It has been recorded within Munmorah State Recreation Area to the south of the Development Estate.	**Moderate** Flora surveys were conducted within the flowering season for this species and it was not recorded within the Development Estate. However, habitat assessment suggests that there is potential for this species to occur in habitats with a heathy to grassy understorey of which those in the best condition occur within the Conservation Estates. Habitat does exist within the Development Estate within the grassy areas located in the southern portion of the Development Estate. Potential habitats for *Caladenia tessellata* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark Forest and Hunter Valley Moist Forest. However, some of the vegetation communities contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchids. Due to the cryptic nature of this species, it is relatively difficult to locate in the field and as such its presence within the	**Low - Moderate** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat (approx 1268ha) for this species will be conserved within the Conservation Estates as part of the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
		Development Estate cannot be discounted.	
Cryptostylis hunteriana Leafless Tongue Orchid (V, V*)	A cryptic Saprophytic orchid species that flowers between December and February. Distribution limits N-Gibraltar Range S- south of Eden. Grows in a variety of habitats from tall open forests to swamp heath on sandy soils	**Moderate** The survey did not record this species within the proposed development area, however surveys were undertaken outside the flowering period for this species. The preferred habitat for this species is Coastal Plains Scribbly Gum Woodland, however this species has been recorded within Coastal Plains Smooth Barked Apple Forest at Freemans Waterhole (Bell, 2004), which is present within the Development Estate. This species generally occurs with other species of the same genus such as *Cryptostylis subulata* and *Cryptostylis erecta.* Neither of these species were recorded within the Minmi Link Road Development Estate. Thus the habitat present within the Development Estate and Conservation Lands is considered to be sub-optimal.	**Low - Moderate** No individuals of this species were recorded during the targeted surveys, however surveys were undertaken outside the flowering period for this species and although there is potential for this species within the Development Estate lands, large areas of potential habitat (approx 160ha) for this species will be conserved within the Conservation Estates as part of the current proposal.
Cynanchum elegans White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast south to Wollongong usually in dry, littoral or subtropical rainforest and occasionally Melaleuca scrub or woodland. A climbing or twining plant species that flowers from August to May with peak flowering in November. One record within the Atlas of NSW Wildlife data occurs within the Lower Hunter Region and Central Coast at Green Point to the north of Belmont.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat of rainforest for this species.	**Low** It is considered that no potential habitat is present within the Development Estate. Habitat in the form of Subtropical Rainforest will be conserved as part of the Conservation Estates at Stockrington to the south west of the site will be conserved within the current proposal. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Dendrobium melaleucaphilum Spider Orchid (E)	Epiphytic orchid growing mostly growing on *Melaleuca styphelioides*, but occasionally on rainforest trees or rocks. Extends from south of the Blue Mountains to Queensland. Preferred habitat is coastal swamp forests.	**Low – Moderate** Although the favoured host plant for this orchid, *Melaleuca styphelioides*, was recorded within the Development Estate during flora surveys, there are no known records for this orchid species in the Newcastle area and it was not recorded during flora surveys. The majority of the habitat of Alluvial Tall Moist Forest will be conserved within the Development Estate as part of the proposal. Nevertheless, due to the occurrence of potential habitat its presence within the Development Estate cannot be totally discounted.	**Low** Unlikely to be adversely affected by the current proposal as the majority of the habitat will be conserved both within the Development Estate and within the Conservation Estates and the species was not recorded within the site during surveys.
Diuris praecox Newcastle Doubletail (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes. This species has been recorded at a number of dry forest locations to the southeast of Lake Macquarie.	**Moderate** There is opportunity for this species to occur within open forest habitats within the Development Estate. However, targeted searches within the flowering period of this species failed to locate any specimens within the Development Estate. Potential habitats for *Diuris praecox* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark Forest and Hunter Valley Moist Forest (approximately 351.9ha). Due to the cryptic nature of this species, it is relatively difficult to locate in the field and as such its presence within the Development Estate cannot be discounted.	**Low** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat (over 2016ha) for this species will be conserved within the Conservation Estates as part of the current proposal.
Eucalyptus camfieldii Camfield's Stringybark (V, V*)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often restricted drainage. Records from the Hunter Sub-bioregion are largely in near-coastal areas from the Port Stephens	**Low** The survey did not record this species within the proposed development area. The Development Estate	**Low** No potential habitat is present within the Development Estate and thus this species is unlikely to be effected by the

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
	LGA to the Central Coast. An isolated stand of trees consistent with this species has been recorded near Kurri Kurri (K. Hill pers. comm.). A local record to the east of the site is reported in the Atlas of NSW Wildlife data.	lacks potential habitat (sandy soils and shrub heath) suitable for this species.	proposed development.
Eucalyptus glaucina Slaty Red Gum (V, V*)	Red Gum species that grows in grassy woodland on deep, fertile and moist soils. Recorded within Hunter Lowland Redgum Forest and Central Hunter Ironbark Spotted Gum Grey Box Forest communities in the lower Central Hunter. Interbreeding known to occur between this species and *E. tereticornis*.	**Moderate** The survey did not record this species within the proposed Development Estates despite careful checking for *Eucalyptus glaucina*. However, potential habitat of Hunter Lowland Redgum Forest does occur within the northern portion of the Development Estate adjoining Minmi. This vegetation community is highly disturbed with high weed incursions.	**Low** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat (approx 11.8 ha) for this species will be conserved within the Conservation Estates as part of the current proposal.
Eucalyptus parramattensis ssp. decadens Drooping Red Gum (V, V*)	Red Gum species that grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Locally, this species occurs almost exclusively in association with Kurri Sand Swamp Woodland and Tomago Sand Swamp Woodland and ecotonal areas, but a small disjunct stand of stunted individuals have been recently recorded within coastal heath in the Lake Macquarie LGA (RPS pers. obs.).	**Low** The survey did not record this species within the proposed development area. The Development Estate lacks potential habitat suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development
Grevillea parviflora subsp. *parviflora* Small Flowered Grevillea (V, V*)	Occurs in light, clayey soils in woodlands and open forests. Most plants appear capable of suckering from a rootstock. Relatively widespread within the Cessnock LGA where it has been recorded in LHSGIF. Occurs within Werakata National Park. Much confusion surrounds the taxonomy of this species and other similar *Grevillea* taxa (S. Bell *pers. comm.*), and a NPWS-funded study of the species is currently in progress.	**Moderate** The survey was unable to locate this species within the proposed Development Estate. The Development Estate has potentially suitable habitat for this species in the form of Lower Hunter Spotted Gum Ironbark Forest. However, a small population of this species was located within the Lower Hunter Spotted Gum - Ironbark vegetation community in the western portion of the Conservation Estates.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species within the Tank Paddock proposed Conservation Estates. Furthermore, the species was not recorded within the Development Estates during surveys.
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas from Jervis Bay to Port Macquarie. Records in the Hunter Region are confined to western Lake Macquarie (Atlas of NSW Wildlife data).	**Low - Moderate** The majority of records of this species occur to the west of Lake Macquarie and the Central Coast, with some scattered records also occurring at Wallsend and Cardiff. Whilst potential habitat exists in the Alluvial Tall Moist Forest vegetation community within the Development Estate, the species was not recorded during flora surveys.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of areas of potential habitat for this species within the Tank Paddock proposed Conservation Estates.
Microtis angusii Angus's Onion Orchid (E, E*)	Record from the Terry Hill's district of Sydney. Occurs upon disturbed soil horizons that were originally ridgetop lateritic soils supporting a distinctive open to low open forest community, Duffy's Forest Vegetation Community, which is listed as an EEC. Suspected occurrences in the southern Lake Macquarie hinterland are derived from a tentative record by Bell (1998) in the Lake Macquarie State Recreation area, which occurs to the south of Gwandalan.	**Low - Moderate** The presence of records within the central coast area and the occurrence of habitat, as described from other locations where this species has been recorded, suggests that this species may have sub-optimal habitat within both the Conservation Estates and the Development Estate within the site.	**Low** Considered unlikely to be adversely affected by the current proposal due to suitable habitat existing within the Conservation Estates.
Rulingia prostrata Dwarf Kerrawang (E, E*)	A prostrate shrub forming mats greater than 1m in width and occurring within heath, dry sclerophyll and coastal sands around Tomago.	**Low** The survey did not record this species within the proposed development area. The site lacks potential habitat (coastal sands) suitable for this species.	**Low** No potential habitat is present within the site and thus this species is unlikely to be effected by the proposed development.
Rutidosis heterogama Heath Wrinklewort (V, V*)	Small Asteraceous herb occurring in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Cessnock LGA. This species is also noted as occurring within coastal heathland habitats between Wyong and Evans Head on sandy substrates or moist areas within open forest.	**Moderate** The targeted survey did not detect this species within the proposed Development Estate. Potentially suitable habitat exists within the Lower Hunter Spotted Gum Ironbark forest community. However a moderate population of this species was located within the Lower	**Low** No individuals of this species were recorded during the targeted surveys and although there is potential for this species within the Development Estate lands, large areas of potential habitat for this species will be conserved within the Conservation Estates as part of the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
		Hunter Spotted Gum - Ironbark vegetation community in the western portion of the Conservation Estates.	
Syzygium paniculatum Magenta Lilly Pilly (V, V*)	A shrub to small tree found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay. Hunter Region records confined to the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	**Low** The survey did not record this species within the proposed Development Estate. Whilst one specimen was recorded within ATMF within the Conservation Estates, the Development Estate contains sub-optimal potential habitat for this species.	**Low** It is considered that better habitat is present within the Subtropical Rainforest which will be conserved as part of the Conservation Estates at Stockrington to the south west of the Development Estate will be conserved within the current proposal. One specimen of this species was located at Stockrington within a disturbed area. Thus it is considered unlikely that this species will be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Tetratheca juncea Black-eyed Susan (V, V*)	Occurs in a variety of forested and heathy habitats. Locally found in Open Forests and Woodlands with dense, undisturbed understorey, often in association with *Angophora costata* / *Corymbia gummifera* on slopes with south-easterly aspects. A number of records exist from the local area including several records from the proposed Conservation Estates within the Tank Paddock Development Estate (Atlas of NSW Wildlife data).	**Moderate – High** Ten plant clumps of this species were recorded in Coastal Plains Smooth-barked Apple Woodland to the south of the Link Road within the Development Estate. However, larger populations of over 350 plant clumps have been recorded within the Conservation Estates to the west of the Development Estate.	**Low - Moderate** Although a small population of this species will be removed as part of the proposal a large proportion will be retained within the Conservation Estates. It is considered that the numbers estimated within the Conservation Estates to be a extreme underestimate of the population as no targeted searches have been conducted and approximately 185 ha of habitat exists within the Conservation Estates. The occurrence of *T. juncea* within the Minmi-Link Road Development Estates is not considered likely to form part of the same population as the Stockrington Conservation Estate, but is likely to function as a small sub-population. The Minmi-Link Road sub-population occurs between the known sub-population within Northlakes to the west and areas of potential habitat (Coastal Plains Smooth-barked Apple Woodland mapped by the L:HCCREMS) with scattered records to the east. Due to the positioning of the Minmi-Link Road sub-population in the middle of two other sub-populations it is likely to form a 'stepping stone' for buzz pollinators and may be required to maintain further sub-populations to the east. The viability of sub-populations to the east is uncertain in the long-term due to existing vegetation fragmentation resulting from urban development. Thus this species is discussed in further detail in the Section 6.2 Assessment of Threatened Species.
Zannichellia palustris (E)	A submerged monoecious weakly rhizomatous aquatic annual or perennial plant. Within Australia it is known only from the Murray River estuary in South Australia and the Lower Hunter region in NSW. This species occurs in fresh to brackish, still to slow moving waters. *Z. palustris* has been collected from Ironbark Creek (Shortland), Black Creek (Cessnock), Kooragang Island and from near Belmont. None of the known sites of this species are formally protected and none are managed in any way for the conservation of the species. This species is ROTAP-coded 3R+, indicating that the species occurs overseas.	**Moderate** The survey did not record this species within the proposed Development Estate. However, potential habitat does occur within the Freshwater Wetland Complex within the northern portion of the Development Estate adjoining Minmi.	**Low** The Freshwater Wetland Complex located within the northern portion of the Development Estate will retained as part of the proposal and additional Freshwater Wetlands are located within Conservation Estates at Tank Paddock. It is considered unlikely that this species will be adversely affected by the proposal as no potential habitat will be removed.
Herpetofauna			
Litoria aurea Green and Golden Bell Frog (E, V*)	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites. Previously widespread within the Sydney Basin Bio-region, but now sparsely distributed within the Lower Hunter and Central Coast areas.	**Low** The survey did not record this species within the proposed Development Estate. Although there is habitat occurring around dams and along lower watercourses within the site, this species only persists in the region within sites exhibiting a saline influence.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
Litoria brevipalmata Green-thighed Tree Frog (V)	Occurs in isolated localities from the NSW Central coast to south-east Queensland. They occur in a range of habitats from rainforest and moist Eucalypt forest to dry eucalypt forest and heath. Breeding occurs following heavy rainfall events in late spring and summer, with frogs congregating around large, temporary pools where males generally only call for one or two nights. This species has been recorded from only one location in the Hunter River catchment, being along creekline habitat within the HEZ study area (Harper Somers O'Sullivan 2004a). Populations of this species are also known to exist regionally within the Watagan National Park (Ehmann, 1997) and Cooranbong (Atlas of NSW Wildlife data).	**Low – Moderate** Riparian and wetland habitats within the site are commensurate with potential habitat for this species, although the survey did not record this species within the proposed Development Estate. However, its presence within the site cannot be discounted since surveys may not have encompassed the most suitable time to detect the species.	**Low** Considered unlikely to be adversely affected by the proposal, due to more extensive areas of habitat retained as Conservation Estates with the proposal.
Varanus rosenbergi Heath Monitor (V)	Inhabits a range of habitats, including coastal heaths, woodland and sclerophyll forests. It shelters in self-made burrows or in hollow logs and rock crevices and is known to be semi-arboreal. Its range extends from southern Western Australia through South Australia. The Victorian and NSW populations are isolated from these western populations and from each other. Within NSW, populations are known from the Canberra region north to Wondabyne.	**Low** The survey did not record this species within the proposed Development Estate. Unlikely to occur due to its more southerly occurrence.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site.
Avifauna			
Botaurus poiciloptilus Australian Bittern (V)	The Australasian Bittern is confined to Australia and New Zealand. Within Australia this species occurs in the southeast and southwest with the occasional vagrant in the northwest of Australia. It favours permanent fresh-waters dominated by sedges, rushes, reeds or cutting grasses (e.g. Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea and Gahnia). Feeds on insects, small fish, eels, frogs and other aquatic life, sometimes in ricefields. It is partly nocturnal in habits, and, keeping as it does to the depths of reedy swamps, is seldom seen during the day. There is an anecdotal record for this species within the proposed Conservation Estates of Tank Paddock.	**Low** The survey did not record this species within the proposed Development Estate. Habitat within the proposed Development Estate lands considered unsuitable for this species due to the lack of permanent wetlands with emergent sedges and rushes.	**Low** The occurrence of this species within the site is unlikely; however, habitats within which this species might potentially occur will be retained within areas dedicated to Conservation Estates within the Tank Paddock site under the proposal.
Lophoictinia isura Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Records exist from the Cessnock and Maitland LGA's and there are records for this species from Cooranbong in the southwest of the Lake Macquarie LGA (Atlas of NSW Wildlife data; HBOC records). Records for this species within the Lower Hunter are generally limited to Autumn.	**Low – Moderate** Due to the generalist habitat requirements of this species, it could potentially occur within the site on a seasonal basis. Records in the Hunter Sub-bioregion are generally sparse and it would be difficult to locate during targeted surveys.	**Low** Given that those areas most suitable as hunting habitat for this species will be retained within proposed conservation areas it is unlikely that the proposal will represent a significant threat to this species.
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Occurs in forests and woodlands where it forages on the seed capsules of Eucalypts. Sedentary, seasonally nomadic or part-migratory, this species shows a general trend to leave highland habitats in winter for more lowland districts. Requires large Eucalypt tree hollows for nesting. Records exist from the Watagan Mountains and adjacent lowlands and foot hills (Atlas of NSW Wildlife data).	**Low – Moderate** Most local records for this species occur from the Watagan Mountains and their adjacent lowlands, to the south-west of the site. However, due to seasonal movements of this species and the occurrence of potential *Eucalyptus* feed trees, there is the chance that this species may use habitat within the Development Estate on at least an intermittent basis.	**Low** Given that those areas most suitable as foraging habitat for this species will be retained within proposed conservation areas at Stockrington and Tank Paddock it is unlikely that the current proposal will represent a significant threat to this species.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on *Allocasuarina* cones. Requires large Eucalypt tree hollows for nesting. Records within the Hunter Sub-bioregion predominantly from relatively undisturbed forested areas on the ranges such as the Watagan Forests, with isolated records from the valley floor remnants.	**Moderate** This species was not recorded within the site during fauna surveys; however, the known feed tree *Allocasuarina littoralis* occurs widely within the site. Therefore, this species may use habitat within the Development Estate on at least an intermittent basis.	**Low** The area of potential habitat that will be affected under the current proposal is small in comparison to the area of potential habitat being conserved within the proposed Conservation Estates within Stockrington and Tank Paddock lands. Therefore, it is unlikely that the current proposal will represent a significant threat to this species.
Melanodryas cucullata subsp. *cucullata*	Ranges from about Mundubbera, Qld, to the Spencer Gulf, SA, intergrading with other subspecies through the northern Murray-Darling Basin (Garnett *et al*, 2000).	**Low** This species was not recorded within the site during fauna	**Low** Considered unlikely to be adversely affected by the proposal

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
Hooded Robin (V)	They occupy drier Eucalypt forest, woodland and scrub as well as grasses and low shrubs. The species is a quiet, shy and largely sedentary bird, most often observed in pairs or small groups. The size of territories throughout Australia has been estimated to be between 5 to 50 hectares. Established pairs keep to their territory year round, banding into family groups only briefly after breeding. (Schodde and Tidemann, 1986).	surveys. Although a record for this species occurs within the site (Atlas of NSW Wildlife data), habitat within the site is not considered suitable for this species and occurs outside its current distribution within the Hunter Valley. Therefore, chance of occurrence is considered low.	due to the lack of suitable habitat within the site.
Stagonopleura guttata Diamond Firetail (V)	Small Finch occupying open woodlands / forests and associated habitats with grassy understorey. Generally found west of the Divide or in drier semi-coastal areas such as the upper Hunter Valley. Appears unable to persist in remnants less than 200ha. Local records for this species are rare, but it has been recorded in the Cessnock LGA during sustained dry periods.	**Low** This species was not recorded within the Development Estate during fauna surveys. Despite occurrences within the Lower Hunter Region (Atlas of NSW Wildlife data) this species occurs sparsely across the western to central Hunter, and as such it is unlikely to occur in the Lower Hunter on more than a rare occasion.	**Low** Considered unlikely to be adversely affected by the proposal due to the Development Estate occurring outside of its normal known range.
Pomatostomus temporalis temporalis Grey-crowned Babbler (V)	Ranges from SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. The Grey-crowned Babbler inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. Also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Forages mainly on insects and spiders in leaf litter and soil, but also venturing into vegetation. Within the Lower Hunter Valley, this species is known from Werakata National Park (University of Newcastle 2001). It has been recorded in Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife; authors pers. obs.).	**Low** This species was not recorded within the site during fauna surveys and there are no records for this species within the locality of the site. The site is dominated by eucalypt forests and lacks this species' preferred open woodland habitat. Therefore, the chance of occurrence is considered low.	**Low** The occurrence of this species within the site is unlikely; however, habitats within which this species might potentially occur will be retained within areas dedicated to Conservation Estates within the Tank Paddock site under the proposal.
Chthonicola sagittatus Speckled Warbler (V)	Occurs in South-Eastern Australia, from South-West Victoria through eastern New South Wales to Central Queensland, mostly on the western slopes and tablelands of the Great Dividing Range, and in the drier areas of coast. Lives in a wide range of Eucalypt dominated vegetation that has a grassy and shrubby understorey often on rocky ridges or gullies (Garnett *et al*, 2000). Within the Lower Hunter Valley, this species is known from Werakata National Park, the HEZ, Elderslie and North Rothbury (Harper Somers O'Sullivan 2004). Records also exist from Wollemi, Goulburn River, Dharug and Yengo National Parks (Atlas of NSW Wildlife 2005).	**Low** This species was not recorded within the site during fauna surveys. Habitat within the site is considered sub-optimal for this species and Lower Hunter records for this species do not occur further east than the Sugarloaf Range. Records occur at the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data).	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the Development Estate. Habitat will retained within the proposed Conservation Estates at Stockrington.
Climacteris picumnus subsp. *victoriae* Brown Treecreeper (V)	Occurs through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys. Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. Within the Lower Hunter Valley, this species is known from Werakata National Park, Rothbury, the HEZ and Ellalong (Atlas of NSW Wildlife).	**Low** This species was not recorded within the site during fauna survey. Although this species is known to occur within Lower Hunter Spotted Gum Ironbark Forest in the Cessnock LGA, birds east of the Sugarloaf population are rare. Nevertheless, records occur at the western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data).	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the Development Estate. Habitat will retained within the proposed Conservation Estates at Stockrington.
Melithreptus gularis gularis Black-chinned Honeyeater (V)	Occurs in eastern Australia, along the inland slopes of the Great Dividing Range, extending to the coast between Sydney and Newcastle, NSW, and north to Rockhampton, Qld. Occupies dry Eucalypt woodland within an annual rainfall range between 400-700 mm, particularly within associations containing Ironbark and Box species (Garnett *et al*, 2000). Within the Lower Hunter Valley, this species is known from Werakata National Park the HEZ and Ellalong lagoon (Harper Somers O'Sullivan 2004). Additionally, substantial and regular records of this species were noted from the Spotted Gum / Ironbark associations in the Cessnock / Kurri Kurri area during 2005 (RPS Ecologists pers. obs.).	**Low – Moderate** This species was not recorded within the site during fauna survey. Although this species is known to occur within Lower Hunter Spotted Gum Ironbark Forest in the Cessnock LGA, birds east of the Sugarloaf population are rare. Records occur at the south-western extremity of lands to be retained for conservation purposes at Stockrington (Atlas of NSW Wildlife data) and this species was recorded during associated fauna surveys to the west of Stockrington.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of records within the vicinity of the Development Estate. Habitat will retained within the proposed Conservation Estates at Stockrington.
Anthochaera phrygia Regent Honeyeater	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the Lake Macquarie LGA this species is generally associated with *Eucalyptus robusta* (Swamp Mahogany). Local occurrences are during winter months when this species flowers, although	**Low** This species was not recorded within the site during fauna surveys, but a single record occurs near riparian	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the site. Potential

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
(E, E*)	their stronghold is west of the great divide and it appears that movements to the coast only occur when foraging resources fail in the west and, to some extent, the Central to Lower Hunter Valley.	vegetation at Holmesville 4km to the site's southwest. Most sitings within the Lower Hunter are from lowland riparian habitats containing winter-flowering canopy trees. These habitat attributes do not occur within the site, hence the chance of occurrence is considered low.	habitat for this species will retained within the proposed Conservation Estates at Stockrington.
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania. When recorded within the Lake Macquarie LGA this species is often associated with winter flowering eucalypt species such as *E. robusta* and *E. tereticornis* (Author pers. obs.), but they are known to forego nectar resources for lerps, which occur on a variety of eucalypt species. Locally this species has been recorded on Point Wollstonecraft and Nord's Wharf to the west (Atlas of NSW Wildlife data).	**Moderate** This species was not recorded within the site during fauna survey. Due to the occurrence of records within the wider locality of the site, its high mobility and the presence of a wide variety of canopy tree species representing a potential food source, the likelihood of this species using the site on an intermittent basis cannot be discounted.	**Low** Considered unlikely to be adversely affected by the proposal due to the conservation of considerably larger areas of potential foraging habitat within the Stockrington and Tank Paddock proposed Conservation Estates.
Neophema discolor Turquoise Parrot (V)	Turquoise Parrot is typically recorded west of the Great Divide on the tablelands and western slopes, extending to the coastal districts through the dry forest corridor of the Hunter Valley (Crome & Shields, 1992). The species occurs in eucalypts woodlands and open forests, with a ground cover of grasses and low understorey of shrubs (NPWS, 2002). This species forages primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of mosses. Breeding pairs nest in small hollow branches of Eucalypts.	**Low** This species was not recorded within the site during fauna survey. Within the Hunter Region this species occurs sparsely across the western to central Hunter, and as such it is unlikely to occur east of the Sugarloaf Range.	**Low** Considered unlikely to be adversely affected by the proposal due to the Development Estate not occurring within its known range.
Glossopsitta pusilla Little Lorikeet (V)	*Glossopsitta pusilla* extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. *G. pusilla* feeds on abundant flowering Eucalypts, but will also take nectar from, *Melaleuca* sp and *Mistletoe* sp. *Eucalyptus albens* (White Box) and *E. meliodora* (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. robusta* (Swamp Mahogany) and *E. pilularis* (Blackbutt). Nesting takes place in hollow bearing trees.	**High** This species was recorded within the northern area of the site. Habitat within the site is considered suitable for both foraging and roosting and records occur within the locality.	**Low – Moderate** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Ninox connivens Barking Owl (V)	Occurs in forests, woodlands, and savannah and riverine woodland although more open country is favoured for foraging and large hollow-bearing eucalypts for breeding. The Barking Owl is widespread within New South Wales, with records from coastal areas along with the slopes, plains, tablelands, and far western plains. Hollands (1991) regards the habitat of this species as open country with a choice of large trees for roosting and nesting. Prey species taken includes arrange of mammals and birds, as well as invertebrates (Readers Digest 1982). Usually occupies permanent territories, generally greater than 100 ha.	**Low** Not recorded during owl call back and nocturnal spotlighting surveys. A number of widely scattered records for this species occur within the Lower Hunter, both to the east and to the west of the site, and as such the chance of its occurrence on a rare occasion cannot be discounted. However, the possibility that the site is part of the home range of individuals or pairs is considered unlikely.	**Low** Considered unlikely to be adversely affected by the proposal due to the Development Estate occurring outside of its normal known range.
Ninox strenua Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas. Records from the Hunter Sub-bioregion are fairly widespread (HBOC records; RPS ecologists pers. obs.).	**Moderate – High** Not recorded within the Development Estate during fauna surveys. However, habitat within the site is considered suitable, and records occur within the locality, including a roosting bird within the Tank Paddock Conservation Estate during associated fauna surveys. Hollows of sufficient size to represent potential breeding sites for this species were noted during habitat assessment within the Development Estate.	**Low** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Tyto novaehollandiae Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and prefers to roost in these hollows as well. Records from the Hunter Sub-bioregion are fairly widespread within the sub-coastal districts and often of road kill birds (HBOC records; RPS ecologists pers. obs.).	**Moderate** Not recorded during the survey, however, habitat within the site is considered potentially suitable, and there are anecdotal records of sightings within the proposed Conservation Estates of Tank Paddock (Green Corridor Coalition). Hollows of sufficient size to represent potential	**Low** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Those areas containing the highest quality foraging habitat and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
		breeding sites for this species were noted during habitat assessment within the Development Estate.	under the current proposal.
Tyto tenebricosa *Sooty* Owl (V)	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows. Most Hunter records exist from the Watagan mountains (Atlas of NSW Wildlife data), but this species has also been observed to the southwest of Awaba (RPS ecologist pers. obs.).	**High** Not recorded during surveys however surveys since on neighbouring lands to the south identified this species responding to call playback from Coal & Allied Land. Despite the large home ranges of this species the presence of wet schlerophyll vegetation assemblages within the forested drainage lines of the site suggests that the Development Estate may provide roosting habitat for this species.	**Moderate** Although it is likely that a small amount of potential habitat for this species may be lost during the process of development. Extensive areas of high quality foraging and nesting habitat for this species will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal
Ptilinopus magnificus Wompoo Fruit Dove (V)	Ranges from Cape York (Qld.) along the coast and ranges south to the Hunter River (NSW.), with the southern end of the range decreasing having once extended to Nowra. This Fruit-Dove is a frugivorous rainforest specialist inhabiting the canopy of sub-tropical, warm-temperate and depauperate rainforests. Occasionally it will stray to fruiting trees outside of rainforest areas. Breeding occurs between July and December and is linked to the fruiting cycles of favoured feed trees including figs, laurels, myrtles and native tamarind. This species prefers relatively undisturbed to completely undisturbed rainforest	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species due to the lack of rainforest habitats. Therefore, the chance of occurrence is considered low. Atlas of NSW Wildlife records occur within proposed Conservation Estates west of Stockrington.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Ptilinopus regina Rose-crowned Fruit Dove (V)	Ranges through Eastern Australia, from Cape York south to the vicinity of Port Stephens. Occasionally it extends into Victoria. The Rose-crowned Fruit Dove generally lives in rainforest, though it also frequents brushes of coastal districts as well as forests and mangroves. It usually feeds on figs or other fruit and berry-bearing trees.	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species (rainforest). Therefore, the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Ptilinopus superbus Superb Fruit Dove (V)	Occurs from north-eastern rainforest, forest and mangroves north of Cardwell, Qld; becoming uncommon nomads or non-breeding migrants further south to the Hunter River, with rare sightings recorded south to Tasmania. It is mainly a rainforest inhabitant but will feed in adjacent mangroves or Eucalypt forest, venturing into coastal brushes also at various times of the year. It usually feeds on figs or other fruit and berry-bearing trees.	**Low** This species was not recorded within the Development Estate during fauna survey. Habitat within the site is not considered suitable for this species (rainforests). Therefore, the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of suitable habitat within the Development Estate.
Mammals			
Dasyurus maculatus Spotted-tailed Quoll (V, V*)	Found sparsely across a relatively wide variety of habitats from coastal heathland to rainforest habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally, it does not occur in otherwise suitable habitats that are in close proximity to urban development. Local records for this species only occur with a level of regularity within large tracts of undisturbed forest as occurs in ranges surrounding the region.	**Low** This species was not recorded within the site during fieldwork. Potential habitat for this species within the site is not considered as highly favourable, due to the lack of extensive areas of high quality habitat. This species is not tolerant of human disturbance and is known to occur within extensive tracts of undisturbed habitat, which do not occur within the site. Furthermore, the site has only distant connectivity to extensive areas of more suitable habitat to the west. Therefore, the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat resources and proximity to human disturbances.
Phascogale tapoatafa Brush-tailed Phascogale (V)	Inhabits dry open forest and woodlands, often in areas with sparse groundcover. It is one of the most arboreal Dasyurids and mainly hunts invertebrates, although some vertebrate prey is taken on occasion. Utilises small tree hollows for nesting and refuge sites.	**Low** This species was not recorded within the site during fieldwork. Much of the habitat within the site is of limited maturity and as such is not considered highly ideal for this species due to limited nesting and refuge sites. Previous records of this species are limited to areas north of the Hunter river (Atlas of NSW Wildlife data). Therefore, the chance of occurrence is considered low.	**Low** Considered unlikely to be adversely affected by the proposal due to the lack of habitat resources and records of this species within the Development Estate and its locality.

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
Petaurus australis Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Most records in the Lower Hunter Region occur in the Watagan Mountains and other areas exhibiting significant stands of forest (Atlas of NSW Wildlife data).	**Low – Moderate** Not recorded during the survey. Some habitat within the Development Estate is considered as containing potential foraging opportunities and potential breeding hollows were noted during habitat assessment. Atlas of NSW Wildlife records occur within proposed Conservation Estates west of Stockrington.	**Low** The current proposal is likely to remove some potential habitat for this species within the Development Estate, however, habitat areas highly suited to this species will be retained as Conservation Estates at Stockrington and Tank Paddock within the current proposal.
Petaurus norfolcensis Squirrel Glider (V)	Occurs in Eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. Widely distributed across the lower Hunter Sub-bioregion, few records from the Upper Hunter (Atlas of NSW Wildlife data).	**High** Two individuals recorded during arboreal trapping surveys within Alluvial Tall Moist Forest in the southern section of the Link Road proposed Development Estate lands.	**Low – Moderate** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particularly *Eucalyptus* spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions. Records from the Hunter Sub-bioregion are generally scarce, with a small number of records from Cessnock, Singleton and Muswellbrook LGA's. Within the Greater Hunter Region it is largely confined to the Port Stephens area, the Lake Macquarie hinterland and the Watagan Mountains (Atlas of NSW Wildlife data).	**High** This species was recorded within the proposed Development Estate of Link Road Minmi during nocturnal fauna surveys.	**Low – Moderate** Whilst one male Koala was recorded within the site, further targeted Koala surveys including SAT plots and transects and spotlighting did not locate any further Koala activity such as scats or scratches within the Development Estates. Therefore, the site does not support a Koala population, and the lack of Koala activity recorded here indicates that this area is not core Koala habitat. The individual recorded within the site is considered to be transient and moving through, rather than a resident. The provision of corridors for fauna including Koalas will be maintained within the proposed Conservation Estates to the west and north at Stockrington and Tank Paddock respectively. Therefore, it is unlikely that the current proposal will represent a significant threat to local populations of this species.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. Frequently observed to forage in flowering Eucalypts. May occur anywhere within the Hunter Sub-bioregion where food or roosting resources are available.	**High** Recorded within the proposed Development Estate site at Link Road. There are no roosting camps for this species in the vicinity of the Development Estate. Extensive foraging habitats and potential roosting camp sites occur within the proposed Stockrington Conservation Estates.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Miniopterus schreibersii subsp. *oceanensis* Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat. Widely distributed across the Hunter Sub-bioregion, particularly in sub-coastal districts (Atlas of NSW Wildlife data). A number of records for this species occur within the vicinity of the site.	**Moderate – High** Not recorded within the Development Estate during fauna surveys; however, there are records occurring within and in its immediate vicinity (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site. Recorded within proposed Conservation Estates at Stockrington, which also contains potential roosting habitat.	**Low** Although the current proposal represents a small incremental loss of foraging habitat for this species, larger areas containing abundant foraging habitat will be retained as Conservation Estates at Stockrington and Tank Paddock with potential roosting habitat occurring with Stockrington under the current proposal.
Miniopterus australis Little Bentwing-bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. Largely confined to more coastal areas in the Hunter region. A number of records for this species occur within the local area (Atlas of NSW Wildlife data).	**High** This species was recorded within the proposed Development Estate during fauna surveys and it is likely that this species may use the site on at least and intermittent basis. No known potential roosting sites exist within the site. Recorded within proposed Conservation Estates at Stockrington, which also contains potential	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
		roosting habitat.	
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. It roosts in tree hollows, under bark and within man-made structures. Found within a scattered distribution across the Lower Hunter Region. Locally it occurs within the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	**High** This species was recorded within the proposed Development Estate near Minmi and there are records occurring within its immediate vicinity (Atlas of NSW Wildlife). Due to the high mobility of this species the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. Hollow-bearing trees within the Development and Conservation Estates represent potential roosting habitats for the species.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Occurs in a range of habitats from rainforest to arid shrubland, roosts in tree-hollows. Near coastal records occur to the south in the Wyong and Gosford LGAs (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. Hollow-bearing trees within the Development and Conservation Estates represent potential roosting habitats for the species.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Few records occur within the Hunter Sub-bioregion.	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its wider locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging and roosting habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Chalinolobus dwyeri Large-eared Pied Bat (V)	This species forages in tall open forests, including dry forests and the edges of rainforest. It roosts in mine shafts and similar structures. Hunter Region records for this species are largely confined to the Watagan Mountains (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Myotis macropus Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Roosts in colonies of between a dozen and several hundred individuals in caves, mines and disused railway tunnels (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its wider locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat along riparian areas within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** The proposed Development Estate will result in a loss of potential foraging habitat. However no known potential roosting habitat will be lost, and larger areas of potential foraging habitat will be retained as Conservation Estates under the current proposal.
Scoteanax rueppellii Greater Broad-nosed Bat	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces / ecotones. This species roosts in tree hollows and is relatively widespread within the Lower Hunter Region (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its wider locality (Atlas of NSW Wildlife). Due to the high mobility	**Low** Although the current proposal represents a small incremental loss of habitat for this species, larger areas containing abundant foraging and roosting habitat will be retained as

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
(V)		of this species and the presence of potential foraging and roosting habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis.	Conservation Estates at Stockrington and Tank Paddock under the current proposal.
Vespadelus troughtoni Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas. The distribution of this species is largely to the north of the Hunter (Strahan 1995), with one record at Windermere Park in south-western Lake Macquarie (Atlas of NSW Wildlife data).	**Moderate** Not recorded within the proposed Development Estate, however, there are records occurring within its locality (Atlas of NSW Wildlife). Due to the high mobility of this species and the presence of potential foraging habitat within the Development Estate, it is likely that this species occurs within the site on at least an intermittent basis. No known potential roosting sites exist within the site.	**Low** The proposed Development Estate will result in an incremental loss of potential foraging habitat. However no known potential roosting habitat will be lost, and larger areas of potential foraging and roosting habitat will be retained as Conservation Estates under the current proposal.
Endangered Ecological Communities			
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Wetlands or parts of wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum*, *Leersia hexandra* and *Carex appressa*. Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as *Baumea articulata, Eleocharis equisetina* and *Lepironia articulata*. Correlates with LHCCREMS Map Unit (MU) 46 – 'Freshwater Wetland Complex'.	**High** The geomorphological characteristics and the species composition of this vegetation community were found to occur within a small wetland present in the northern portion of the Development Estate.	**Low - Moderate** This community will be retained as part of the development proposal. Furthermore, this vegetation community also occurs within Tank Paddock and will be retained as Conservation Estates within the current proposal. However, indirect threats to the long-term retention of this community may potentially exist without appropriate sediment and water control measures that have been recommended to be incorporated into the planning and construction phases of the development. Thus, it is unlikely that the proposal will have a significant effect upon this EEC.
Hunter Lowland Redgum Forest in the Sydney Basin and NSW Coast Bioregions	Fund on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor in the Sydney Basin and NSW North Coast Bioregions. Recorded from the local government areas of Maitland, Cessnock and Port Stephens (in the Sydney Basin Bioregion) and Muswellbrook and Singleton (in the NSW North Coast Bioregion) but may occur elsewhere in these bioregions. Common canopy tree species are *Eucalyptus tereticornis* (Forest Red Gum) and *E. punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora costata*, *Corymbia maculata*, *E. crebra* and *E. moluccana*. The mid-storey is open and characterised by sparse shrubs such as *Breynia oblongifolia*, *Leucopogon juniperinus*, *Daviesia ulicifolia* and *Jacksonia scoparia*. The ground cover typically comprises grasses and herbs. Correlates with LCCREMS Map Unit (MU) 19 'Hunter Lowland Redgum Forest'.	**High** The geomorphological characteristics and the species composition of this vegetation community were found to occur to the north of the Alluival Tall Moist Forest in the northern portion of the Development Estate.	**Low – Moderate** This community will be removed for the construction of Sporting Fields as part of the development proposal. This vegetation community occurs within Tank Paddock and Stockrington Conservation Estates and will be retained within the current proposal. The area of this community which occurs within the Development Estate is degraded due to past clearing and agricultural practices and has little native diversity. Thus due to the retention of approx 11.80 ha of this good quality example of this EEC within the proposed conservation estates, the removal of a small degraded (0.39ha) within the proposed development represents a small incremental loss.
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.	This community is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark) with occasional occurrences of *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark). Several distinctions have been noted within the LHCCREMS community profiles between this community and other Spotted Gum / Ironbark associations, often characterised by the dominant canopy composition, range, soil type and topography (NPWS 2000). Within the Lower Hunter, the peak of distribution occurs within the forested areas between Beresfield and Cessnock. On the basis of revised vegetation mapping conducted in 2002, a total of 32,366ha of LHSGIF has been mapped within the LHCCREMS study area boundary. Correlates with LCCREMS Map Unit (MU) 17.	**High** The geomorphological characteristics and the species composition of this vegetation community were found to occur over most of the Development Estate.	**Low - Moderate** Whilst this community comprises the greater proportion of this Development Estate, due the widespread occurrence of this community on a regional basis, and the retention of large areas of this EEC within the proposed Conservation Estates, the proposed development represents a small incremental loss.
Lowland Rainforest of the NSW North Coast and Sydney Bioregion	Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: Emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have	**Low** This community was not found to occur within the Development Estate.	**Low** This vegetation community occurs within the Conservation Estates to the west of the Development Estate and will be retained as Conservation Estates within the current proposal. Thus, it is unlikely that the proposal will have a significant

Species	Habitat Description and Known Populations	Chance of Occurrence within Development Estate	Likely Level of Impact within Development Estate
	buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions.		effect upon this EEC.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions	This community is associated with periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, typically occurring on grey-black clay-loams and sandy loams. Usually occurring below 20m altitude.	**Low** This community was not found to occur within the Development Estate.	**Low** This vegetation community occurs within Tank Paddock and will be retained as Conservation Estates within the current proposal. Thus, it is unlikely that the proposal will have a significant effect upon this EEC.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions	The community is associated with humic clay or sandy loams on waterlogged or episodically flooded alluvial flats and drainage lines within coastal floodplains. It is generally characterised by an open to dense canopy of Eucalypts and / or Paperbarks. Canopy heights generally vary from 8m to 25m depending on species composition. In the Hunter Region the canopy often contains *Eucalyptus robusta* and / or *Melaleuca quinquinervia* although other species, such as *Casuarina glauca*, *Eucalyptus resinifera* subsp. *hemilampra* and *Livistona australis* may be present.	**Low** This community was not found to occur within the site.	**Low** This vegetation community occurs within Tank Paddock and will be retained as Conservation Estates within the current proposal. Thus, it is unlikely that the proposal will have a significant effect upon this EEC.

Notes: (V) = Vulnerable Species listed under the *Threatened Species Conservation Act 1995*.
(E) = Endangered Species listed under the *Threatened Species Conservation Act 1995*.
(V*) = Vulnerable Species listed under the *Commonwealth EPBC Act 1999*.
(E*) = Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(CE*) = Critically Endangered Species listed under the *Commonwealth EPBC Act 1999*.
(M*) = Migratory Species listed under the *Commonwealth EPBC Act 1999*.

6.2 Assessment of Threatened Species, Populations and Ecological Communities

As per the assessment carried out within Table 6-1, the following species / communities have been deemed appropriate to be applied further detailed assessment due to projected potential levels of impacts likely to result from the proposal.

Flora

- *Caladenia tessallata*
- *Callistemon linearifolius*
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Grevillea parviflora* subsp. *parviflora*
- *Eucalyptus glaucina*
- *Rutidosis heterogama*
- *Tetratheca juncea*
- *Zannichellia palustris*

Endangered Ecological Communities

- Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East corner Bioregions;
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions; and
- Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregions.

Fauna

- *Calyptorhynchus lathami* Glossy Black-Cockatoo
- *Xanthomyza phrygia* Regent Honeyeater
- *Lathamus discolor* Swift Parrot
- *Ninox strenua* Powerful Owl
- *Tyto novaehollandiae* Masked Owl
- *Petaurus norfolcensis* Squirrel Glider
- *Phascolarctos cinereus* Koala
- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Miniopterus schreibersii* Eastern Bentwing-bat
- *Miniopterus australis* Little Bentwing-bat
- *Mormopterus norfolkensis* Eastern Freetail-bat
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat

- *Falsistrellus tasmaniensis* Eastern False Pipistrelle
- *Chalinolobus dwyeri* Large-eared Pied Bat
- *Myotis adversus* Large-footed Myotis
- *Scoteanax rueppellii* Greater Broad-nosed Bat
- *Vespadelus troughtoni* Eastern Cave Bat

6.2.1 Threatened Flora

It should be recognised (as alluded to below) that potential habitat for unrecorded species does exist within the site, including in areas that were not intensively surveyed during these investigations. The following species are considered to have potential habitat within the Minmi - Link Road site, with the exception of *Tetratheca juncea* which was recorded within the Development Estate.

Caladenia tessellata

Caladenia tessellata was not recorded, despite targeted surveys within the Development Estates. However, the cryptic nature of this orchid, combined with sporadic flowering makes it difficult to detect. Suitable habitat for this species exists within the Development Estates and as such it has been addressed here even though it was not recorded.

As a precautionary approach, areas of vegetation communities that have been known to support this cryptic orchid have been included in calculations of potential habitat within the Development Estates. Potential habitats for *Caladenia tessellata* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark Forest and Hunter Valley Moist Forest (approximately 351.14ha). However, some of the vegetation communities contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid. As such, the potential habitat calculations given above are likely to be an overestimate.

Considering the cryptic nature of this species, it is not known whether any *C. tessellata* individuals would be removed as a result of the proposal. An incremental loss of 351.14ha of potential *C. tessellata* habitat in the locality would occur. Moreover, the proposal will result in the conservation 'in perpetuity' of 1268.12ha of potential habitat for this species.

Given that approx 1268.12ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Callistemon linearifolius

Targeted searches for this species within the Minmi-Link Road Development Estate did not locate any individuals of this species. However, suitable habitat for the species exists within the Lower Hunter Spotted Gum Ironbark Forest.

An incremental loss of approximately 136.8ha of suitable habitat in the locality would

occur as a result of the proposal. However, this species was not recorded during the survey period and approximately 181.66ha of suitable habitat will be protected within the Conservation Estates. A population of this species was located within northern portion of the Stockrington Conservation Estates and will be protected in perpetuity.

Given that over 181.66ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Cryptostylis hunteriana

The proposal would remove approximately 22.98ha of Coastal Plains Smooth-barked Apple Woodland habitat within the Development Estate. Whilst this species has previously been located within this community at Freeman's Waterhole (Bell, 2004) this species habitat is generally woodland habitats and it occurs with other species of the same genus such as *Cryptostylis subulata* and *Cryptostylis erecta.* Neither of these species were recorded within the Minmi Link Road Development Estate. Thus the habitat present within the Development Estate and Conservation Estates is considered to be sub-optimal. Targeted surveys have been undertaken for this species within the Minmi Link Road Development Estates during the flowering period of this species.

Considering the cryptic nature of this species, it is not known whether any *C. hunteriana* individuals would be removed as a result of the proposal. An incremental loss of approx 22.98ha of potential *C. hunteriana* habitat in the locality would occur. Moreover the proposal will result in the conservation 'in perpetuity' of approx 160.58ha of potential habitat for this species.

Given that approx 160.58ha of habitat for this species will be reserved within the Conservation Estate, is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Diuris praecox

Diuris praecox was not recorded, despite targeted surveys within the Development Estates. However, the cryptic nature of this orchid, combined with sporadic flowering makes it difficult to detect. Suitable habitat for this species exists within the Development Estates and as such it has been addressed here even though it was not recorded.

As a precautionary approach, areas of vegetation communities that have been known to support this cryptic orchid have been included in calculations of potential habitat within the Minmi - Link Road Development Estate. Potential habitats for *Diuris praecox* include dry sclerophyll forests such as Lower Hunter Spotted Gum-Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark Forest and Hunter Valley Moist Forest (approximately 351.14ha). However, some of the vegetation communities contain sub-optimal micro-habitat and other factors such as aspect and topography would also influence the suitability of habitat for this cryptic orchid. As such, the potential habitat calculations given above are likely to be an overestimate.

A number of records of this species occur to the east of the Northern Estates, along the

coast between Merewether and Tingira Heights. The species was not recorded within the Development Estates despite targeted surveys.

Notably, approximately 1268.12ha of potential habitat will be protected within the Stockrington and Tank Paddock Conservation Estates. However, approximately 351.14ha of potential habitat will be removed as part of the proposal within the Minmi-Link Road Development Estates, representing an incremental local loss of habitat in the locality.

Given that over 1268.12ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Grevillea parviflora* subsp. *parviflora

This species was not recorded during surveys within the Development Estate. However, potential habitat for this species occurs throughout the Lower Hunter Spotted Gum-Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Coastal Foothills Spotted Gum-Ironbark, Forest and Hunter Lowland Redgum Forest vegetation communities (Approximately 329.59ha) within the Development Estates.

Given that approx 1213.05ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Eucalyptus glaucina

An incremental loss of approximately 0.39ha of suitable habitat in the locality would occur as a result of the proposal. However, this species was not recorded during the survey period and approximately 11.8ha of suitable habitat will be protected within the Stockrington and Tank Paddock Conservation Estates.

Since the species was not recorded within the Development Estates during surveys it is considered unlikely to be impacted as a result of the proposal. The proposal would represent an incremental loss of only 0.39ha of potential *Eucalyptus glaucina* habitat in the locality. Therefore, the proposal is not considered likely to have a significant impact on the species.

Rutidosis heterogama

Targeted searches for this species within the Minmi-Link Road Development Estate did not locate any individuals of this species. However, suitable habitat for the species exists within the Lower Hunter Spotted Gum Ironbark Forest.

An incremental loss of approximately 136.8ha of suitable habitat in the locality would occur as a result of the proposal. However, this species was not recorded during the survey period and approximately 181.66ha of suitable habitat will be protected within the Conservation Estates. In addition a large population of this species was located within the western portion of the Stockrington conservation estates and will be conserved in perpetuity.

Given that over 181.66ha of habitat for this species will be reserved within the Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Zannichellia palustris

This species was not detected within the habitat of Freshwater Wetland Complex located in the northern portion of the Development Estate. The Freshwater Wetland Complex located within the northern portion of the Development Estate will retained as part of the proposal.

Whilst the habitat for this species will be retained as part of the proposal indirect impacts of the proposal may occur from stormwater runoff. Thus if nutrient and sediment control measures are put in place to mitigate runoff, prior to and during the construction phase, then this will ensure that any adverse impacts from the development will be avoided and thus a significant impact will not result.

Given that habitat for this species will be retained as part of the proposal and potential habitat for this species is present within the wider Conservation Estate, it is considered highly unlikely that removal of habitat within the conservation estate will significantly impact upon this species.

Tetratheca juncea

A total of 10 *Tetratheca juncea* plant clumps were located during the targeted surveys in August 2007 within the Minmi-Link Road Development Estates (Figure 4-5 shows the distribution). At least 352 plant clumps have been identified within the Conservation Estates. Furthermore, it is estimated that 256 ha of habitat within the Conservation Estates remains to be surveyed. Thus, it is considered that the population within the Conservation Estates will be significantly larger in size than the population within the Development Estate.

The occurrence of *T. juncea* within the Minmi - Link Road Development Estates is not considered likely to form part of the same population as the Stockrington Conservation Estate, but is likely to function as a small sub-population. The Minmi-Link Road sub-population occurs between the known sub-population within Northlakes to the west and areas of potential habitat (Coastal Plains Smooth-barked Apple Woodland mapped by the Lower Hunter Central Coast Regional Environmental Management Strategy) with scattered records to the east. Due to the positioning of the Minmi-Link Road sub-population in the middle of two other sub-populations it is likely to form a 'stepping stone' for buzz pollinators and may be required to maintain further sub-populations to the east. The viability of sub-populations to the east is uncertain in the long-term due to existing vegetation fragmentation resulting from urban development.

It is unknown if the small population within Minmi Link Road Development Estate will be a stepping stone for gene flow, further targeted searches are required to ascertain the distribution of the population to the east of the Development Estate. Therefore the removal of the population may have a significant impact upon this species in the locality of

Cameron Park. However, a large population of this species to be retained within the Stockrington Conservation Estate will ensure the survival of the species within the region.

6.2.2 Endangered Ecological Communities

Three of the EEC's listed in Section 5 are present within the Development Estates, being Lower Hunter Spotted Gum Ironbark Forest, Hunter Lowland Redgum Forest and Freshwater Wetlands. The impacts upon extant EEC's within the Development Estate are discussed below.

Lower Hunter Spotted Gum – Ironbark Forest

This vegetation community encompasses the majority of the Development Estate. It was noted that within this community there seemed to be a particularly young cohort of canopy trees. This could indicate forest regrowth resulting from previous disturbance. This young cohort of *Eucalyptus* sp. was found in the area adjoining Blue Gum Reserve in the north east and to the south of the Link Road. Thus, the habitat which is available for flora and fauna within this area of young cohort is considered to be of lower quality than the habitat found within the Conservation Estates. The differences in disturbance regime between the Development and Conservation Estates may be a result of more difficult access into the Conservation Estates. The Conservation Estates are largely composed of mature forests which have a high diversity of flora, this is evidenced by the large number of habitats and the number of different threatened flora and fauna found within these lands.

Approximately 136.8 ha of extent may be removed as part of the Minmi - Link Road Development Estate. However, approx 181.66ha will be conserved within the Conservation Estates to the west of the Development Estate. Of the area to be removed it is expected that further portions of this vegetation community will be retained within the development layout, due to other constraints on development such as topography. Given that approx 181.66 ha of this EEC will be reserved within the Conservation Estate, it is considered highly unlikely that removal of an area of this EEC will significantly compromise the viability of the local stand. The LHCCREMS mapping project has mapped over 31,000 ha of this vegetation community within the LHCCREMS study area. Thus, the removal of 0.4% of this community within the Lower Hunter Valley as a consequence of the proposal is unlikely to have a significant impact upon this EEC on a regional basis, particularly as the proposal will result in the retention of large areas of this EEC and other native vegetation communities within Conservation Estates.

Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions

This vegetation community encompasses 0.39 ha and occurs along a creekline which is a tributary to Minmi Creek and flows into Hexham Swamp in the north of the Development Estate. This example of HLRF is highly disturbed with weed incursions as it adjoins urban development to the west with cleared agricultural land present to the east of the community. The HLRF will be removed for sporting fields as part of the proposal. . LHCCREMS mapping project has mapped over 7,000 ha of this vegetation community within the LHCCREMS study area. Thus, the removal of 0.005% of this community within the Lower Hunter Valley as a consequence of the proposal is unlikely to have a significant

impact upon this EEC on a regional basis, particularly as the proposal will result in the retention of approx 11.8ha of this EEC and other native vegetation communities within Conservation Estates. Therefore, it is unlikely that the development proposal will have a significant impact upon this EEC.

Freshwater Wetlands on Coastal Floodplains in the NSW North Coast, Sydney Basin and South East corner Bioregions

This vegetation community encompasses 0.37 ha and occurs in the northern portion of the Development Estate adjoining Minmi. This wetland has been subjected to grazing for a number of years and has high weed incursions of pasture grasses and Blackberry along the edges of the community. The water flowing through this wetland enters the floodplain below and continues into Hexham Swamp. Water from Hexham Swamp then flows into Ironbark Creek and subsequently into the Hunter River. This extends through to the internationally significant Hunter Estuary Wetland (Ramsar Wetland 24).

The Freshwater Wetland complex will be retained as part of the proposal, however, urban development may occur to the south east of this community as a result of the proposal. If nutrient and sediment control measures are put in place to mitigate runoff prior to and during the construction phase, then this will ensure that any adverse impacts from the development will be avoided and thus a significant impact will not result.

6.2.3 Threatened Fauna

Potential foraging habitat for this species, in the form of *Allocasuarina* sp., occurs within Coastal Plains Smooth-barked Apple Woodland to the south of the Link Road. This species has been recorded on a number of occasions in the past from the Sugarloaf Range to the west of the Development Estate (HBOC). Other records within the region occur within the Hunter Valley's adjacent ranges with records from the valley floor relatively sparse. Habitat within the site is considered of marginal quality for this species due to the protracted occurrence of its favoured food items and the low incidence of large hollow-bearing trees (outside of gullies), which this species requires for breeding purposes. Greater areas of more suitable habitat occur within proposed Conservation Estates at Stockrington, where *Allocasuarina* sp. trees occur as a mid-storey component of Coastal Foothills Spotted Gum Ironbark Forest. It is considered that the current proposal will ensure that locally occurring individuals or family groups of Glossy Black Cockatoos will benefit due to increases in conserved habitat. Therefore, it is unlikely that the current proposal will threaten the viability of the local population of this species.

Swift Parrot

This species does not occur in the Lower Hunter Region on a continuous basis, as it only moves from Tasmania into south-eastern Australia during the winter months and migrates back to Tasmania in the summer, where the population breeds. Regional records for this species occur at western Lake Macquarie, Raymond Terrace, Maitland and widely within the Cessnock LGA. Regional habitat preferences for this species are for Swamp Sclerophyll Forests containing *E. robusta* (Swamp Mahogany), Spotted Gum – Ironbark dominated vegetation communities, *E. tereticornis* (Forest Red Gum) occurrences across

the Lower Hunter Region and *E. tereticornis* on the lower drainage flats and lower lakeside slopes adjacent to Lake Macquarie and Port Stephens.

No Swift Parrots were observed within either the Conservation or Development Estates during the 2008 surveys. The widespread occurrence of *Corymbia maculata* (Spotted Gum) across large areas of both proposed Development and Conservation Estates suggests that these lands have the potential to attract Swift Parrots during those seasons when Spotted Gum is an important winter flowering species within the central to lower Hunter Valley. Investigation of forests containing Spotted Gum during 2008 surveys found that there were only occasional Spotted Gums flowering, which were attracting small widespread parties of Noisy Friarbirds.

Although no Swift Parrots were observed within the Coal & Allied lands during the 2008 survey these results are not considered to be a representative indication of the capacity of these lands to support the Swift Parrot or Regent Honeyeater. Overall the Conservation Estates exhibit greater habitat opportunities for these species, due to the greater extent of widespread habitat, predominantly Spotted Gum-Ironbark assemblages, ATMF, and the inclusion of riparian Forest Red Gum communities, which are likely to represent focal habitat points for these species during seasons when they occur within the locality. The absence of both of these species from the site during the winter of 2008 is consistent with the paucity of coastal and Lower Hunter records for both of these species during the 2008 season. There have been few Swift Parrot records within the region compared with previous years and no Regent Honeyeaters during the 2008 winter period. Evaluation of potential habitats within Conservation Estates suggests that there is a good probability that both of these species would use the site during favourable years within the region. However, the same assumptions are not considered to apply to the Development Estates, due to the smaller amounts of suitable habitat, lack of Forest Red Gum habitats and the somewhat isolated and to some extent fragmented nature of these lands in comparison with the extent of the Conservation Estates and their continuity to large significant forest areas in the regional context. On this basis it is concluded the proposal will benefit this species by securing local habitat in the proposed conservation estates and thus a deleterious impact on the long term viability of this transient population as a direct result of this proposal is unlikely. Nevertheless it is recommended that preferred forage tree species for *Lathamus discolor* (Swift Parrot) be included within landscaping plant schedules.

Powerful Owl

This species was not recorded within potential habitats occurring within the Development Estate and adjacent lands, despite the occurrence of records to the immediate south of the site (Atlas of NSW Wildlife data) and fauna surveys. This species was observed to the north of the Development Estate within the Tank Paddock Conservation Estate during associated fauna surveys. Forest habitats within the site provide suitable habitat for arboreal mammal populations, which are an important component of the suite of prey species targeted by *Ninox strenua* (Powerful Owls). Furthermore, the gullies within the Development Estate contain trees of sufficient maturity to provide hollows suitable for the breeding requirements of this species. Due to the presence of potential foraging and breeding habitat within the site it is considered that the proposed Development Estate is

likely to incrementally reduce habitat for this species in the locality. However, a greater abundance of more suitable *Ninox strenua* (Powerful Owl) habitat at Stockrington and Tank Paddock are to be retained as Conservation Estates under the proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Masked Owl

Although this species was not recorded within the site during nocturnal fauna surveys, there is a single Atlas of NSW Wildlife record for this species within the north-eastern section of the Development Estate. Other records (Atlas of NSW Wildlife data) occur within lands to be retained as Conservation Estates at Stockrington (three records) and Tank Paddock (one record). Although some potentially occupied habitat for this species will be lost within the Development Estate, much greater areas of potentially occupied habitat will be retained as Conservation Estates at Stockrington and Tank Paddock. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Sooty Owl

This species was not recorded within the Development Estate during field surveys but has since been recorded within Coal & Allied Land during surveys by RPS ecologists during surveys on land immediately south of the Development Estate. The surveys to the south of the Development Estate recorded a single male responding to call playback over numerous nights from within the Coal & Allied Lands. The bird was observed flying from the Development Estate to the location of the broadcasting on the adjacent land.

Sooty Owls live as monogamous, sedentary, life-long pairs and are often faithful to the same nesting hollow within large permanent home ranges (Kavanagh, 2002). This species prefers old-growth mesic forests, inhabiting pockets of rainforest and wet sclerophyll forest mainly in mountainous areas, and often in south-east facing gullies (Higgins 1999). Although the preferred roosting and foraging habitat for this species will be largely retained within the Development Estate as Riparian and Vegetated Buffers under the WM Act 2000, without knowing the exact location of the roost tree/s and gathering more detailed information on this individual and its habits within the Development Estate it is difficult to understand the full impact that the current proposal will have on the individuals on site.

Work on another forest owl species, *Tyto novaehollandiae* (Masked Owl), by John Young at Murrays Beach, NSW, identified a resilience of that particular owl species to encroaching development with a pair breeding successfully despite a house being developed within 30m or the nest tree during the season (Conacher Travers 2009).

Whilst the proposed development represents a small cumulative loss of habitat, much greater areas of suitable habitat for this species is to be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal.

Squirrel Glider

This species was recorded along a drainage line in Alluvial Tall Moist Forest within the southeast extremity of the Development Estate during nocturnal spotlighting fauna

surveys and was captured to the south of the Link Road. At least one male and one female were recorded (a total of two female captures and two male captures). Other records from the locality occur to the northeast, the south and within Stockrington Conservation Estate. Suitable foraging habitat for this species occurs throughout the Development Estate, although, most of the open forest habitats occurring upon the site's ridge tops contain low incidences of hollow-bearing trees, which limits their potential to support this species. While any loss of habitat must be regarded as an incremental loss of habitat for this species within the locality, much greater areas of suitable habitat for this species is to be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Koala

A single Koala was recorded within Lower Hunter Spotted Gum Ironbark Forest to the north of the Link Road within the Development Estate. This record is considered to be unusual within the known distribution of the species within the region. Apart from those records occurring to the north of the Hunter River, the nearest records for this species occur more than 10 km away at Buchanan and Freeman's Waterholes, with sparse records occurring with the Watagan Mountains and western Lake Macquarie (Atlas of NSW Wildlife data). Detailed Koala searches targeting feed tree species within potential habitat were conducted across the Development Estate to determine the status of Koalas on the site. No further sign of Koalas including individual animals, scats or tree bark scratches were observed during these targeted surveys. Results from these targeted surveys, when assessed together with regional occurrences, suggest that the individual observed within the Development Estate is not likely to be indicative that an extant population occurs within the vicinity of the site, but is likely an unattached individual moving between sub-populations. Despite the loss of potential habitat for this species within the Development Estate, much greater areas of habitat suited to this species are to be retained as Conservation Estates at Stockrington and Tank Paddock under the current proposal including the conservation of the important Watagan to Stockton corridor. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Grey-headed Flying Fox

This species was recorded within the Development Estate lands in Lower Hunter Spotted Gum Ironbark Forest, although there is no indication that there are roosting camps for this bat in the vicinity of the site. Potential foraging habitat for this species occurs widely across the Development Estate and bushland areas within the wider locality, which is not surprising in light of the mobility of this species. A large established population of this species is known form Blackbutt Reserve in Newcastle, as such a high probability exists that the individuals observed were members of this population. Although an incremental loss of potential foraging habitat for this species will occur within the Development Estate, much greater areas of suitable foraging habitat will be retained as Conservation Estates under the current proposal, including potential roosting habitat opportunities within Stockrington lands. Therefore it is considered that the current proposal will benefit this species by securing local habitat.

Eastern Bentwing-Bat

This species was not recorded within the Development Estate during fauna surveys. However, it has been previously recorded within the site, the immediate vicinity and the wider locality, including lands to be retained for conservation purposes at Stockrington. Being a species that utilises a diverse range of open forest and woodland habitats for foraging, it is likely that the Development Estate lands may be regularly used as part of its local foraging range. No potential cave roosting sites for this species exist within the Development Estate, although caves occur locally on the Sugarloaf Range and railway tunnels occur within lands to be retained as Conservation Estates at Stockrington. It is also possible that locally culverts under the Link Road offer cave roosting habitat to this species; however, these were not part of the Development Estate. Although it is likely that an incremental loss of foraging habitat for this bat will be removed as a result of the proposal, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Furthermore, potential roosting habitat will be retained within the Conservation Estate. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Little Bentwing-Bat

This species was recorded within the Development Estate during fauna surveys and other records occur within the vicinity and wider locality of the site, including lands to be retained for conservation purposes at Stockrington. Being a species that utilises a diverse range of open forest and woodland habitats for foraging, it is likely that the Development Estate lands may be regularly used as part of its local foraging range. No potential roosting sites for this species exist within the Development Estate, although caves occur locally on the Sugarloaf Range and railway tunnels occur within lands to be retained as Conservation Estates at Stockrington. It is also possible that locally culverts under the Link Road offer cave roosting habitat to this species; however, these are not part of the Development Estate. Although it is likely that an incremental loss of foraging habitat for this bat will be removed during the as a result of the proposal, large areas of suitable foraging and roosting habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. It is therefore, unlikely that the current proposal will represent a significant threat to this species.

East Coast Freetail-Bat

This species was recorded within the Development Estate during fauna surveys and it has been previously recorded within the site, it's immediate vicinity and the wider locality. Being a species that utilises a diverse range of open forest and woodland habitats for foraging and roosting purposes, it is likely that the Development Estate lands may be used as part of its local foraging range and may be used for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will occur as a result of the proposal, large areas of suitable foraging and roosting habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Yellow-bellied Sheathtail-Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the wider locality of the site. Records from the wider locality are scarce, but onsite habitats represent continuous open forest and woodland habitat, which provide both foraging and roosting opportunities for this species. As such the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range and may be used for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will occur as a result of the proposal, large areas of suitable foraging and roosting habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Large-eared Pied Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the immediate vicinity of the site and its wider locality. Being a species that utilises a diverse range of open forest and woodland habitats for foraging, it is likely that the Development Estate lands may be used on at least an intermittent basis as part of its local foraging range. No potential roosting habitat cave overhangs is known within the site, but potential cave roosting sites occur within the Sugarloaf Range to the southwest. Although it is likely that an incremental loss of foraging habitat for this bat will occur as a result of the proposal, large areas of suitable foraging and roosting habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Eastern False Pipistrelle

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the wider locality of the site. Records from the wider locality are scarce, but onsite habitats represent continuous open forest and woodland habitat, which provide both foraging and roosting opportunities for this species. As such the Development Estate may be used on at least an intermittent basis as part of its local foraging range and may be used for roosting purposes. Although it is likely that an incremental loss of foraging and roosting habitat for this bat will occur as a result of the proposal, large areas of suitable foraging and roosting habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Large-footed Myotis

This bat was not recorded within the Development Estate, but records occur within the wider locality of the site and there are foraging opportunities within dams occurring within disturbed areas of the site. No potential roosting sites for this species exist within the Development Estate, although caves occur locally on the Sugarloaf Range and railway tunnels occur within lands to be retained as Conservation Estates at Stockrington. It is also possible that locally culverts under the Link Road offer cave roosting habitat to this species; however, these are not part of the Development Estate. Although potential

foraging habitat such as dams within the Development Estate may be modified as a result of the proposal, large areas containing both foraging and roosting opportunities will be retained as Conservation Estate at Stockrington under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

Eastern Cave Bat

This species was not recorded within the Development Estate during fauna surveys although it has been previously recorded within the wider locality of the site. Being a species that utilises open forest and woodland habitats for foraging, it is likely that the Development Estate may be used on at least an intermittent basis as part of its local foraging range. No potential roosting sites for this species exist within the Development Estate, although caves occur locally on the Sugarloaf Range and railway tunnels occur within lands to be retained as Conservation Estates at Stockrington. It is also possible that locally culverts under the Link Road offer cave roosting habitat to this species; however, these are not part of the Development Estate. Although it is likely that an incremental loss of foraging habitat for this bat will occur as a result of the proposal, large areas of suitable foraging habitat will be retained as Conservation Estate at Stockrington and Tank Paddock under the current proposal. Therefore, it is considered that the current proposal will benefit this species by securing local habitat.

6.2.4 Additional Threatened Fauna Species

The list of threatened species generated from the 10 km search included a number of species that are considered to have a low chance of occurrence within the Development Estate based on the lack of suitable habitat within the Development Estate. The requirements of these species include specific coastal, wetlands or inland habitats. For this reason, the following species were omitted from the Assessment of Significance Table 6-1.

Anseranas semipalmata	Magpie Goose
Stictonetta naevosa	Freckled Duck
Charadrius leschenaultia	Greater Sand-plover
Calidris tenuirostris	Great Knot
Chelodina mydas	Green Turtle
Charadrius mongolus	Lesser Sand-plover
Pterodroma leucoptera	Gould's Petrel
Pterodroma solandri	Providence Petrel
Sterna albifrons	Little Tern
Haematopus longirostris	Pied Oystercatcher
Irediparra gallinaceae	Comb-crested Jacana
Pandion cristatus	Osprey
Hamirostra melanosternon	Black-breasted Buzzard
Ephippiorhynchus asiaticus	Black-necked Stork
Ixobrychus flavicollis	Black Bittern
Limicola falcinellus	Broad-billed Sandpiper
Limosa limosa	Black-tailed Godwit
Oxyura australis	Blue-billed Duck

Rostratula australis	Australian Painted Snipe
Xenus cinerius	Terek Sandpiper

6.3 Key Threatening Process (KTP)

A Key Threatening Process (KTP) is defined in the *TSC Act (1995)* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Something can be a threat if it:

- *adversely affects two or more threatened species, populations or ecological communities; or*
- *could cause species, populations or ecological communities that are not currently threatened to become threatened.*

KTPs are listed in Schedule 3 of the *TSC Act 1995*. Those potentially applicable to the proposal are as follows:

- Loss of Hollow-bearing trees;
- Clearing of native vegetation;
- Human-caused climate change;
- Infection of native plants by *Phytophthora cinnomomi*;
- Invasion of native plant communities by exotic perennial grasses;
- Removal of dead wood and dead trees;
- Predation by the Feral Cat;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- *Lantana camara;* and
- Predation by the European Fox

Loss of Hollow-bearing trees

The proposed development will require the removal of some hollow-bearing trees and as such is considered as contributing to the KTP "Removal of Hollow-bearing Trees". It is expected that low to moderate numbers of hollow-bearing trees will be removed, depending on the vegetation community. This is due to the general low age cohort of trees which were found to be present throughout the Development Estate. LHSGIF has the lowest incidence of hollow-bearing trees, due to the relatively low age cohort of most trees throughout this community. CPSBAW contains a low to moderate incidence of hollow-bearing trees, due to the presence of tree species such as *Angophora costata*, which has a greater potential for developing hollows that other tree species. ATMF contains some large mature trees, which have the potential for carrying a range of different sized hollows. Those guilds of threatened fauna that may potentially be affected by this KTP are threatened Microchiropteran bats, forest owls and arboreal mammals

including gliders.

Although hollow-dwelling Microchiropteran bats may use hollows on the site for shelter, the securing of large areas of potential roosting habitat within lands to be retained as Conservation Estates at Stockrington and Tank Paddock will ensure that significant areas of local habitat for these species will be protected.

Petaurus norfolcensis (Squirrel Glider) was recorded within the southern portion of the Development Estate and may be adversely affected by the removal of hollow-bearing trees, due to their use of this habitat resource for nesting purposes. However, large areas of suitable habitat for this species including areas with numerous hollow-bearing trees will be secured within lands to be retained as Conservation Estates at Stockrington and Tank Paddock.

There are low numbers of large hollow-bearing trees within the Development Estate that are suitable for the breeding purposes of forest owl species. The removal of these resources could adversely affect *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl) that might potentially use the site for breeding purposes. However, large areas of suitable breeding habitat for these species will be secured within lands to be retained as Conservation Estates at Stockrington and Tank Paddock.

It is considered that although the proposal is likely to represent a loss of locally occurring hollow-bearing trees, these losses are more than adequately compensated for by a greater abundance of similar and greater quality habitat that will be secured as Conservation Estates at Stockrington and Tank Paddock.

Clearing of Native Vegetation

The proposed development will require the removal of native vegetation and as such is considered to contribute to the KTP "Clearing of Native Vegetation". Vegetation that will be removed for the Development Estate will include the following native vegetation communities, LHCCREMS MU 17 Lower Hunter Spotted Gum Ironbark Forest, MU 15 Coastal Foothills Spotted Gum Ironbark Forest, MU 30 Coastal Plains Smooth-barked Apple Woodland, MU 5 Alluvial Tall Moist Forest. Approximately 292 ha of LHSGIF EEC occurs within the Development Estate and will be removed as part of the proposal. However, approximately 408 ha of LHSGIF will be secured outside the Development Estate as part of Conservation Estates within the proposal.

A number of threatened fauna guilds potentially use the Development Estate for foraging, including, insectivorous Microchiropteran bats, nectivorous species such as flying-foxes, birds and arboreal mammals and forest owls. As such, removal of native vegetation within the Development Estate has the potential to impact upon local populations of dependant species. Those threatened species, which may be affected by the proposal include, *Petaurus norfolcensis* (Squirrel Glider), *Pteropus poliocephalus* (Grey-headed Flying-fox), Microchiropteran bats and *Lathamus discolor* (Swift Parrots). It is considered that although the proposal is likely to represent a loss of locally occurring native vegetation, these losses are more than adequately compensated for by a greater abundance of similar and greater quality habitat that will be secured as Conservation

Estates at Stockrington and Tank Paddock.

One threatened flora species, *Tetratheca juncea* (Black-eyed Susan), is considered likely to have individuals displaced by the Development Estate. However, there is abundant habitat of much greater quality throughout the Northern Estates Conservation offsets for this species that will be secured in perpetuity.

For all of these species and communities, it is considered that the removal of vegetation from within the Development Estate will not represent a significant impact upon locally occurring entities, in light of the much greater areas of similar or higher quality habitat that will be secured as Conservation Estates within the current proposal, although vegetation removal must be viewed as an incrementally contributing to the action of this KTP in the locality.

Human caused climate change

The proposal is likely to contribute to the KTP "Human Caused Climate Change" as a result of clearing vegetation. It is considered that clearing and modification of the landscape would constitute only a minor incremental increase in the effects of this KTP. Thus, the extent to which the proposal could contribute to this process is considered unlikely to be significant.

Infection of native plants by Phytophthora cinnamomi

Phytophora cinnomomi is a water mould (like a fungus) that attacks the roots of susceptible plants, in many cases killing the plants. In some native plant communities, epidemic disease can develop causing death of large numbers of plants. This water mould has recently been discovered in the Sydney region and within Barrington Tops and is becoming more widespread within NSW.

P. cinnamomi may spread with the movement of infected soil or plant material by people, animals and may be transported by percolating through the soil, in creeks or stormwater runoff. People can also transport the fungus to new areas on dirt adhering to vehicles, items they are carrying or footwear.

Humans have the capacity to spread the fungus long distances and across barriers which sets us apart from the natural mechanisms which normally spread this water mould. Due to the use of heavy machinery that will be used for the construction of the Development Estate there is opportunity for the KTP "Infection of native plants by *Phytophthora cinnomomi"* to operate. The transportation of *Phytophthora cinnomomi* from other areas may occur by the movement of soils attached to earth moving machinery. Precautionary measures such as cleaning of machinery prior to clearing can help to limit the potential for this KTP to occur, and should be addressed in Environment Management plans generated for Development Estate construction activities.

Invasion of native plant communities by exotic perennial grasses

There is opportunity for the KTP "Invasion of native plant communities by exotic perennial grasses" to occur within the Development Estate due to the removal of vegetation and the exposure of underlying soils. For the most part, this KTP already occurs within weeds and cleared areas of the Development Estate. It is expected that those measures employed to reduce potential sediment and erosional impacts to surrounding areas will contribute to minimising the potential for this KTP to impact upon surrounding lands.

Removal of dead wood and dead trees

During the clearing of vegetation within the site a number of dead trees are likely to be removed and this may represent opportunity for the KTP "Removal of dead trees and dead wood". Within the Development Estate land there is a relatively low incidence of these habitat attributes and it is unlikely that this KTP will represent a significant threat to threatened species occurring within the site, provided an ecologist is present during clearing works. Consideration should be given to selective relocation of dead trees and logs into Conservation Estates.

Predation by feral cats

The increase of residential development within the area has the potential to increase opportunities for the KTP "Predation by feral cats". This KTP is unlikely to significantly impact upon local wildlife provided responsible pet ownership is encouraged and adopted.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The displacement of natural vegetation communities as a result of the proposal is likely to increase the opportunity for the KTP "Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands". This is due to increased water flows and runoff potentials as a consequence of water falling upon manmade surfaces. Of greatest risk with regard to this KTP are downstream wetland vegetation assemblages including EEC's and fauna associated with these communities such as threatened waterbird species and other aquatic fauna. Impact to these threatened entities will be minimised through the implementation of sediment and water management plans during the planning and construction phases of development and suitable stormwater runoff treatment and control, coupled with riparian vegetation retention.

Lantana camara

There is a small opportunity for *Lantana camara* to establish, due to the removal of canopy vegetation and the exposing of underlying soils. This exotic plant species already occurs within the Development Estate in relatively high densities in the Alluvial Tall Moist Forest in the centre of the Development Estate. It is likely that the development will considerably reduce the incidence of Lantana within the Development Estate. Nevertheless, there will still be opportunities for this KTP at the edges of the development without appropriate management. It is expected that those measures employed to reduce potential sediment and erosional impacts to surrounding areas will contribute to minimising the potential for this KTP.

Predation by the European Fox

The removal of vegetation and hence habitat for this species has the potential to increase habitat competition within retained areas and the Conservation Estates. As such this may contribute to an increase in the KTP "Predation by the European Fox". If appropriate management measures are employed by the land manager (currently Coal & Allied and DECCW in the long term) this KTP should not have a significant impact on the local wildlife.

No other KTP's are believed to be relevant to the current proposal.

6.4 SEPP 44 (Koala Habitat Protection)

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

6.4.1 First Consideration – Is the Land 'Potential Koala Habitat'?

Schedule 2 of State Environmental Planning Policy (SEPP) No. 44 – 'Koala Habitat Protection' lists 10 tree species that are considered indicators of 'Potential Koala Habitat'. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for 'Potential Koala Habitat'. SEPP 44 defines potential Koala Habitat as:

> *"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".*

One tree species listed in Schedule 2 of SEPP No. 44 – 'Koala Habitat Protection' occurs on site, namely, *Eucalyptus punctata* (Grey Gum), and was found to occur within the Development Estate. Another grey gum species, *E. propinqua* (Small-fruited Grey Gum), also occurs widely across the Development Estate, and this species provides similar Koala foraging resources as *E. punctata* (Phillips *et al*. 2000). In addition to these species a further 10 tree species listed within the LHCCREMS fauna survey guidelines (Murray *et al*. 2002) as Koala feed and browse trees, occur within the site including, *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood), *C. maculata* (Spotted Gum), *E. acmenoides* (White Mahogany), *E. capitellata* (Brown Stringybark), *E. grandis* (Flooded Gum), *E. paniculata* (Grey Ironbark), *E. piperita* (Sydney Peppermint), *E. resinifera* (Red Mahogany) and *E. umbra* (Broad-leaved White Mahogany).

A. costata, *C. gummifera* and *E. umbra* occur widely within Lower Coastal Plains Smooth-barked Apple Woodland (CPSBAW) at individual densities greater than 15% with *E. resinifera E. capitellata* and *E. punctata* occurring in a more patchy distribution at densities > 15% in some areas.

C. maculata, *E. propinqua*, *E. punctata* and *E. umbra* occur widely within LHSGIF at a

density greater than 15% of total canopy cover.

E. capitellata occurs in CPSBAW adjacent to the Newcastle Link Road at a density lower than 15% total canopy cover.

E. acmenoides, *E. grandis*, *E. paniculata*, *E. propinqua* and *E. punctata* occur within ATMF at individual densities greater than 15% of total canopy cover. *E. grandis* is limited to gullies at the northern extremity of the site at the northern end of Minmi.

Based upon the occurrence of *E. punctata* alone LHSGIF, ATMF and to a lesser extent CPSBAW within the site can be regarded as 'Potential Koala Habitat' according to the provisions of SEPP 44. Additionally, based upon locally occurring Koala feed trees, as listed within regional fauna survey guidelines (Murray *et al*. 2002), CPSBAW, LHSGIF and ATMF widely represent 'Potential Koala Habitat', due to the widespread occurrence of potential foraging trees within the Development Estate.

6.4.2 Second Consideration – Is the Land 'Core Koala Habitat'?

A single immature male Koala was observed in LHSGIF on the northern side of the Newcastle Link Road during nocturnal fauna surveys. Due to the presence of this individual within the site, targeted searches (in line with the methodology outlined within Section 3.12) were conducted across the site where feed tree species occurred at densities greater than 15% total canopy cover. These surveys were conducted in addition to general searches for any secondary indications of Koalas on the site including scats, scratches on tree trunks, scent markings on tree trunks, tracks in the soil and audible noises including territorial or mating calls, fighting and movement in the trees. Searches for direct observations of Koalas were also conducted during diurnal fauna surveys in addition to spotlighting during nocturnal surveys. No secondary Koala evidence could be found to suggest that the individual observed within the Development Estate might be an indicator that an extant population occurs within the Development Estate.

Apart from those records that occur north of the Hunter River and the onsite record, Koala records in the Lower Hunter Valley are very sparse; the nearest record to the Development Estate being a record some 10.5 km to the northwest of the Development Estate, the only other occurring some 12.5 km to the southwest in the Watagan Mountains. Due to the absence of evidence to suggest otherwise, the recent observation within the Development Estate is considered to be transitory movements by an unattached individual and not that of a sedentary animal representing a part of an in-situ population. Despite the occurrence of 'Potential Koala Habitat' within the site, the lack of secondary indications during searches within the Development Estate suggest that Koalas are not using the Development Estate as part of the range within a local population. As such, it is considered that any Koala activity in the locality would be representative of a low density population.

No further provisions of this policy apply to the site.

6.5 SEPP 14 (Coastal Wetlands)

Mapping of SEPP 14 'Coastal Wetlands' was consulted to determine if vegetation within the vicinity of the site might be deemed as Coastal Wetlands under the SEPP. A SEPP 14 Wetland is designed to protect wetlands from ad hoc clearing, draining, filling and levee construction. Where a development is proposed to involve any of these actions, preparation of an environmental assessment is required.

There is one SEPP 14 "Coastal Wetland" being Hexham Swamp situated to the north east, approximately 1.3km from the proposed development site.

Due to an ongoing history of disturbance and human interference, Hexham Swamp wetland has become significantly degraded. Changes to the natural flow regime have been caused by clearing, surrounding development and construction of flood gates. Much of the diverse wetland community that once exhibited in the swamp has been reduced to a monospecific community. Although the wetland is degraded many birds, frogs, reptiles and aquatic life still depend on the ecosystem for survival.

The water that flows into Hexham Swamp is generated by rainfall and runoff from surrounding suburbs. This becomes important during heavy rainfall when the swamp acts as temporary storage for excessive amounts of water. A wetland located in the northern part of Minmi has linkages with a low-lying wetland that feeds into Hexham Swamp. The area surrounding the wetland has been used for stock grazing and as such is highly degraded and exhibits an array of weed species. Water from Hexham Swamp then flows into Ironbark Creek and subsequently into the Hunter River. This extends through to the internationally significant Hunter Estuary Wetland (Ramsar Wetland 24). Ramsar is designed to promote and protect wetlands throughout the world. Due to the ecological and hydrological connectivity of onsite swamps to Hunter Estuary Wetland, any potential impacts from the proposed development must also consider impacts upon Ramsar Wetland 24.

There is potential for alterations in the flow regimes of onsite watercourses to change water flow characteristics where onsite water enters other wetlands. Impact to these threatened entities will be minimised through the implementation of sediment and water management strategies during the planning and construction phases of development by incorporating suitable stormwater runoff treatment and control, coupled with riparian vegetation retention and rehabilitation.

Therefore, no further provisions of this policy apply to the site.

6.6 Groundwater Dependant Ecosystem's

The estuarine soils which have been mapped by Matthei (1995) within the north of the proposed Development Estate are expected to contain unconfined aquifers perched above the less permeable underling residual soils and rock. This low-lying area's source of recharge to the aquifers is from surface runoff and direct rainfall. The upslope area to the south will contribute to the recharge of these aquifers will include the Development

Estate. Thus, it is important that surface runoff flows are maintained at the current level to ensure that adequate recharge to the aquifers will occur post-development. To the north of the Development Estate further wetlands and GDEs are present, these include Hexham Swamp. It is vital that these ecosystems are protected from any runoff from the Development Estate.

If existing surface water flow rates are maintained there will be minimal impact upon the GDE's present within the Link Road Minmi Development Estate. This can be achieved by appropriate water sensitive design via the provision of surface water detention basins or swales to limit peak flows.

In conclusion, three of the vegetation communities within the Link Road Minmi Development Estate have been classed as GDE's. If the above recommendations are implemented the impact of the development proposal on GDE's will be minimal.

6.7 Corridors

Within the Lower Hunter region there are numerous reports, strategies, policies and stakeholder expectations surrounding corridor form, function, establishment and management all of which are of key relevance to Greenfield release sites. Of key relevance to the Coal & Allied Lower Hunter Lands Project are the following:

- Lower Hunter Regional Strategy;
- Lower Hunter Regional Conservation Plan;
- Western Corridors Study (WCS);
- In principle the Water Management Act; and
- Plans of Management associated with local conservation reserves.

The proposed land dedication at Stockrington as a component of this proposal and Tank Paddock that will be dedicated to the NSWG in consideration for development rights at Coal & Allied's Black Hill Estate, will consolidate a long sought after regional corridor for the Lower Hunter running from the Watagan Range to Stockton Bight. Further to its corridor function, the size of the Stockrington land holding will provide an area of vast habitat opportunities for regional flora and fauna.

In addition to the aforementioned land dedication, environmental provisions have been made in and around the proposed Development Estates. Firstly the WCS seeks to provide west to east corridor opportunities within all new developments for the locality with the intention of maintaining avifauna and highly mobile faunal guild movements along Link Road, whilst allowing development of the land to the north and south. While these corridors will generally be linear in nature, they will also provide further habitat for resident fauna. At a local scale, the Newcastle Link Road reserve currently provides such a habitat corridor.

To provide further corridor surety, and to offset any possible Newcastle Link Road

widening to accommodate for future population growth or from the F3 to Branxton Link, the current proposal allows for a vegetated corridor within the northern boundary of the Link Road south Development Estate. This will tie into the extensive bushland situated to the east and the existing corridor associated with the Cameron Park, Northlakes development situated to the west which in turn is linked to the Stockrington land via a series of vegetation patches adjacent to and within the F3. The proposed corridor is showing within cross-sections provided in Appendix 6.

Notably the green corridor was not instituted for the purposes of maintaining a diverse range of habitats for local species. Conservation lands within Stockrington and Tank Paddock realise these biodiversity outcomes. The Concept Plan provides a "green corridor" and will function in the capacity of maintaining avifauna and highly mobile faunal guild movements.

In addition, the Minmi-Link Road Development Estate is designed to accommodate, a matrix of interconnecting vegetated areas and riparian corridors similar to that proposed within the Blue Gum Hills Regional Park Plan of Management (as graphically demonstrated in Figure 3.6 Page 3.7). This matrix serves several purposes in providing for stormwater management, ecological enhancement, corridor, habitat, heritage and visual values.

The proposal seeks to encompass the intent of the *Water Management Act* where riparian corridors have been established based on the developments stormwater management requirements coupled with the need to provide a diversity of habitat types for terrestrial and aquatic flora / fauna and to contribute towards connectivity between wildlife habitats. Furthermore, secondary uses within these areas have been minimised, as such bushfire Asset Protection Zones and public open space have been provided for outside the riparian corridors.

At a landscape scale, it is considered the proposal delivers a sound development and conservation outcome where the built environment has made way for the biophysical, thus greatly assisting in the maintenance of local ecological character and faunal movements.

6.8 Environmental Management & Impact Mitigation

This section of the report has been included to provide the reader with an 'in principle' elucidation of the Statement of Commitment (SoC) outlined within the overarching EA report. Specifically Coal & Allied's intent to manage the retained open spaces and riparian corridors within the development areas and conservation land edge zones adjacent to the development areas for predetermined periods. Coal & Allied proposes entering into a Voluntary Planning Agreement (VPA) with Newcastle City Council and Lake Macquarie City Council to manage all local open space and other areas proposed to be dedicated to Council for 5 years or until the adjacent development is completed whichever the later. Coal & Allied will also enter into a Statement of Interim Management Intent (SIMI) with DECCW to manage the immediately adjacent conservation land up to 100m of the development land boundary again for a period of 5 years or until development in the adjacent development areas is complete whichever the later. The SIMI will

specifically cover the management and impact mitigation at the interface between development and conservation land.

While each of the end user agencies (Newcastle City Council, Lake Macquarie City Council and State Government – DECCW/ NPWS) future management will be in line with their internal practices, a VPA and SIMI will provide a 'stepping stone' for the environmental management during construction periods. On completion of the VPA periods the lands will be dedicated to the relevant council in the case of the open space associated with the development area. The areas of conservation land the subject of the SIMI will revert back to DECCW/ NPWS for their ongoing management.

Generally the proposed VPA and SIMI will cover issues such as biodiversity maintenance, stormwater management both permanent and temporary, ecological and bushfire management, cultural and natural heritage which will be consistent with other related Plans of Management that the SoC sets out and strategies for the region. This should not necessarily be construed as a comprehensive list.

The SIMI will specifically cover the management and impact mitigation at the interface between regional conservation reserves. The following brief discussion on Blue Gum Hills Regional Park and the Hunter Estuary National Park cover the aforementioned heads of consideration.

Importantly the SIMI will deal with the aims and objectives of the *DECCW (2010) Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water.* In summary this guideline seeks to ensure that all developments consider and mitigate where possible the impacts of:

- Erosion and sediment control
- Stormwater runoff
- Wastewater
- Management implications relating to pests, weeds and edge effects
- Fire and the location of asset protection zones
- Boundary encroachments and access through DECCW land
- Visual, odour, noise, vibration, air quality and amenity impacts
- Threats to ecological connectivity and groundwater-dependent ecosystems
- Cultural heritage

Blue Gum Hills Regional Park

This park adjoins the Minmi Link Road Development Estate and several measures have been implemented to mitigate impacts which may be caused by the proposed residential development. These include:

- The installation of Bio-retention basins, erosion and sediment control devices to mitigate any runoff which may occur within the park.

- Bushfire Asset Protection Zones have been kept wholly within the boundary of the Development Estate.
- Responsible pet ownership will be encouraged and adopted within the proposed Development Estate.
- Landscaping within the Development Estate will involve the use of locally occurring native species.
- Boundary fencing between the Development Estate and Blue Gum Regional Park is recommended to be fauna friendly fencing with no razor barbed wire to protect fauna species.

The heads of consideration for mitigation measures proposed are as follows:

Erosion and Sediment Control
Appropriate erosion and sedimentation control measures will be implemented prior to construction. These erosion and sediment controls will be maintained for the duration of construction and remain in force until soil is stabilised post construction, ensuring that runoff is appropriately managed.

Sedimentation control will comply with the relevant guidelines ('Managing Urban Stormwater – Soils and Construction, Volume 1' (Landcom 2004)) preventing sediment flow from the development site onto DECC land.

The soils on site are potentially erodible. Mitigation measures such as silt fences, revegetation/reshaping batters, drainage structures (catch drains), sediment traps and sedimentation basins will be constructed (as deemed necessary) to ensure erosion and sedimentation are minimised.

All future works will be guided by appropriate management plans that reflect current industry best practice at that time.

Stormwater Runoff
Water sensitive urban design techniques will be employed to maximise natural site hydrology and ensure high water quality of stormwater with no excessive export of sediments and nutrients.

It is envisaged that stormwater runoff treatment will be addressed on housing lots prior to discharge into the road system and riparian corridors. The retention of riparian vegetation (along and surrounding creeklines and drainage channels) will assist in trapping sediments prior to entering watercourse(s).

Infrastructure associated with stormwater treatment will not be located on any part of the DECCW land.

Wastewater
Similar to stormwater, all waste water management will look to utilise the topography for its trunk main system elements and direct waste to a series of pump stations. All stations,

associated infrastructure and overflow contingencies will be designed to minimise direct and indirect impacts on DECCW Estate.

Management Implications, Pets, Weeds, Edge Effects

As the development is adjacent to DECCW land, it is important that future residents and the general public are educated in regard to the impacts of weeds, pets and rubbish dumping etc. on surrounding conservation lands.

Individual control, regulation and monitoring of the public with regard to pets, weeds and dumping are difficult to achieve, therefore community education will be the main focus to manage these issues. Pamphlets and information sheets can be distributed or attached to sale documents advising potential buyers of the advantages of having conservation reserves close to new homes, and advising them of the responsibilities and potential impacts associated with weeds, pets and rubbish dumping in these conservation areas.

Fire and the Location of APZs

Bushfire assessment has been undertaken under the provisions of NSW legislation and policy which is generally exercised through Planning for Bushfire Protection (2006). To this end, all APZs have been located entirely within the development estates and will not require additional management by DECCW.

Boundary Encroachments

No pre-construction, construction or post-construction activities will occur on DECCW managed land. All material and works associated with construction will occur on the proposed development site.

All future works will be guided by appropriate management plans that reflect current industry best practice at that time.

Visual, Odour, Noise, Air Quality Impacts and Amenity

Coal & Allied has considered that visual, odour, noise and air quality impacts may occur to the BGHRP during the construction and post construction stages of development throughout the assessment process. Measures to avoid the magnitude of these impacts will be instigated.

All future works will be guided by appropriate management plans that reflect current industry best practice at that time.

Threats to Ecological Connectivity

The proposed development will reduce the amount of vegetation adjacent to BGHRP however a matrix of vegetation patches (largely public open space) and linear tracts (largely riparian corridors) throughout the Development Estate will ensure that habitat linkages are retained and provide corridor opportunities for highly mobile, less vulnerable faunal guilds and avifauna. These linkages will connect with land at Stockrington and Tank Paddock (that will be conserved as part of the proposal), together with other conservation lands surrounding the development.

Notably the level of connectivity has been balanced between the significant offset associated with this development coupled with the aims and objectives of the LHRS and subsequent LHRCP in conjunction with the operational nature of the BGHRP.

GDEs have been assessed as part of this proposal. This assessment found that no GDEs adjoin the BGHRP.

Hunter Estuary National Park Hexham Swamp Nature Reserve and Pambalong Swamp Nature Reserve.
There is potential for alterations in the flow regimes of onsite watercourses to change water flow characteristics where onsite water enters other wetlands. Impact to these National Parks and Nature Reserves will be minimised through the implementation of sediment and water management strategies during the planning and construction phases of development by incorporating suitable stormwater runoff treatment and control, coupled with riparian vegetation retention and rehabilitation. Fencing of the boundaries between these conservation reserves and the proposed residential estate will also help mitigate any edge effects from the urban development.

7 Key Thresholds Assessment (Part 3A)

As required by the Draft *Guidelines for Threatened Species Assessment* for Part 3A applications (DEC / DPI 2005), the following assessment of Key Thresholds (four in total) is provided for the proposed Development Estate at Minmi - Link Road.

This EAR has determined that whilst there will be a direct impact upon some individual threatened species due to the removal of vegetation, habitat retention within larger tracts of conservation offsets would ensure threatened species within the locality would not be significantly impacted .

The proposal is fundamental to achieving the outcomes of the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan. These guiding policies have been developed in consultation with local and state government agencies along with the wider community. As such planning has taken into account the environmental, economic and social parameters operating in the Lower Hunter. Therefore on a landscape scale these strategies coupled with this proposal deliver a sound and strategic environment conservation outcome for the region.

Best practice urban design has been incorporated into the concept plan in order to acknowledge, where possible, the corridor requirements of local and state government agencies and the wider community. Whilst the proposal will sever some vegetation remnants within the locality, efforts have been made during the planning phase of the development to incorporate green corridors for the purposes of retaining connectivity. The result, a matrix of linear riparian corridors, green buffers, patches of retained vegetation and public open space is provided by the proposed concept plan. The riparian corridors serve a number of functions including biodiversity connectivity, ecological enhancement, corridor, habitat, heritage, visual and stormwater detention / treatment devices. Whist the riparian corridors within the Development Estate are not exclusive conservation areas, they do provide local connectivity for arboreal and mobile fauna. Furthermore a hierarchy of roads has been proposed with appropriate treatment of adjacent parks and riparian corridors. Refer to the landscape documentation for more information.

Whilst biodiversity will be strengthened where possible the green corridors have been incorporated into development plans largely to buffer creek lines and aid mobile fauna species movements throughout the area. These important corridors will provide links to the larger, habitat diverse lands at Stockrington and Tank Paddock that are to be secured as valuable conservation lands.

1. **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

It is considered that the information presented within this document, and in particular the proposal that includes the proposed land dedication to NPWS for the site as detailed within the concept plan and this EAR, is likely to result in a maintained if not an improved

outcome for biodiversity values within the region.

2. ***Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.***

The threatened species, populations and ecological communities considered within the report occurring within the proposed Development Estate are well represented in the proposed dedication lands and wider locality, and are also represented or have potential habitat within other conservation offset lands and considered unlikely to reduce the long-term viability of a local population of species or endangered ecological community.

3. ***Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.***

The threatened species, populations and ecological communities considered within the report occurring within the proposed Development Estate are well represented in the proposed Conservation Estates and wider locality, and are also represented or have potential habitat within other conservation reserves and are considered unlikely to be placed at risk of extinction.

4. ***Whether or not the proposal will adversely affect critical habitat.***

There is no declared "Critical Habitat" within the Development Estate locality, and as such the proposal will not adversely affect any such habitat.

7.1 Offsetting Principles (Lower Hunter Regional Conservation Plan: Appendix 1)

In order to comply with the broader biodiversity objectives of the DGEARs, an assessment against the Offsetting Principles outlined within Appendix 1 of the Lower Hunter Regional Conservation Plan has been undertaken herewith.

1. Impacts must be avoided first by using prevention and mitigation measures. Offsets are then used to address remaining impacts.

The Development Estates have been selected within areas of previous disturbance and/or areas that represent an extension of the existing urban framework. The scope of the estates were also subject to extensive discussions with NSW Government, consultations with the community, Federal and NSW Government environmental agencies, independent hearings under the EP&A Act, urban design charrettes and public exhibition and refinement of proposals.

All of the proposed development and conservation offsets are in accordance with the provisions of the Lower Hunter Regional Strategy (LHRS) and supporting LHRCP, noting here that the LHRCP cites the LHRS as a 'partner document', emphasising that the two should be considered together and that is precisely what the Coal & Allied proposals do. The proposals improve biodiversity protection through transfer of proposed conservation lands from private to NSW Government ownership. Such lands have been identified within

these planning and conservation documents and are fundamental to the success and achievement of the objectives and benchmarks therein as detailed within Appendix 2 of the LHRS and succinctly captured within the LHRCP executive summary.

2. All regulatory requirements must be met.

The proposal has considered the regulatory and statutory frameworks associated with the NSW Part 3A assessment process and beyond. The Environmental Assessment Report identifies and assesses the impacts associated with the ecological constraints and opportunities of the proposal. Other accompanying Environmental Assessment Reports identify and assess the impacts on Cultural Heritage, European Heritage, Contamination, Water Sensitive Urban Design and other relevant environmental impacts. All recommend actions to be taken to mitigate or compensate for such impacts have been duly considered within the concept master planning process and represent additional project benefits that are separate from the offset proposal.

Notably Coal & Allied's proposal has been determined as not a controlled action by the Federal Minister for the Environment under the Environment Protection and Biodiversity Conservation Act. Importantly the proposal assessed herewith is consistent with that provided to the Minister for his consideration and determination. Refer to Appendix 7.

3. Offsets must never reward ongoing poor performance.

The proposed Development Estate lands are part of lands owned by Coal & Allied that are not required for their current or future mining operations. In part these lands have been utilised previously for open-cut and underground mining and related activities and as such clearing has occurred.

The conservation lands proposed to be dedicated have not been the subject of unnecessary clearing and where mining activity has been undertaken on parts of the site it has largely been underground and as a consequence the overlying high biodiversity surface and vegetative cover has been preserved. The lands have been (and continue to be) managed by Coal & Allied such that they do not become an environmental burden and/or degrade adjacent lands.

The proposed development seeks to use industry best practice urban design and will be tested through the Part 3A assessment process.

As such the offsets will not be rewarding poor land management practices or poorly designed development proposals as they are of high biodiversity value as identified through the ecological assessment process and the environmental audit.

4. Offsets will complement other government programs.

The proposed offsets represent a significant conservation opportunity that will secure environmental assets, in perpetuity, that have been highly sought after under the NSW Government Lower Hunter Regional Strategy (LHRS) and specifically identified as highly