



Mona Vale Road East Detailed
Biodiversity Investigation Report:
Volume 2 Assessments of Significance

Final
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ecology / vegetation / wildlife / aquatic ecology / GIS

Acronyms and abbreviations

Abbreviation	Expansion
DECC	NSW Department of Environment and Climate Change (currently Office of Environment and Heritage)
DoE	Commonwealth Department of Environment
EEC	Endangered Ecological Community (under the TSC Act)
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic information system
ha	hectare
IUCN	International Union for the Conservation of Nature
Km	Kilometre
LGA	Local Government Area
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PKFT	Preferred koala food tree
Roads and Maritime	Roads and Maritime Services
SAT	Spot Assessment Technique
SIS	Species Impact Statement
Spp.	Species (plural)
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

Glossary

Biobanking	'A market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme as well as an opportunity for rural landowners to generate income by managing land for conservation' (OEH 2012).
Direct impact area	Area to be cleared within concept design footprint as per design dated 20 September 2014 (Figure 1 of main report)
Indirect impact area	5 m buffer from direct impact area
Main report	Mona Vale East Detailed Biodiversity Investigation Report: Volume 1. Draft 1. Report prepared for Roads and Maritime Services, Ecosure, Burleigh Heads.
Proposed road upgrade	Current project being assessed, Mona Vale Road East which covers Mona Vale Road from Manor Road, Ingleside to Foley Street Mona Vale
Study area	This is the area that was investigated for this report and covers 10 kilometres either side of the centre of the direct impact area
Survey area	This is the area intensively investigated during field surveys and covers 100 metres either side of the existing road, including all areas likely to be impacted by the proposed road upgrade

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1 Introduction

Roads and Maritime Services (Roads and Maritime) proposes to upgrade a 3.2 kilometre section of Mona Vale Road approximately 30 kilometres north of Sydney, between Manor Road, Ingleside and Foley Street, Mona Vale. The upgrade will include the following key features:

- Widening to provide a four lane dual carriageway with concrete median barrier, with most widening occurring north of the current alignment
- Upgrading of the existing roundabout at Ponderosa Parade/Samuel Street
- Provision of fauna crossing structure(s) where practical
- Establishment of site compounds and stockpiles within the impacted area.

Ecosure has been engaged by Roads and Maritime to carry out biodiversity investigations as part of the project planning and development. The results of this study are detailed in *Mona Vale East Detailed Biodiversity Investigation Report: Volume 1* (main report).

Flora and fauna impact assessment was carried out based on Roads and Maritime’s concept design (as of 21 April 2015). Assessments of significance under both the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Threatened Species Conservation Act 1995* (TSC Act) were completed for seven and 30 threatened species respectively, identified as having the potential to be impacted on by the proposed road upgrade.

At time of writing, the concept design includes the removal or disturbance of 6.59 hectares of native vegetation, and a further 3.28 hectares of disturbed vegetation and the remainder woodland or heath (Table 1 and 2) (See Section 5.2 of main report for further details).

Table 1 Summary of vegetation to be cleared

Vegetation community type	Biometric Vegetation Type (BVT) code	Possible endangered ecological community (EEC)	Direct impact area (ha)	Indirect impact area (ha)	Total impact area (ha)	Similar vegetation within study area (10 km radius of centre of the survey area) (ha)
Coastal Sandstone Sheltered Peppermint-Apple Forest	ME012	No	0.04	0.03	0.07	3,129
Hornsby Sandstone Exposed Bloodwood Woodland	ME014	No	2.49	0.79	3.28	5,143
Hornsby Sandstone Heath – Woodland	ME014	No	0.30	0.21	0.51	2,244
Coastal Sandstone Plateau Rock Plate Heath	ME008	No	0.11	0.02	0.13	97
Coastal Enriched Sandstone Moist Forest	ME032	No	2.03	0.57	2.60	332

Vegetation community type	Biometric Vegetation Type (BVT) code	Possible endangered ecological community (EEC)	Direct impact area (ha)	Indirect impact area (ha)	Total impact area (ha)	Similar vegetation within study area (10 km radius of centre of the survey area) (ha)
Total native vegetation			4.97	1.62	6.59	10,945
Other vegetation type						
Urban Exotic/Native	n/a	No	1.61	0.99	2.60	1,677
Disturbed – wattle scrub	n/a	No	0.03	0.00	0.03	7
Native revegetation	n/a	No	0.37	0.28	0.65	29
Grand total			6.98	2.89	9.87	12,658

Table 2 Fauna habitat to be cleared

Fauna habitat type	Direct impact area (habitat removal in direct impact area (ha))	Indirect impact area (5 m buffer around direct impact area(ha))	Total impact area (ha)	Similar habitat within study area (10 km radius of centre of the survey area) (ha)
Disturbed	2.01	1.27	3.28	1,714
Sandstone heath	0.41	0.23	0.64	2,432
Woodland	4.56	1.39	5.95	10,246
Total	6.98	2.89	9.87	14,392

This present report contains the assessments of significance, and should be read in conjunction with main report.

2 EPBC Act Assessments of Significance

Detailed assessments of significance *using Significance Impact Guidelines 1.1 Matters of National Environmental Significance* (DoE 2013) were undertaken for fourteen species listed under the EPBC Act (Table 3). Only one species (Angus's onion orchid) had the potential to be significantly impacted and a referral is recommended.

Table 3 Summary of Assessments of Significance under the EPBC Act

Family	Scientific name	Common name	EPBC status	TSC status	Significance assessment question									Likely significant impact? Referral recommended?
					a	b	c	d	e	f	g	h	i	
Myrtaceae	<i>Eucalyptus camfieldii</i>	Camfield's stringybark	V	V	N	N	N	N	N	N	N	N	N	No. There are no occurrences within the survey area, after detailed surveys.
Orchidaceae	<i>Genoplesium baueri</i>	Bauer's midge orchid	E	E	N	N	N	N	N	N	N	N	N	No. There are no occurrences within the survey area, despite detailed surveys.
Proteaceae	<i>Grevillea caleyi</i>	Caley's grevillea	E	CE	N	N	N	N	N	N	N	N	Y	No. Minimal habitat occurs and no records despite detailed surveys of this conspicuous species.
Orchidaceae	<i>Microtis angusii</i>	Angus's onion orchid	E	E	N	Y	N	Y	Y	N	N	N	Y	Possible. Referral is recommended, after development of conservation strategy.
Proteaceae	<i>Persoonia hirsuta</i>	hairy geebung	E	E	N	N	N	N	N	N	N	N	N	No. There are no occurrences within the survey area, despite detailed surveys.
Thymelaeaceae	<i>Pimelea curviflora</i> var. <i>curviflora</i>	curved rice-flower	V	V	N	N	N	N	N	N	N	N	N	No. There are no occurrences within the survey area, despite detailed surveys.
Vespertilionidae	<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V	N	N	N	N	N	N	N	N	N	No. Possibly occurs within survey area. Minimal foraging habitat and no roosting habitat will be impacted.
Myobatrachidae	<i>Heleioporus australiacus</i>	giant burrowing frog	V	V	N	N	N	N	N	N	N	N	N	Unlikely. Only small amount of foraging habitat to be impacted. Occurrence of this species has not yet been confirmed, and detailed surveys scheduled for February – April will be reported on separately.

Family	Scientific name	Common name	EPBC status	TSC status	Significance assessment question									Likely significant impact? Referral recommended?
					a	b	c	d	e	f	g	h	i	
Psittaculidae	<i>Lathamus discolor</i>	swift parrot	E	E	N	N	N	N	N	N	N	N	N	No. Not detected during surveys. Small amount of foraging habitat to be impacted, unlikely to be impacted by habitat fragmentation. At best an occasional visitor to this area.
Phascolarctidae	<i>Phascolarctos cinereus</i>	koala	V	V	N	N	N	N	N	N	N	N	N	No. Unlikely to be a resident population, maximising fauna connectivity will allow transients to move through survey area if required.
Dasyuridae	<i>Dasyurus maculatus</i>	spotted-tailed quoll	E	V	N	N	N	N	N	N	N	N	N	No. No recent records and minimal removal of potential foraging and denning habitat.
Meliphagidae	<i>Anthochaera phrygia</i>	regent honeyeater	E	CE	N	N	N	N	N	N	N	N	N	No. Not found within survey area and habitat is minimal. Occasional visitor to the area.
Pteropodidae	<i>Pteropus poliocephalus</i>	grey-headed flying-fox	V	V	N	N	N	N	N	N	N	N	N	No. Marginal foraging habitat to be removed. No camps in survey area.
Muridae	<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	N/a	N	N	N	N	N	N	N	N	N	No. No records within the area, marginal habitat to be removed.

3 Camfield's stringybark (*Eucalyptus camfieldii*)

3.1 Background

Camfield's stringybark (*Eucalyptus camfieldii*, Myrtaceae) is listed as a vulnerable species on Schedule 2 of the NSW TSC Act and as a vulnerable species under the Commonwealth EPBC Act.

Camfield's stringybark is restricted to the Royal National Park, Middle Harbour and Ku-ring-gai Chase National Park (Robinson 2003) where it occurs in poor (low nutrient) coastal country in shallow sandy and poorly drained soils overlying Hawkesbury sandstone, associated with coastal heath mostly on exposed sandy ridges. It is found mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas (Office of the Environment and Heritage (OEH) 2012; Robinson 2003).

The flowering period is irregular with flowering recorded throughout the year, especially from April to December (Benson and McDougall 1998; OEH 2012; Department of the Environment (DoE) 2008; DoE 2014).

Camfield's stringybark was not recorded during the field survey. The desktop survey revealed four records within a five kilometre radius, and 25 records within the study area since 1980 (OEH 2014). Potential habitat occurs in the study area.

Eucalyptus camfieldii

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of an important population of the species?</p>	<p>Population</p> <p>BioNet contains four records of Camfield's stringybark within a 5 km radius of the centre of the survey area (OEH 2014), with the closest three individuals occurring approximately 4 km north of the concept design within the Ku-Ring-Gai Chase National Park. More broadly, there are 25 records within the study area (OEH 2014). The species was not detected within the direct impact area during the field surveys conducted by Niche and Ecosure in spring 2013 and spring 2014 (Main report) despite being a conspicuous species. For this reason and given the distance of known records from the survey area, it is unlikely that there is a viable population in the survey area.</p> <p>Assessment</p> <p>A viable population of Camfield's stringybark is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade is unlikely to lead to a long-term decrease in the size of an important population.</p>
<p>b) Reduce the area of occupancy of an important population?</p>	<p>Camfield's stringybark has previously been found within Hornsby sandstone dry sclerophyll forest and heath. Approximately 6.59 ha of Camfield's stringybark potential habitat, including dry sclerophyll forest and sandstone rock plate heath habitat, that occurs within the concept design will be removed or modified as a result of the proposed road upgrade, which is considered negligible compared to the extent of similar habitat within the broader locality (12,678 ha - much of which is well-reserved in national parks). As a viable population is unlikely to occur within the direct impact area, a substantial soil seed bank is also considered unlikely to occur. Therefore, the proposed road upgrade is unlikely to reduce the area of occupancy of a population.</p>
<p>c) Fragment an existing important population into two or more populations?</p>	<p>A viable population of Camfield's stringybark is unlikely to exist within the direct impact area and potential habitat for the species is considered to be of limited value to the local existence of the species. The proposed road upgrade constitutes the widening and realignment of Mona Vale Road, and therefore is unlikely to result in the fragmentation of an existing population of Camfield's stringybark into two or more populations.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>Camfield's stringybark has previously been found within Hornsby sandstone dry sclerophyll forest and heath. Approximately 6.59 ha of potential habitat for Camfield's stringybark within the concept design will be removed or modified as a result of the proposed road upgrade, which is considered negligible compared to the extent of similar habitat within the broader locality (12,678 ha - much of which is well-reserved in national parks). As a viable population is unlikely to occur within the direct impact area, a substantial soil seed bank is also considered unlikely to occur. Therefore, any impact on habitat that is critical to the survival of the species is likely to be negligible.</p>

Eucalyptus camfieldii

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

e) Disrupt the breeding cycle of an important population?	<p>Life cycle factors</p> <p>The flowering period for Camfield's stringybark is irregular, with flowering recorded throughout the year, especially between April and December (Benson and McDougall 1998; OEH 2012; DoE 2014). Seed is dispersed by wind or gravity and no dormancy mechanism has been recorded. Camfield's stringybark also has an extensive lignotuber that can grow up to 25 m across and which is known to resprout after fire (Benson and McDougall 1998; DoE 2014). The species is also sensitive to frequent fires, however the lack of fire has also been recorded to affect survival and reproduction rates (DoE 2014). Camfield's stringybark is reported to be long-lived (>100 years; Benson and McDougall 1998).</p> <p>Assessment</p> <p>A viable local population of Camfield's stringybark is unlikely to exist within the survey area and, therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the species such to disrupt the breeding cycle of a population.</p>
f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	<p>Camfield's stringybark has previously been found within Hornsby sandstone dry sclerophyll forest and heath. Approximately 6.59 ha of potential habitat for Camfield's stringybark within the survey area will be removed or modified as a result of the proposed road upgrade, which is considered negligible compared to the extent of similar habitat within the broader locality (12,678 ha - much of which is well-reserved in national parks). The proposed road upgrade is therefore unlikely to impact habitat of Camfield's stringybark to the extent that the species is likely to decline.</p>
g) Result in invasive species that are harmful to the species becoming established in the species' habitat?	<p>The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.</p>
h) Introduce disease that may cause the species to decline?	<p>The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on Camfield's stringybark.</p>

Eucalyptus camfieldii

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

<p>i) Interfere substantially with the recovery of the species?</p>	<p>No Recovery Plan is known for Camfield's stringybark. Therefore, the action proposed is unlikely to interfere substantially with the recovery of the species.</p> <p>An Approved Conservation Advice under the EPBC Act for the species is available (DoE 2008) and includes the following regional and local priority actions:</p> <ul style="list-style-type: none"> · Monitor known populations to identify key threats and the progress of recovery of the species · Identify populations of high conservation priority · Implement a management plan to control Bitou bush and boneseed and undertake weed control in priority areas · Ensure mechanisms to eradicate weeds do not adversely impact Camfield's stringybark · Ensure infrastructure and development activities such as road widening and maintenance work that results in vegetation disturbance does not impact on known populations · Develop and implement a suitable fire management strategy · Undertake seed collection and storage of the species as well as implement national translocation protocols · Raise awareness of Camfield's stringybark within the local community. <p>Whilst the proposed road upgrade would lead to the loss of 6.59 ha of potential habitat, this represents less than 0.11 % of the total potential habitat in the study area. It is unlikely that Camfield's stringybark occurs in the survey area, so it is unlikely that the proposed road upgrade would interfere substantially with the recovery of the species.</p>
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3.2 Conclusion

The proposed road upgrade is unlikely to have an adverse effect on the breeding cycle of Camfield's stringybark such that it may lead to a long term decrease in the local population of the species. The potential habitat for Camfield's stringybark affected by the proposal is considered unlikely to be important to the long-term survival of the species within the locality. The proposed road upgrade is considered unlikely to have a significant impact on Camfield's stringybark, and no referral is recommended.

4 Bauer's midge orchid (*Genoplesium baueri*)

4.1 Background

Bauer's midge orchid (*Genoplesium baueri*, Orchidaceae) is listed as an endangered species under the NSW TSC Act and as an endangered species under the Commonwealth EPBC Act.

Bauer's midge orchid grows in sparse sclerophyll forest and in microhabitats that have moss gardens over sandstone. It has been recorded within coastal areas between Port Stephens on the mid north coast to Ulladulla in the south coast (OEH 2014a; Robinson 2003). It prefers sandy dry eucalypt habitat and mainly occurs in isolated populations which flower after fires (Fairley 2004).

The flowering period ranges from December to May (OEH 2012; OEH 2014a; Robinson 2003), however peak flowering occurs from December to March (Benson and McDougall 2005). Seeds are shed 6-12 weeks after pollination by insects (Drosophilids or Chironomids) (Benson and McDougall 2005).

Bauer's midge orchid was not recorded during the recent field surveys. In the period since 1980, only one record has been found within a five kilometre radius of the survey area. Additionally, there are 32 records from between five and 10 kilometres of the survey area (falling within the study area), all recorded in 2010 (OEH 2014). Shaded, damp sandstone overhangs (required microclimate for this species) are not located within the survey area, and therefore it is highly unlikely that this species occurs within the direct impact area.

Genoplesium baueri

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of a population</p>	<p>Population There is one individual record of Bauer’s midge orchid within a 5 km radius of the survey area, just south of Newport (OEH 2014). There are an additional 32 records from within the study area, occurring between 5-10 km from the survey area, all of which occurred in 2010 (OEH 2014). The bulk of the Sydney population occurs in a strip from Gladesville to Lane Cove, Wahroonga and Hornsby. Given this historic distribution and the fact that the species has not been previously recorded within the direct impact area, it is considered unlikely that a local population of the species exists within the survey area.</p> <p>Assessment A local population of Bauer’s midge orchid is unlikely to exist within the survey area, therefore, the proposed road upgrade is unlikely to remove any individuals of a viable local population. As such, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of Bauer’s midge orchid such that there is a long term decrease in the size of a population.</p>
<p>b) Reduce the area of occupancy of the species</p>	<p>This species has not been shown to occur within the survey area, and therefore it is unlikely that the area of occupancy for this species will be reduced.</p>
<p>c) Fragment an existing population into two or more populations</p>	<p>This species has not been shown to occur within the direct impact area and is therefore unlikely to be affected by the proposed road upgrade, such that an existing population is fragmented into two or more populations.</p>
<p>d) Adversely affect habitat critical to the survival of a species</p>	<p>To date, critical habitat has not been declared for this species under the EPBC Act.</p>
<p>e) Disrupt the breeding cycle of a population</p>	<p>Life cycle factors Bauer’s midge orchid peak flowering period occurs from December to March (Benson and McDougall 2005). This species readily germinates after fire (OEH 2012).</p> <p>Assessment A local population of Bauer’s midge orchid is unlikely to exist within the direct impact area and, therefore no adult individuals of the population would be at risk within the survey area. It is also unlikely that a soil seed bank of this species exist within the direct impact area. Therefore, the proposed road upgrade is unlikely to disrupt the breeding cycle of this species.</p>
<p>f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>Habitat for this species does not occur within the survey area (although it is present within the study area) and Bauer’s midge orchid habitat therefore unlikely to be affected by the proposed road upgrade to the extent that the species is likely to decline.</p>

Genoplesium baueri

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</p>	<p>The proposed road upgrade may aid in the introduction of weed species to the area, however due to no records of Bauer's midge orchid existing within the survey area, the proposed road upgrade is unlikely to result in invasive species becoming established in Bauer's midge orchid habitat. It is anticipated that weed management will be undertaken to mitigate against weed invasion.</p>
<p>h) Introduce disease that may cause the species to decline</p>	<p>There is no available information of diseases that may cause a decline in Bauer's midge orchid.</p>
<p>i) Interfere with the recovery of the species</p>	<p>No Recovery Plan is known for the Bauer's midge orchid.</p> <p>A targeted strategy for managing the orchid is available (OEH 2014b). It shows that the species will be managed at four sites including Ku-ring-gai Chase National Park, Ku-ring-gai Wildflower Garden, Bomaderry Creek and Callala. The management actions detailed in this plan include:</p> <ul style="list-style-type: none"> · Minimise the impacts of slashing on the species/habitat · Minimise the impacts of recreational activities · Minimise impacts of development · Prevent access of recreational users to site · Restrict access to native browsers · Maintain suitable drainage/hydrological regime. <p>It is unlikely that Bauer's midge orchid occurs in the survey area, so it is unlikely that the proposed road upgrade would interfere substantially with the recovery of the species.</p>

4.2 Conclusion

The species has not been previously recorded within the survey area. Similarly, potential habitat for this species is unlikely to occur within the direct impact area and therefore it is unlikely that any substantial soil seed bank will be affected by the proposed road upgrade. The proposal is unlikely to have an adverse impact on the breeding cycle of Bauer's midge orchid population. Thus, the proposed road upgrade is considered unlikely to have a significant impact on Bauer's midge orchid and a referral is therefore not recommended.

5 Caley's grevillea (*Grevillea caleyi*)

5.1 Background

Caley's grevillea (*Grevillea caleyi*, Proteaceae) is listed as a critically endangered species under the NSW TSC Act and as an endangered species under the Commonwealth EPBC Act.

Caley's grevillea is a medium to tall shrub confined to a few lateritic ridges in association with the Duffys Forest EEC dominated by *Eucalyptus sieberi*, *Corymbia gummifera* and local stringybarks (OEH 2014a; Fairley 2004). This species is found only in an 8 square kilometre area around Frenchs Forest, Belrose, Terrey Hills and Duffys Forest, approximately 20 kilometres north of Sydney within the Ku-ring-gai, Pittwater and Warringah LGAs (OEH 2014a). Most individuals are naturally occurring, however some have been planted.

The flowering period is sporadic throughout the year (particularly around July-November) however a definite flowering period occurs in spring (Robinson 2003). Seeds are dispersed by gravity at maturity. It has a high seed viability of 69-95 per cent with a dormancy of 93 per cent (Benson and McDougall 2000). The seed germinates after heat or mechanical damage and responds best to high intensity fires (Benson and McDougall 2000).

Caley's grevillea was not recorded during the field survey. The desktop survey revealed 142 records from the study area since 1980, with some records consisting of up to 2000 individual plants (OEH 2014a). Potential habitat for this species does not occur within the survey area.

Grevillea caleyi

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of a population</p>	<p>Population</p> <p>There are 142 previous records of Caley’s grevillea within a 10 km radius of the centre of the survey area (OEH 2014). Most of these local records occur within Duffys Forest EEC and in bloodwood-scribbly gum woodland vegetation (OEH 2014; main report). There are no records within the survey area, and the closest record is approximately 1 km to the west of the survey area (OEH 2014).</p> <p>Targeted field surveys to prescribed guidelines (DEC 2004a and b) conducted by Niche and Ecosure in spring 2013 and spring 2014 (main report) did not record Caley’s grevillea within the survey area.. The proposed road upgrade will not affect any known records of Caley’s grevillea.</p> <p>Assessment</p> <p>A local population of Caley’s grevillea is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade would not remove any adult individuals of the local population. It is also unlikely that a soil seed bank of this species exist within the survey area, as the preferred habitat, Duffys Forest EEC, is not present. Therefore, the proposed road upgrade is unlikely to lead to a long-term decrease in the size of any Caley’s grevillea population.</p>
<p>b) Reduce the area of occupancy of the species</p>	<p>The individuals found within the study area occur on sandstone ridges of ironstone laterite in association with Duffys Forest EEC (main report). However, this habitat does not occur within the direct impact area and therefore the proposed road upgrade is unlikely to reduce the area of occupancy of this species.</p>
<p>c) Fragment an existing population into two or more populations</p>	<p>The individuals found within the study area occur on sandstone ridges of ironstone laterite in association with Duffys Forest EEC (main report). However, this habitat does not occur within the direct impact area and is therefore unlikely to be affected by the proposed road upgrade and is also unlikely to fragment an existing population into two or more populations.</p>
<p>d) Adversely affect habitat critical to the survival of a species</p>	<p>To date, critical habitat has not been declared for this species under the EPBC Act.</p>

Grevillea caleyi

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>e) Disrupt the breeding cycle of a population</p>	<p>Life cycle factors</p> <p>Caley's grevillea is reproductively mature at 2-5 years of age (DEC 2004). The peak flowering period occurs in late winter and spring and fruit maturation occurs in November and December (OEH 2014b). The plant has a low fecundity with only 3% of flowers resulting in a single, wingless seed. Caley's grevillea is killed by fire and relies on regeneration of the seed that is stored in the soil (DEC 2004). The species readily germinates after fire, as seen from the response in 1994 within the locality and also more recently in the burnt areas at the intersection of Mona Vale and Booralie Road, Terrey Hills (N. Smith pers. comm. Aug 2014). Very little of the habitat for the species within the direct impact area has been burnt since 1994, but soil seed bank may still be present.</p> <p>Assessment</p> <p>A local population of Caley's grevillea is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade would not remove any adult individuals of a viable population within the study area. It is also unlikely that a soil seed bank of this species exist within the direct impact area as the preferred habitat, Duffys Forest EEC, does not occur within the direct impact area or the survey area. Therefore, the proposed road upgrade is unlikely to disrupt the breeding cycle of the Caley's grevillea population.</p>
<p>f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The individuals found within the study area occur on sandstone ridges of ironstone laterite in association with Duffys Forest EEC (main report). However, this habitat does not occur within the direct impact area and is therefore unlikely to be affected by the proposed road upgrade to the extent that the species is likely to decline.</p>
<p>g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</p>	<p>The effect of invasive weeds on Caley's grevillea has not specifically been studied but some general assumptions can be made such that weeds can change the vegetation structure and also change potential fire behaviour (DEC 2004). The proposed road upgrade may aid in the introduction of weed species to the area, however due to there being no records of Caley's grevillea within the direct impact area, and a lack of preferred habitat occurring within the survey area, the proposed road upgrade is unlikely to result in invasive species that are harmful to Caley's grevillea.</p>
<p>h) Introduce disease that may cause the species to decline</p>	<p>Currently, Caley's grevillea is not known to be affected by any disease that may cause it to decline.</p>

Grevillea caleyi

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

i) Interfere with the recovery of the species

The overall recovery objective as per the species recovery plan (DEC 2004) is to “...minimise human imposed disturbance to *Grevillea caleyi* populations and to maintain viable wild populations into the foreseeable future. The objective is to minimise the risk of local extinction, not necessarily to maximise the number of aboveground *G. caleyi* plants.” Other objectives of the recovery plan include:

1. Community education and awareness – inform land managers and owners of the presence of *G. caleyi*
2. Fire management – implement an appropriate fire management strategy
3. Threat and habitat management – ensure the conservation of all sites through appropriate management
4. Reservation and/or protection of remnant sites – ensure and increase level of protection to locations of the species outside existing national parks
5. Ecological research – increase knowledge of the biology of the species for management purposes
6. Locate and protect new sites – identify and protect new locations of the species
7. Identify critical habitat – identify critical habitat for the species.

As suitable habitat does not occur within the survey area, it is unlikely that this species will be affected by the proposed road upgrade, and therefore that the proposed road upgrade will interfere substantially with the recovery of the species.

5.2 Conclusion

Caley's grevillea has not been previously recorded within the direct impact area. Similarly, the known or potential habitat for this species is unlikely to occur within the survey area and therefore there is unlikely to be a substantial soil seed bank which could be affected. The proposed road upgrade is unlikely to have an adverse disrupt the breeding cycle of Caley's grevillea population. No referral is recommended.

6 Angus's onion orchid (*Microtis angusii*)

This assessment of significance against EPBC Act criteria is based on a scenario where the proposed road upgrade is able to avoid the two known occurrences of Angus's onion orchid (*Microtis angusii*, Orchidaceae) within the survey area. The alignment will go to within 1.5 metres of one known location of this plant (Figure 4).

6.1 Background

Angus's onion orchid is listed as an endangered species under the TSC and EPBC Acts.

Angus's onion orchid is a terrestrial orchid with affinities to *M. parviflora* and *M. unifolia* but is more robust, with a number of small morphological differences in the inflorescence. It is about 25-60 centimetres tall, flowering between May and October (NSW Scientific Committee 1997).

Surveys by Niche and Ecosure detected Angus's onion orchid at two locations within the Mona Vale Road East survey area (Figure 4). The first occurrence of six individuals (i.e., stems) was located on the north side of Mona Vale Road, approximately 170 metres east of the Lane Cove Road intersection. Whilst this occurrence does fall within the area of direct impact, it does occur within a five metre buffer of indirect impact. The second occurrence within the survey area is a single individual located at the end of the unmade portion of Ingleside Road, also north of Mona Vale Road (approximately 650 metres east of the Lane Cove Road intersection with Mona Vale Road). This second location does not occur within the area of direct impact, but is only 1.5 metres from direct impact. These two occurrences are a significant and important extension of the previously known distribution of the species to the east by approximately 1.3 kilometres, the nearest other occurrence being at Addison Road.

Until recently, the Angus's onion orchid was only known in northern Sydney from a single population opposite the intersection of Mona Vale Road and Kimbriki Road, Terrey Hills (the 'Kimbriki site'). An additional five occurrences (sub-populations) were recorded by Ecosure and Niche as part of biodiversity investigations for the upgrade of Mona Vale Road West. Each of these occurrences, including the two detected within the survey area (seven stems), constitute the known extent and distribution for the species both locally and regionally. It has been estimated that the current population size constitutes 1,738 stems (main report). Note that due to the difficulties associated with field identification, sampling and the clonal nature of the species, stem counts are only indicative of population size.

Habitat occupied by the species is highly disturbed road and track edges, usually associated with an adjacent sealed surface and diffuse drainage (i.e. no kerb and guttering). This severely degraded habitat exhibits no ecosystem resilience, i.e. it does not resemble native bushland and has no capacity for regeneration to locally occurring native vegetation types. The species appears to have an association with exotic perennial grasses such as Coolatai grass (*Hyparrhenia hirta*). No plants were detected within the locally occurring native

vegetation types as mapped (Figure 4 in main report), although it is assumed that hanging swamps or moist heath are potential habitat.

RMS is currently supporting research by the Royal Botanic Gardens (RBG) on the breeding biology, genetics, propagation and translocation in order to provide information on the best mitigation strategies for this species (RBG 2014).

The potential impacts of the proposal on Angus's onion orchid are assessed in the following Assessment of Significance under the EPBC Act.

Microtis angusii

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of a population</p>	<p>Population Mona Vale West</p> <p>Until recently, Angus’s onion orchid was only known from a single population opposite the intersection of Mona Vale Road and Kimbriki Road, Terrey Hills in northern Sydney (referred to as the ‘Kimbriki site’) Population estimates vary from year to year but 1,240 stems were counted by the RBG in 2014/15. The exact number of individuals cannot be determined due to its clonal nature, but it is assumed here that the number of stems is representative of the number of individuals.</p> <p>Surveys for the species, conducted by Niche and Ecosure in October 2013 and September 2014 (main report and Ecosure 2014b), demonstrated that the species actually occurs in a number of other locations along Mona Vale Road, from the intersection with McCarrs Creek Road at Terrey Hills to Ingleside (where the unmade portion of Ingleside Road meets Mona Vale Road). Although the exact population size is unknown due to the clonal nature of the species and the variability in counts from season to season, an estimated 491 stems exist within the broader locality (79 stems confirmed along Wirreanda Road (Mona Vale West) in September 2014).</p> <p>Mona Vale Road East</p> <p>Within the current survey area, two locations of this species (with 7 stems) were confirmed to occur in an area of exotic vegetation, where the unmade portion of Ingleside Road meets Mona Vale Road on its northern side, as well as along the road verge on the far western part of the direct impact area.</p> <p>Combining historical records (OEH 2014), surveys by Niche and Ecosure and historical counts by RBG at the Kimbriki site, it is clear that a viable population of Angus’s onion orchid exists within the locality, and this is currently estimated at 1,738 stems (1,240 + 491 + 7).</p> <p>Assessment</p> <p>No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures will reduce indirect impacts such as changes to drainage, dust, inadvertent trampling, construction exclusion zones and sediment control.</p> <p>Therefore, the proposed road upgrade is unlikely to lead to a long-term decrease in the size of the population, provided that the closest location to the road footprint is adequately protected.</p>
<p>b) Reduce the area of occupancy of the species</p>	<p>Within the survey area, Angus’s onion orchid was found by Niche and Ecosure at two locations approximately 650 metres apart, on the north-western part of the survey area (see Figure 4 in main report) which represent a significant extension to the east of previously known locations by approximately 1.3 kilometres. Neither of these locations will be removed and, therefore, the proposal is unlikely to reduce the area of occupancy of the species.</p>

Microtis angusii

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

c) Fragment an existing population into two or more populations	No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures (including construction exclusion zones and appropriate sediment control) will reduce indirect impacts such as changes to drainage, dust, and inadvertent trampling. Therefore the proposal is unlikely to fragment an existing population into two or more populations.
d) Adversely affect habitat critical to the survival of a species	To date, critical habitat has not been declared for this species under the EPBC Act.
e) Disrupt the breeding cycle of a population	<p>Life cycle factors</p> <p>Angus's onion orchid exists largely as subterranean tubers for most of the year, producing leaves and then flowering stems in late winter and spring (OEH 2014a). The above ground parts wither over summer (OEH 2014a). <i>Microtis</i> spp. are known to reproduce vegetatively by the formation of "daughter" tubers from the main tuber (OEH 2014a), whilst germination is reliant on soil fungal relationships (RBG 2014). The species is likely to be predominantly self-pollinated; however wasp, ant and fly pollination is evident in other <i>Microtis</i> taxa (RBG 2014). Apomixis, the ability for plants to reproduce asexually from sexual parts without fertilisation, is evident in other <i>Microtis</i> species (RBG 2014). Flowering is likely to be related to rainfall during flower development. In addition, rainfall in the 12 months prior to the flowering season and higher soil moisture increase the rate at which later stages of germination are reached (RBG 2014). Insects of the order Hemiptera, or true bugs, were observed on the flowers and may be damaging plants (RBG 2014).</p> <p>Assessment</p> <p>No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures (including construction exclusion zones and appropriate sediment control) will reduce indirect impacts such as changes to drainage, dust, and inadvertent trampling. None of the life cycle factors described above will be affected by the proposal and therefore the proposed road upgrade is unlikely to disrupt the breeding cycle of the population.</p>

Microtis angusii

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>Potential habitat for Angus’s onion orchid within the survey area includes exotic and disturbed environments that are affected by diffuse drainage, clearing and weed infestation (approximately 3.28 hectares within the survey area). Further, two extensive and in-season field surveys have targeted the species and only found the two occurrences of the species as assessed in this report. Therefore, it is considered unlikely that further occurrences exist within the survey area.</p> <p>Due to the degraded nature of the potential habitat for the species, the proposed road upgrade is unlikely to result in a net decrease the extent of this habitat and no individuals will be removed within the two known areas of habitat.</p> <p>Therefore the proposal is unlikely to modify, destroy, remove, isolate or decrease the availability, or quality, of habitat to the extent that the species is likely to decline.</p>
<p>g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species’ habitat</p>	<p>Within the survey area, two occurrences of this species (with seven known individuals in total) were confirmed to occur within an area of exotic vegetation with little or no resilience, where the unmade portion of Ingleside Road meets Mona Vale Road on its northern side and along the existing road verge. Habitat for the species within the survey area occurs in similarly disturbed environments and along road edges and therefore invasive species introduced through the proposed road upgrade are unlikely to be harmful to Angus’s onion orchid.</p>
<p>h) Introduce disease that may cause the species to decline</p>	<p>Currently, Angus’s onion orchid is not known to be affected by a disease that may cause it to decline.</p>
<p>i) Interfere with the recovery of the species</p>	<p>A National Recovery Plan for Angus’s onion orchid exists (Department of Environment, Climate Change and Water (DECCW) 2010) and the overall objective of this recovery plan is to prevent the extinction of Angus’s onion orchid through maintaining self-sustaining populations in the wild in the long term.</p> <p>The recovery objectives and actions detailed in DECCW (2010) include to:</p> <ol style="list-style-type: none"> 1. Co-ordinate recovery of the species 2. Protect the known population by minimising the loss and fragmentation of habitat using conservation planning mechanisms 3. Conduct research into the genetics, ecology and biology of the species in order to provide information to assist future management decisions 4. Develop and implement a survey program that will provide information on the extent and viability of <i>Microtis angusii</i> populations and habitat 5. Identify and minimise threats to <i>Microtis angusii</i> 6. Raise awareness of the species with public authorities, and provide public authorities with information to assist

Microtis angusii

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

	<p>conservation</p> <p>7. Implement a monitoring program for <i>Microtis angusii</i> and</p> <p>8. Consider of the need for ex situ conservation.</p> <p>No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures (including construction exclusion zones and appropriate sediment control) will reduce indirect impacts such as changes to drainage, dust, and inadvertent trampling. Further, RMS are currently providing funding to the RBG to carry out objectives (3), (4), (7) and (8). Therefore, the proposed road upgrade is unlikely to interfere with any of the objectives of the Recovery Plan.</p>
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6.2 Conclusion

No individuals of *Microtis angusii* will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures (including construction exclusion zones and appropriate sediment control) will reduce indirect impacts such as changes to drainage, dust, and inadvertent trampling. Measures to minimise indirect impacts will be implemented as part of the CEMP for the proposed road upgrade.

As demonstrated above, the proposal will not:

- Lead to a long-term decrease in the size of a population of *Microtis angusii*
- Reduce the area of occupancy of *Microtis angusii*
- Fragment an existing population of *Microtis angusii* into two or more populations
- Disrupt the breeding cycle of a population of *Microtis angusii*
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat for *Microtis angusii* to the extent that the species is likely to decline
- Interfere with the recovery of *Microtis angusii*.

Therefore, the proposal is considered unlikely to have a significant impact on the endangered plant, *Microtis angusii*.

7 Hairy geebung (*Persoonia hirsuta*)

7.1 Background

Hairy geebung (*Persoonia hirsuta*, Proteaceae) is listed as endangered under the TSC Act and also as endangered under the Commonwealth EPBC Act.

Hairy geebung is restricted to the Greater Sydney district and can be found on ridge tops in sandy soils in dry sclerophyll open forest, woodland and heath with a shrubby understorey on sandstone (OEH 2013; Robinson 2003). It is usually present as isolated individuals or very small populations in disturbed areas such as track edges (OEH 2013; DoE 2014; Fairley 2004).

The flowering period generally occurs over summer months with peak flowering from November to January (DoE 2014; Robinson 2003). The diaspore fruit is dispersed by large birds and possibly large mammals, and is stored in a seedbank (Benson and McDougall 2000).

The hairy geebung was not recorded during the field surveys carried out by Niche/Ecosure. The desktop survey revealed one record from within a five kilometre radius of the survey area. Additionally, there are 30 records between five and 10 kilometres of the survey area (within the study area) since 1980 (OEH 2014). A limited amount of potential habitat occurs in the study area.

Persoonia hirsuta

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of a population</p>	<p>Population</p> <p>One record of hairy geebung was recorded within a 5 km radius of the centre of the survey area (OEH 2014), well north of the direct impact area in the vicinity of Elvina Bay. There are 30 records since 1980 recorded between five and 10 km of the survey area (within the study area). No individuals have been recorded within the direct impact area and none were detected during the field surveys conducted by Niche and Ecosure in 2013-2015. This species is unlikely to occur within the survey area, and a viable local population is unlikely to occur with the direct impact area.</p> <p>Assessment</p> <p>Whilst this species is unlikely to occur within the survey area, there is some possibility, although marginal, that there is seed stored within the soil capable of maintaining the existence of the species within the survey area. On the balance of likelihood, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the hairy geebung such that there is a long-term decrease in the size of a population.</p>
<p>b) Reduce the area of occupancy of the species</p>	<p>This species has not been shown to occur within the survey area and is therefore unlikely to be affected by the proposed road upgrade such that the area of occupancy of the species is reduced.</p>
<p>c) Fragment an existing population into two or more populations</p>	<p>The proposal constitutes the widening and realignment of Mona Vale Road, however will not result in the fragmentation of potential habitat for the hairy geebung.</p>
<p>d) Adversely affect habitat critical to the survival of a species</p>	<p>To date, critical habitat has not been declared for this species under the EPBC Act.</p>
<p>e) Disrupt the breeding cycle of a population</p>	<p>Life cycle factors</p> <p>The peak flowering period for hairy geebung is November to January (DoE 2014; Robinson 2003) and the fruit is usually dispersed by large birds and possibly fruit-eating mammals (Benson and McDougall 2000). The species does not reproduce vegetatively and is probably killed by intense fire (Benson and McDougall 2000). In general the <i>Persoonia</i> genus relies on insects for pollen transfer and heat or mechanical disturbance for germination (DoE 2014), however the seed of hairy geebung persists in a soil stored seed bank (Benson and McDougall 2000).</p> <p>Assessment</p> <p>Preliminary survey and assessment suggest that this species is unlikely to occur within the survey area. While there is some possibility that there is seed stored within the soil, it is considered that any soil stored seed bank would be marginal in terms of maintaining the existence of the species within the survey area. Therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the hairy geebung such that the breeding cycle is disrupted.</p>

Persoonia hirsuta

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>A viable local population of hairy geebung is unlikely to extend to within the survey area and any potential soil stored seed bank is likely to be marginal for maintaining the existence of such a population. The area of potential habitat affected (directly or indirectly = 9.87 ha; OEH 2014) is considered negligible compared to that available for the species within the study area (14,392 ha; OEH 2014). For these reasons, it is considered that the habitat affected by the proposed road upgrade is of relatively low importance to the long-term survival of hairy geebung in the study area and will not affect the habitat of the hairy geebung to the extent that the species is likely to decline.</p>
<p>g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</p>	<p>The proposed road upgrade may aid in the introduction of weed species to the area, however due to there being no records of hairy geebung existing within the survey area, the proposed road upgrade is unlikely to result in invasive species becoming established in hairy geebung habitat. The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.</p>
<p>h) Introduce disease that may cause the species to decline</p>	<p>There is no available information of diseases that may cause a decline to hairy geebung.</p>
<p>i) Interfere with the recovery of the species</p>	<p>No Recovery Plan or Threat Abatement Plan is known for the hairy geebung.</p> <p>Hairy geebung has been included in a species conservation project by OEH (2014b) which has nominated management actions such as minimising the impacts of recreational activities, maintaining appropriate fire regimes and tracking species abundance and condition over time within the population within the Pittwater local government area.</p> <p>It is therefore unlikely that the proposed road upgrade would interfere substantially with the recovery of the species.</p>

7.2 Conclusion

Hairy geebung has not been previously recorded within the survey area. Similarly, the preferred habitat for this species is unlikely to occur within the direct impact area and therefore a substantial soil seed bank is also unlikely to be affected. The proposal is unlikely to disrupt the breeding cycle of any hairy geebung population. Thus, a referral under the EPBC Act is not recommended.

8 Curved rice-flower (*Pimelea curviflora* var. *curviflora*)

8.1 Background

Curved rice-flower (*Pimelea curviflora* var. *curviflora*, Thymelaeaceae) is listed as a vulnerable species under the NSW TSC Act and as a vulnerable species under the Commonwealth EPBC Act.

Curved rice-flower is restricted to the coastal area of Sydney and is known from about 20 locations from northern Sydney to Maroota (OEH 2012; DoE 2014). The species occurs in woodlands on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes. It often grows amongst dense grasses and sedges and responds well to disturbance such as fire or grazing (OEH 2012). It has also been observed in heath and woodland on sandstone (Robinson 2003).

Pimelea curviflora var. *curviflora* differs from *Pimelea curviflora* by having sparsely hairy narrow-elliptic to elliptic or oblanceolate leaves 5-10 mm long and 2-4 mm wide; *Pimelea curviflora* has oblong to elliptic or oblanceolate leaves that are longer (5-20 mm) and wider (2-8 mm) (Royal Botanic Gardens and Domain Trust 2014). The peak flowering period occurs between October and January but this species has also been observed in flower as late as May (OEH 2012; DoE 2014).

Curved rice-flower has not been recorded during recent field assessment within the survey area. The desktop survey revealed ten records within a five kilometre radius of the survey area, and 36 records between five to 10 kilometre radius of the survey area (within the study area) since 1980 (OEH 2014a). Potential habitat occurs in the study area.

Pimelea curviflora* var. *curviflora

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of an important population of the species?</p>	<p>Population</p> <p>Ten records of curved rice-flower exist within a 5 km radius of the centre of the survey area, with 36 records between five and 10 kilometres of the survey area (within the study area) (OEH 2014a). Within those records, many hundreds of individuals are present, particularly on the fringes of the Duffys Forest and Terrey Hills localities (N. Smith, pers. comm., 20 Aug. 2014). The closest record occurred approximately 100 m north of the direct impact area. Potential habitat for this species is mainly Duffys Forest EEC (which does not occur within the survey area), but may also include Hornsby Sandstone Heath –woodland, which makes up approximately 0.51 ha of the direct impact area. This is considered negligible compared to habitat that is available in the broader locality. The species has not been detected during field surveys by Niche/Ecosure.</p> <p>Assessment</p> <p>Due to the records of the species within the study area as well as one record (with an accuracy of 50 m) within close proximity of the direct impact area, it is possible that this species occurs within the survey area. However, field surveys undertaken during the peak flowering period failed to detect any individuals, and the primary potential habitat, Duffys Forest EEC, does not occur within the survey area. For this reason, the proposed road upgrade is unlikely to result in a decrease in size to any important population of this species.</p>
<p>b) Reduce the area of occupancy of an important population?</p>	<p>As the species has not been detected in the survey area, the proposed road upgrade is unlikely to result in a reduction of the area of occupancy of curved rice flower.</p>
<p>c) Fragment an existing important population into two or more populations?</p>	<p>The proposal constitutes the widening and realignment of Mona Vale Road. As the species has not been detected in the survey area, the proposed road upgrade is unlikely to result in the fragmentation of potential habitat for curved rice-flower.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>To date, critical habitat has not been declared for this species under the EPBC Act.</p>

Pimelea curviflora* var. *curviflora

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

e) Disrupt the breeding cycle of an important population?	<p>Life cycle factors</p> <p>Curved rice-flower flowering occurs between October and January but has also been observed as late as May (OEH 2012; DoE 2014). The species is likely to be tolerant to fire due to the presence of a tap root and has also been observed sprouting after fire (OEH 2012).</p> <p>Assessment</p> <p>A single record for the species (OEH 2014a) exists within close proximity of the direct impact area, approximately 100 m to the north in vegetation mapped as Hornsby sandstone heath-woodland - heath form vegetation community. OEH (2014a) records this species as being accurate to 50 m, and therefore it may occur within 50 m of the direct impact area. Despite this, ideal habitat for the species does not exist within the survey area, and the species was not detected by Niche and Ecosure in 2013/14 surveys. Therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the species, such that a viable local population of the species is likely to be placed at risk of extinction.</p>
f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	<p>Curved rice-flower has previously been found within multiple vegetation communities including Duffys Forest endangered ecological community (EEC), sandstone heath and Hornsby sandstone heath-woodland – heath form. From these communities, only Hornsby sandstone heath-woodland – heath form occurs within the direct impact area. Therefore, approximately 0.51 ha of potential habitat for curved rice-flower within the survey area is likely to be removed or modified as a result of the proposed road upgrade. This amount of habitat is considered negligible compared to the extent of Hornsby sandstone heath woodland within the broader locality (2244 ha - much of which is well-reserved in national parks and other reserves).</p>
g) Result in invasive species that are harmful to the species becoming established in the species' habitat?	<p>The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species (such as weeds) into the study area.</p>
h) Introduce disease that may cause the species to decline?	<p>The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on <i>Pimelea curviflora</i> var. <i>curviflora</i>.</p>

Pimelea curviflora var. curviflora

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

i) Interfere substantially with the recovery of the species?

No Recovery Plan or Threat Abatement Plan is known for the curved rice-flower for NSW under the TSC Act. Therefore, the proposed road upgrade is not inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

However, an Approved Conservation Advice is available for this species under the EPBC Act (DoE 2008). The regional and local priority actions nominated in DoE (2008) include:

- Identify populations of high conservation priority
- Monitor known populations to identify key threats and the progress of recovery of the species
- Identify and remove weeds in the area and manage sites to prevent introduction of invasive weeds
- Manage threats to areas of vegetation that contain the species and ensure chemicals used in weed management do not significantly impact the curved rice-flower
- Ensure an infrastructure and development activity such as road widening and maintenance work that results in vegetation disturbance does not impact on known populations
- Control introduced pests (rabbits, pigs and goats) to manage threats at known locations
- Undertake seed collection and storage of the species as well as implement national translocation protocols.
- Raise awareness of the curved rice-flower within the local community.

The proposed action is therefore unlikely to interfere substantially with the recovery of the species.

8.2 Conclusion

The proposed road upgrade is unlikely to have an adverse effect on the breeding cycle of curved rice-flower such that it may lead to a long term decrease in the local population of the species. The potential habitat for curved rice-flower affected by the proposed road upgrade is considered unlikely to be important to the long-term survival of the species within the locality. The proposed road upgrade is considered unlikely to have a significant impact on curved rice-flower.

9 Giant burrowing frog (*Heleioporus australiacus*)

9.1 Background

The giant burrowing frog (*Heleioporus australiacus*) is listed as vulnerable under the TSC Act and EPBC Act. It is a large, burrowing frog that is found in south-eastern Australia in a range of habitats including heath, woodland, open dry sclerophyll forest and tall montane forest and on a variety of soil types, except for clay-based soils (OEH 2012). They are not known to inhabit cleared environments (Lemckert and Brassil 2004; Penman et al. 2004).

Two distinct populations have been suggested to occur: a northern population confined to the sandstone geology of the Sydney Basin and extending south to Ulladulla, and a southern population found in a wider range of habitats from Narooma in southern NSW to Walhalla in Victoria (Penman et al. 2004; OEH 2012). The genetics of these two populations are not clearly understood and they may represent different genetic units (most probably subspecies).

The species calls and breeds sporadically from spring to autumn; with a peak period in NSW of November to February (Lemckert and Mahony 2008). Individuals remain at the breeding site for no more than a few days before moving back into the adjacent forested lands (Penman et al. 2008). Eggs are usually laid outside of water in a moist burrow in the banks of small creeks, dams or ephemeral pools in woodland (Anstis 2013). Breeding within the northern population generally occurs along smaller ephemeral to semi-permanent creek lines, although individuals have been occasionally reported calling at permanent ponds in forests. Tadpoles have a long pond life and can be observed at any time of the year, and so permanent pools within the breeding streams appear to be essential for the survival of the species (Penman et al. 2004).

The giant burrowing frog is difficult to observe outside of the breeding season as it is active above ground only after rain (Penman et al. 2004). Individuals occupy activity areas that are usually 50-200 m from the breeding site, with larger males having activity areas closer to the breeding site than smaller males, and males tending to have activity areas closer to the breeding site than females (Lemckert and Brassil 2004; Penman et al. 2008). These activity areas are occupied for months at a time and frogs use several very specific burrowing points on a regular basis. Burrowing itself is undertaken in areas of loose soil and frogs usually remain just below the surface, depending on the availability of moisture. Burrows are not permanent holes (Lemckert and Brassil 2004). Individuals are opportunistic foragers and eat most invertebrates small enough to consume (Rose 1974; Webb 1983). The movements and behaviour of sub-adult and juvenile frogs is not known. They are able to move further from water bodies/drainage lines, but it is not clear if there are features of the landscape that are important for them.

This species has not been recorded to date within the survey area during this present study (main report). Targeted surveys are scheduled for the peak activity for this species

(February- April 2015) and results will be appended to a later draft of this report, however it is not expected to significantly alter this assessment

Potential foraging habitat for this species that will be removed or indirectly impacted on as part of the proposed road upgrade is sandstone heath and woodland areas (6.59 hectares), with 12,678 hectares of similar habitat occurring within the study area (eg 10 kilometres from centre of direct impact area) (OEH 2014).

Heleioporus australiacus

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of an important population of the species?</p>	<p>Although detailed surveys have not been finalised for this species (to be completed by April 2015 and reported on separately), the limited amount of potential foraging habitat that will be removed (maximum sandstone heath and woodland to be directly or indirectly is 6.59 ha) and minor potential impact on breeding areas from hydrological changes. No breeding habitat will be removed and sediment and erosion control measures will be implemented to minimise any downstream impacts during construction. For this reason, even if giant burrowing frogs occur within the survey area, it is unlikely that the proposed road upgrade will lead to a long-term decrease in the size of a population of this species.</p>
<p>b) Reduce the area of occupancy of an important population?</p>	<p>Giant burrowing frogs are rarely recorded since they spend much of their time outside of the breeding season underground, and therefore distribution and occupancy are difficult to quantify. Taking a conservative approach, it can be assumed that they could occupy all potential habitat to be removed or modified as part of the proposed road upgrade. A total of 6.59 hectares of potential foraging habitat would be impacted, primarily along the existing road. Large areas of potential habitat will be retained and fauna fencing will be installed to reduce the risk of road kill to this species.</p>
<p>c) Fragment an existing important population into two or more populations?</p>	<p>There are no known records within the survey area, however the species has been recorded at Fern Creek, approximately 400 m from the survey area (<i>Mona Vale Road East Detailed Biodiversity Report: Volume 1</i> (main report)). In addition, there are 363 records for this species within the study area (OEH 2014). Habitat removal will be confined to areas around the existing road, which may already be a barrier to this species but this amount of clearing would be unlikely to further fragment the population significantly. In addition, fauna fencing and the enhancement of the current underpass will allow passage by this species, if it occurs on either side of the road.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>Critical habitat has not been declared for this species under the EPBC Act.</p>
<p>e) Disrupt the breeding cycle of a population?</p>	<p>The proposed road upgrade will not remove any potential breeding habitat and standard erosion and sediment control measures will be incorporated into the construction environmental management plan (CEMP) for the proposed road upgrade, in order to minimise potential impacts on downstream creeks which provide breeding habitat for this species. Quarterly downstream water quality monitoring of Narrabeen Creek would be incorporated in the CEMP to monitor any changes in water quality.</p>

Heleioporus australiacus

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it will:

<p>f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?</p>	<p>The proposed road upgrade will remove or indirectly impact on 6.59 ha of potential foraging habitat for this species, however much of this may be too far from breeding areas to be utilised regularly (eg more than 300 m from nearest suitable breeding habitat). If present, this species is likely to only occasionally utilise this foraging habitat, most likely by juveniles and sub-adults during dispersal events.</p>
<p>g) Result in invasive species that are harmful to the species becoming established in the species' habitat?</p>	<p>The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.</p>
<p>h) Introduce disease that may cause the species to decline?</p>	<p>The proposed road upgrade has a small risk of increasing the change of exposure to chytrid fungus, due to increased edge effects and increased vehicle and pedestrian traffic. However, it is generally recognised that most populations of frogs have been exposed to this disease, and therefore it is unlikely to be a significant new threat. The flora and fauna management component of the CEMP will include appropriate measures to reduce the risk of spread of this disease, and therefore it is unlikely that the proposed road upgrade will introduce disease such that it may cause the species to decline.</p>
<p>i) Interfere substantially with the recovery of the species?</p>	<p>The survey area is not an important location for the giant burrowing frog, and although the proposed road upgrade will be unlikely to contribute substantially to the recovery of the species (except by increasing knowledge about the occurrence and distribution of the species from targeted surveys), it is also unlikely to have a significant detrimental effect on its recovery.</p>

9.2 Conclusion

The giant burrowing frog occurs within close proximity to the survey area, and there appears to be a viable local population within a five kilometre radius of the centre of the proposed direct impact area. An area of 6.59 hectares of potential foraging habitat will be removed as part of vegetation clearing for the proposed road upgrade. This represents a small amount of disturbed potential habitat that may be used, and only irregularly, by this species. No breeding habitat will be directly affected, and although there is a small risk of indirect impacts from changes to hydrological regimes and runoff, appropriate sediment and erosion control and drainage management will reduce this impact to negligible. Further fragmentation of habitat is unlikely given that Mona Vale Road is already present, and strategic fauna-proof fencing and fauna underpass at Narrabeen will be set in place to reduce the risk of fatalities from collisions with cars and increase connectivity. A referral is not recommended for this species.

10 Regent honeyeater (*Anthochaera phrygia*)

10.1 Background

The regent honeyeater (*Anthochaera phrygia*) is listed as endangered under the EPBC Act. It is also listed as critically endangered in NSW under the TSC Act and critically endangered internationally, in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Birdlife International 2013). It is sometimes known by the synonym *Xanthomyza phrygia*.

The regent honeyeater is endemic to south-eastern Australia, but is rare and thinly spread across its distribution. Fifteen years ago it was believed to number about 1500 individuals (Menkhorst et al. 1999). However, following very rapid declines there were thought to be just 350-400 mature individuals remaining by 2010 (Garnett et al. 2011; Birdlife International 2013). It mainly inhabits temperate woodlands and open forests of the inland slopes between north-eastern Victoria and south-eastern Queensland (Menkhorst et al. 1999; OEH 2014a). It is also found in drier coastal woodlands and forests, during eucalypt flowering events in these areas. The species' range has contracted considerably in recent decades, and there are only three key breeding regions known, all on the inland slopes: the Chiltern-Albury region in Victoria; Capertee Valley in central New South Wales (NSW) and the Bundarra-Barraba region in northern NSW (Menkhorst et al. 1999; OEH 2014a). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands (National Parks and Wildlife Service (NPWS) 1999). In some years flocks converge on flowering coastal woodlands and forests (OEH 2014a), although coastal records in central NSW are scattered and infrequent (Higgins et al. 2001). Swamp mahogany forests in coastal NSW are important refuge areas when conditions on the inland slopes are unfavourable (Menkhorst et al. 1999). However, there appear to be no specific reports of breeding in coastal NSW.

Regent honeyeater occurs in eucalypt woodlands and open forests. Most records of the species are from box-ironbark eucalypt forest and woodland including mugga ironbark *Eucalyptus sideroxylon*, lowland coastal forests that are dominated by *Eucalyptus robusta* (swamp mahogany) and *Corymbia maculata* (spotted gum) and riparian forests of *Casuarina cunninghamiana* (river she-oak) (OEH 2014a). These woodlands have large numbers of mature trees, high canopy cover and an abundance of mistletoes (OEH 2014a). The seasonal movements of regent honeyeater are thought to be dependent on spatial and temporal patterns of flowering and other resources (OEH 2014a).

Nectar is the main component of the diet of regent honeyeater, with at least 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: *Eucalyptus sideroxylon*, *E. albens* (white box) and *E. melliodora* (yellow box) (Webster and Menkhorst 1992; Menkhorst et al. 1999; Higgins et al 2001). Lerp and honeydew comprise a large proportion of the diet when nectar is scarce. Insects comprise a smaller dietary component but are important for nestlings (Menkhorst et al. 1999; OEH 2014a).

Breeding occurs between July and January in box-ironbark and other temperate woodlands and riparian gallery forest dominated by *Casuarina cunninghamiana* (OEH 2014a). Nests are frequently located in *E. sideroxylon* and *E. camaldulensis* (river red gum), but may also be in other eucalypts, mistletoe clumps and *Casuarina* species (OEH 2014a). In the Bundarra-Barraba breeding area, the presence of regent honeyeater is correlated with linear remnants, small habitat patch sizes and good local connectivity (Oliver and Lollback 2010).

The regent honeyeater was recorded in the study area (eg a 10 kilometre radius from the centre of the survey area) during bird surveys in May and June 2014. The desktop survey identified two other records in the study area since 1980 (OEH 2014b). Potential non-breeding habitat may occur throughout the survey area as woodland, there is 5.95 hectares directly or indirectly impacted of this habitat type.

Anthochaera phrygia

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of a population?</p>	<p>The regent honeyeater has a wide but very scattered distribution in NSW. The species has not been recorded nesting in the Sydney Basin. Nesting is largely confined to the western slopes of the Great Dividing Range with some records from the Upper Hunter Valley and the Clarence Valley. The regent honeyeater utilises coastal woodlands during non-breeding times, in winter or during droughts. Coastal woodlands are critical for the species, but the patterns of use are erratic. The occurrence of three individuals in the study area (a 10 km radius from the centre of the survey area) during the assessment period was considered highly unusual. They were recorded on the Chiltern Trail in Ku-ring-gai Chase National Park on 24 May, 18 June and 17 July 2014. . Surveys did not locate the species elsewhere in the study area. The species is not normally found in the study area, is not resident there and is not likely to have bred there. The habitat (Hornsby Sandstone Heath-Woodland) was also unusual. The desktop survey identified 55 previous records in the study area since 1980, just two have been recorded within 5 km (Terrey Hills in September 1988 and Warriewood Wetlands in May 1998; OEH 2014b).</p> <p>The pattern suggests that the regent honeyeater is a very rare non-breeding visitor to the area in the winter and spring, where it seeks highly productive food concentrations. There is unlikely to be a resident or migratory population reliant on the study area. Consequently, the removal or indirect impacts on 5.95 ha of potential wintering woodland habitat for the species is unlikely to lead to a decrease in the size of the population. There is approximately 10,200 ha of similar habitat within the study area (OEH 2014).</p>
<p>b) Reduce the area of occupancy of the species?</p>	<p>In NSW, the regent honeyeater has an area of occupancy of less than 200 km² (DoE 2014). This does not include the Sydney Basin as the species is not known to breed there or concentrate there when not breeding. The proposed road upgrade would remove or indirectly impact 5.95 ha potential wintering woodland habitat for the species. However, this would not contribute to a reduction in the area of occupancy.</p>
<p>c) Fragment an existing population into two or more populations?</p>	<p>The proposed road upgrade would increase the width of the existing road and has potential to decrease the connectivity between Ku-ring-gai Chase and Garigal national parks. However, the regent honeyeater is capable of flying over linear clearings such as roads and utilising habitat in fragmented landscapes. It has been shown to favour small connected remnants in highly fragmented landscapes (Oliver and Lollback 2010). The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on any regent honeyeater population.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>No habitat areas in the Sydney Basin are considered to be critical habitat for the regent honeyeater (DoE 2014). The species does not breed in the Sydney Basin and does occur in or rely on non-habitats in the Sydney Basin during non-breeding times. Its occurrence in the Sydney Basin seems to be rare and sporadic.</p>

Anthochaera phrygia

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

e) Disrupt the breeding cycle of a population?	The regent honeyeater does not breed in the study area and has not been known to breed in the Sydney Basin. Therefore the proposed road upgrade would not disrupt the breeding cycle.
f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The regent honeyeater does not rely on habitats in the study area. The removal or indirect impacts on of 5.95 ha of potential woodland habitat would be unlikely to lead to a decline in the species. There is approximately 10,200 ha of similar habitat within the study area (OEH 2014).
g) Result in invasive species that are harmful to the species becoming established in the species' habitat?	The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.
h) Introduce disease that may cause the species to decline?	The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on the regent honeyeater.
i) Interfere with the recovery of the species?	The study area is not an important location for the regent honeyeater. It does not breed in the vicinity of the study area and utilises non-breeding habitat there only very infrequently. The proposed road upgrade would be unlikely to contribute to the decline of the species or interfere with its recovery in any way.

10.2 Conclusion

There is unlikely to be a resident population or regular wintering population of regent honeyeaters in the Sydney region. The recent occurrence of three regent honeyeaters in the study area is a rare and unusual event likely to have been triggered by a localised lerp infestation. The proposed road upgrade would be unlikely to cause a decline in the species or any significant loss of habitat for the species.

11 Swift parrot (*Lathamus discolor*)

11.1 Background

The swift parrot (*Lathamus discolor*) is listed as endangered under the EPBC Act. The swift parrot is also listed as endangered in NSW under the TSC Act and endangered internationally in the IUCN Red List of Threatened Species (Birdlife International 2013).

This species breeds only in Tasmania in spring and summer, migrating to the mainland in autumn and winter months, where it occurs in south-eastern Australia from Victoria and the eastern parts of South Australia up to south-east Queensland (Tzaros 2002; OEH 2014a).

The swift parrot has been recorded throughout NSW, except for the north western parts of the state, although it mostly occurs on the central and southern inland slopes and along the coast (DoE 2013; OEH 2014a). On the slopes it mainly inhabits dry open eucalyptus forests and woodlands, usually box-ironbark communities. On the coast, forests and woodlands dominated by spotted gum (*Corymbia maculata*), red bloodwood (*C. gummifera*) blackbutt (*Eucalyptus pilularis*) and/or swamp mahogany (*E. robusta*) are important, particularly in years when the dryer box-ironbark woodlands fail to produce adequate food resources (Higgins 1999; Tzaros 2002). However, it seems to be selective and occupies only a small proportion of the apparently suitable habitats available. It seeks trees growing on the most fertile soils, probably because such trees produce more reliable quantities and/or higher nutrient quality foods (Tzaros 2002). The swift parrot feeds mainly on nectar from eucalypts but also take psyllids, lerp (a protective cover produced by psyllid insect larvae), seeds and fruits. It is typically seen feeding in the canopy of flowering trees or flying high overhead. It often flocks with small lorikeets and honeyeaters at abundant food sources (Higgins 1999).

The swift parrot was not recorded during winter surveys of the survey area and surrounds. There are six records from the study area since 1980 (OEH 2014b). Potential foraging habitat occurs in the study area.

Lathamus discolor

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of a population?</p>	<p>There are six records of swift parrot within the study area (10 km from the centre of the survey area). This species is recorded during localised flowering events in autumn and winter months. It has been recorded approximately 850 m from the survey area, but most of the study area records are around Narrabeen Lagoon (OEH 2014), where they were attracted to flowering swamp mahogany (<i>E. robusta</i>). The last recorded sightings in BioNet (OEH 2014) were in 2009 with two recorded on the same day in April 2009 in the suburb of Mona Vale and one in May 2009 at Warriewood Wetlands, to the north east of the survey area. In addition, two were reported by birdwatchers on Birdline NSW (2013) on 1 June 2013, in swamp mahoganies at Warriewood Wetlands. It is likely that the study area provides resources that are utilised infrequently and sporadically by the nomadic swift parrot. This species occasionally utilises parts of the study area during autumn and winter for foraging. The proposed road upgrade would lead to the loss or direct impact of 5.95 ha of woodland habitat, however this is not a preferred habitat for this species, with much more favourable habitat available in nearby Ku-ring-gai Chase National Park. Therefore, it is unlikely that the proposed road upgrade would lead to any decrease in the size of the population.</p>
<p>b) Reduce the area of occupancy of the species?</p>	<p>The area of occupancy of the swift parrot is estimated to be 4000 km² (DoE 2014). This is based on the number of primary squares in which the species is recorded when it is most constrained. It is assumed to have decreased significantly due to broadscale loss of woodland habitat loss in Tasmania and the mainland. The proposed road upgrade would remove or indirectly on 5.95 ha potential wintering habitat for the species, but which is not one of this species preferred woodland habitats. This would not contribute to a reduction in the area of occupancy.</p>
<p>c) Fragment an existing population into two or more populations?</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal and Ku-ring-gai Chase National Parks. Nevertheless, the swift parrot is a long distance migrant that undertakes annual migrations over Bass Strait and across the fragmented woodland landscapes of modern Australia. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade would not be likely to have a significant impact on any population of the swift parrot.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>The swift parrot is not resident in the study area and it does not occur in the study on a regular basis during migration or other non-breeding parts of the life cycle. The species does not breed on the Australian mainland. It is unlikely that any habitat in the study area is critical for the survival of the species. The proposed road upgrade would involve loss or indirect impact of only 5.95 ha of potential habitat that is not amongst the preferred habitat types of the species.</p>
<p>e) Disrupt the breeding cycle of a population?</p>	<p>The swift parrot does not breed in NSW. Therefore the proposed road upgrade would not disrupt the breeding cycle.</p>

Lathamus discolor

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The swift parrot does not rely on habitats in the study area. The removal or indirect impacts of 5.95 ha of potential woodland habitat would be unlikely to lead to a decline in the species.
g) Result in invasive species that are harmful to the species becoming established in the species' habitat?	The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.
h) Introduce disease that may cause the species to decline?	The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on the swift parrot.
i) Interfere with the recovery of the species?	The study area is not an important location for the swift parrot. It does not breed in the vicinity of the study area and utilises non-breeding habitat there only very infrequently. The proposed road upgrade would be unlikely to contribute to the decline of the species or interfere with its recovery in any way.

11.2 Conclusion

The proposed road upgrade would lead to a combined direct and indirect impact area of approximately 5.95 hectares of potential foraging habitat for the swift parrot, but there will be no loss of breeding habitat. Increased fragmentation would not be likely to affect this mobile species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that a local population would decline.

12 Large-eared pied bat (*Chalinolobus dwyeri*)

12.1 Background

The large-eared pied bat (*Chalinolobus dwyeri*) is a medium-sized insectivorous bat with shiny black fur, large ears and a white stripe on their vent (OEH 2014a). They are listed as vulnerable under both the New South Wales TSC Act and the Commonwealth EPBC Act.

The distribution of the large-eared pied bat is not well known, but appears to be patchy and naturally rare. In NSW the largest concentrations are known from the Sydney Basin and north-west slopes. Only four maternity roosts have been confirmed, with two of these no longer being used. A further potential maternity cave is being investigated at Michael's Cave in Avalon (B. Law pers. comm. 2013). One maternity roost is located in a disused mine in Barraba (250 kilometres from study area), the other is in a sandstone cave in Coonabarabran, about 400 kilometres north west of the study area (DoE 2013).

Large-eared pied bats have been recorded from a diverse range of vegetation types including (Churchill 2008):

- Dry and wet sclerophyll forest
- Cyprus pine (*Callitris glauca*) dominated forest
- Tall open eucalypt forest with a rainforest sub-canopy
- Sub-alpine woodland
- Sandstone outcrop country.

This species is known to roost in:

- Sandstone cliffs, especially in the vicinity of fertile woodland valleys, such as box gum woodlands or river/rainforest corridors which are used for foraging
- Disused mine shafts
- Caves
- Overhangs
- Disused fairy martin (*Petrochelidon ariel*) nests (OEH 2014a)
- Road culverts.

Mating is assumed to occur in early winter with females giving birth by early December. Females usually give birth to two young that leave the maternity roost by March. The required structure of the maternity roost site is very specific, comprising caves with arched roofs with indentations, and which are also deep enough to allow juvenile bats to learn to fly. Maternity roosts are thought to be occupied between September and April.

Found in well-timbered areas containing gullies, the diet of the large-eared pied bat is assumed to consist entirely of insects (Churchill 2008).

Chalinolobus dwyeri

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of an important population of a species</p>	<p>There are no previous official records within the study area (10 km from the centre of the footprint) (OEH 2014b). Calls tentatively attributed to this species were recorded at a rock shelf on Narrabeen Creek within the survey area during preliminary biodiversity surveys (Ecosure 2014a). We have not been able to confirm the occurrence of this species within the survey area but it has been recorded within the study area at Oxford Falls in proximity to Wakehurst Parkway, a similar road to Mona Vale Road East (Bonsen 2012). Searches of the rock shelf found that there were few roosting locations for this species, with most of the shelf being too low or exposed to allow safe roosting for bats. The shelf had small sections of honeycombing in the roof that may be used occasionally by small numbers of bats. Another three calls from this species were possibly recorded within the road corridor 3 km west near Tumburra Street during November 2014 field surveys. These calls could not be positively identified due to a short, fragmented duration. The species was also recorded recently within 1 km of the survey area (Bonsen 2012) at Ingleside.</p> <p>No known maternity roosts occur within the local area and no caves or mine shafts suitable for maternity roosts were identified during the surveys. The rock shelf on Narrabeen Creek provides limited and marginal roosting habitat and is unlikely to be a significant roost site for this species. It is possible that a population of large-eared pied bats occur near or within the vicinity of the proposed road upgrade.</p> <p>The proposed road upgrade will impact 6.59 ha of potential large-eared pied bat foraging habitat (this excludes disturbed habitats). Detailed surveys indicate that no significant roosting habitat suitable for large-eared pied bats is available within the road footprint. It is unlikely that the removal of 6.59 ha of foraging habitat (0.11% of the available foraging habitat within 10 km of the study site) would lead to a long-term decrease in the size of an important population.</p>
<p>b) Reduce the area of occupancy of an important population</p>	<p>The proposed road upgrade will impact 6.59 ha of potential large-eared pied bat foraging habitat (this excludes disturbed habitats). Detailed surveys indicate that no significant roosting habitat suitable for large-eared pied bats is available within the road footprint. It is unlikely that the removal of 6.59 ha of foraging habitat (0.11% of the available foraging habitat within 10 km of the study site) would reduce the area of occupancy of an important population.</p>
<p>c) Fragment an existing important population into two or more populations</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal and Ku-ring-gai National Parks; however will not newly fragment an existing population into two or more populations. Large-eared pied bats are a highly mobile species and so a small increase in fragmentation is unlikely to be significant for this species. There is a small risk that increased traffic may lead to greater risk of vehicle strikes on this species, however this is difficult to quantify since small animals such as microbats are rarely recorded as road kill (see main report for more discussion on this)</p>

Chalinolobus dwyeri

d) Adversely affect habitat critical to the survival of a species	No critical habitat has been declared for this species. However, maternity roosts are critical to this species survival. Two confirmed maternity roosts are known to be used by this species in NSW. A third maternity cave is being investigated at Michaels Cave in Avalon (approximately 8 km north-east of the study area). No confirmed maternity caves have been recorded near the footprint. The species requires large domed caves (or mine shafts) with indentations for breeding which do not occur within the footprint. There are no known maternity roosts within the footprint and surveys within the road footprint did not locate any caves that may be suitable in the future. However, 6.59 ha of foraging habitat does occur within the footprint although this habitat may not be of high quality due to traffic noise and lights, so it is unlikely that this foraging habitat will be critical to the species survival.
e) Disrupt the breeding cycle of an important population	Two confirmed maternity roosts are known to be used in NSW (both outside the study area). A third maternity cave is being investigated at Michaels Cave in Avalon (approximately 8 km north-east of the study area). No confirmed maternity caves have been recorded near the footprint. The species requires large domed caves (or mine shafts) with indentations for breeding which do not occur within the footprint. Therefore the proposed road upgrade is unlikely to significantly impact the breeding cycle of large-eared pied bats.
f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The removal of 6.59 ha of foraging habitat from the available 12,678 ha in the study area is unlikely to reduce the availability of habitat to the extent that the species would decline. Traffic, traffic noise and artificial lighting will all increase under the proposed road upgrade and this could impact bats indirectly through a decrease in habitat quality. Traffic on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026) following the road upgrade, although the majority of this increase will occur during the day when bats are not typically mobile. The small reduction in habitat quality along the road verge is unlikely to significantly impact large-eared pied bats to the point where the species would decline.
g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Roosting bats can be susceptible to dog, cat and fox predation. However, the proposed road upgrade is unlikely to increase the presence and/or abundance of these species to above that currently present in the survey area.
h) Introduce disease that may cause the species to decline, or	There are no known bat diseases that could potentially be spread by the proposed road upgrade.

Chalinolobus dwyeri

- i) Interfere substantially with the recovery of the species.
- The National Recovery Plan for the large-eared pied bat lists five specific objectives (DERM 2011):
- Identify priority roost site and maternity sites for protection
 - Implement conservation and management strategies for priority sites
 - Educate the community and industry to understand and participate in the conservation of the large-eared pied bat
 - Research the large-eared pied bat to augment biological and ecological data to enable conservation management
 - Determine the meta-population dynamics throughout the distribution of the large-eared pied bat.
- The proposed road upgrade will not interfere with these objectives.

12.2 Conclusion

Until recently, large-eared pied bat had not been recorded within the Pittwater and Warringah Local Government Area. Recent confirmed sightings of this species (Bonsen 2012) have demonstrated its occurrence within the study area at Oxford Falls, and possible calls from this species were recorded on Narrabeen Creek at a rock shelf on the eastern side of Mona Vale Road. Further investigations of the rock shelf found that the shelf is unlikely to be a significant roosting location due to vulnerability to predators and lack of microhabitat locations for roosting. However, potential foraging habitat occurs within the study area. No maternal roosting habitat has been identified within the study area. The proposed road upgrade will result in the removal of, or indirect impact to, 6.59 hectares of foraging and roosting habitat for large-eared pied bat. The disturbed nature of the habitat surrounding the road, and impacts from traffic and artificial light sources mean it is not likely to be important to this species. Given that no roosting habitat is likely to occur within the proposed footprint and that only a small amount (0.11 per cent of the habitat available in the study area) of foraging habitat is to be removed, it is unlikely that the proposed road upgrade will significantly impact populations of large-eared pied bats.

13 Spotted-tailed quoll (*Dasyurus maculatus*)

13.1 Background

The spotted-tailed quoll (*Dasyurus maculatus maculatus* – south-eastern mainland population) is listed as endangered under the EPBC Act. It is also listed as endangered in NSW under the TSC Act.

The spotted-tailed quoll is distributed along the east coast of Australia from Tasmania in the south to Bundaberg in central Queensland to the north, with a small sub-population occurring in far north Queensland. In NSW the species occurs all along the coast and inland by approximately 200 kilometres (OEH 2014a).

This species is known to use a variety of habitats, including rainforest, open forest, woodland, coastal heath, inland riparian forest, coast lines and sub-alpine zones. Preferred habitat comprises areas of wet mature forest that contain an abundance of prey (mostly small mammals and birds), and which are free from logging and other anthropogenic disturbances. For denning, the species requires hollow bearing trees, fallen logs, small caves, rock outcrops and rocky cliffs (DoE 2014).

The spotted-tailed quoll is a carnivorous marsupial that predominately preys on small to medium sized mammals. Specifically, species most often preyed on include the common ringtail possum, common brushtail possum, greater glider, and rabbit. A range of insects, lizards, poultry, birds, frogs, fish, and other smaller mammals also form part of their diet.

The breeding season of the spotted-tailed quoll occurs between April to July (Van Dyck and Strahan 2008). Gestation is 21 days, with females giving birth to four to six young in late July to mid-August. Young are attached to the teat for the first eight weeks but then left in the den until they reach 19 to 21 weeks old (DoE 2014) when they become independent. Both sexes become sexually mature at around one year of age.

There are six previous records of the spotted-tailed quoll within the study area (OEH 2014a). One individual was recorded dead (road kill) within in the direct impact area in 1998. Camera traps were used in an attempt to identify this species in the survey area, but no spotted-tailed quolls or signs of this species were recorded.

Dasyurus maculatus

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of a population?</p>	<p>There are seven previous records for this species within the study area, six of which are within a 5 km radius of the study area centre (OEH 2014a). One individual was recorded dead in 1998 within direct impact area. Another three records occur south of the footprint in Narrabeen. A more recent record from 2004 was in Ku-ring-gai National Park off McCarrs Creek Road, approximately 4.8 km north of the study area. No signs of this species were recorded during field surveys. This species is rarely seen, even in areas where it is relatively common, so it is possible that a viable population occurs in the study area.</p> <p>Spotted-tailed quolls inhabit woodlands and open forests (as well as other habitats), and typically occupy large home ranges to satisfy foraging, denning and breeding needs. This species requires trees with large hollows, rocky outcrops or hollow logs for denning, all habitat features which occur within the survey area.</p> <p>Approximately 9.87 ha (total vegetation to be directly or indirectly impacted) of potential foraging and denning habitat would be removed or directly impacted by the proposed road upgrade. This relatively small area represents just 0.14% of the potential habitat within 5 km of the survey area. Given the past and current disturbance (particularly the high traffic volume) and historical loss of connectivity in the study area, it is unlikely that a viable population of spotted-tailed quoll occurs within the proposed footprint. As a result, it is unlikely that the proposed road upgrade would lead to a long-term decrease in the size of a population.</p>
<p>b) Reduce the area of occupancy of the species?</p>	<p>The area of occupancy of the spotted-tailed quoll is not known precisely. In NSW the subspecies occurs generally from the Queensland border to Kosciuszko NP and generally within 200 km of the coast. The loss of 9.87 ha of potential habitat would not reduce the area of occupancy by any significant amount.</p>
<p>c) Fragment an existing population into two or more populations?</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Katandra Bushland and the Warriewood Escarpment. This could potentially have two impacts:</p> <p><i>1. Increased vehicle strikes</i></p> <p>Vehicle strike mortality is a common threat to the spotted-tailed quoll. Individuals often feed on road kill beside the road exposing them to an increased likelihood of vehicle strike. Male quolls travel large distances looking for mates, which exposes them to higher risks of vehicle strike. Without mitigation, the proposed road upgrade could increase the likelihood of a vehicle strike for individuals that may exist in the study area. However, the proposed road upgrade includes a fauna underpass at Narrabeen Creek and strategic fauna fencing to keep animals out of the path of vehicles and maintain connectivity. With this mitigation measure, it is unlikely that vehicle strikes will impact the population to the point where it could face local extinction.</p> <p><i>2. Population isolation</i></p> <p>Without mitigation, the wider road is likely to deter animals from crossing, which would result in less movement of individuals between Katandra Bushland and the Warriewood Escarpment. This could isolate individuals and</p>

Dasyurus maculatus

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

	increase inbreeding and the risk of local extinction from stochastic events. There is currently a single fauna underpass. As part of the proposed road upgrade, the underpass would be upgraded to improve connectivity between Katandra Bushland and the Warriewood Escarpment. Therefore it is unlikely that the proposed road upgrade would significantly increase population isolation above that which already exists.
d) Adversely affect habitat critical to the survival of the species?	The proposed road upgrade would result in impacts to 9.87 ha of potential habitat for the quoll. It is unlikely that this is of critical importance to the survival of the species. Habitat currently present is highly disturbed through weed incursion, traffic noise, frequented walking trails and management activities (slashing of grass, track maintenance). Road edges typically allow greater access to introduced species (eg dogs, cats, foxes), that will either prey on, or compete with the spotted-tailed quoll. Low quality disturbed habitat, and the potential high abundance of competitors/predators mean that habitat in the survey area is unlikely to be critical to the survival of the species.
e) Disrupt the breeding cycle of a population?	The proposed road upgrade would result in impacts to 9.87 ha of potential habitat for the quoll. Given the past and current disturbance (particularly the high traffic volume) and historical loss of connectivity in the study area, it is unlikely that the spotted-tailed quoll breeds within the proposed footprint. As a result, it is unlikely that the proposed road upgrade would disrupt the breeding cycle of any individual quolls. Improved connectivity via an upgraded fauna underpass may allow males to more easily and safely cross between Katandra Bushland and the Warriewood Escarpment
f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The proposed road upgrade would result in impacts to 9.87 ha of potential habitat for the quoll. It is unlikely that this is of critical importance to the survival of the species. Habitat currently present is highly disturbed through weed incursion, traffic noise, frequented walking trails and management activities (slashing of grass, track maintenance). Road edges typically allow greater access to introduced species (eg dogs, cats, foxes), that will either prey on, or compete with the spotted-tailed quoll. It is unlikely that the species is resident or regularly present in the foot print area. Therefore, loss of this small area of habitat would be unlikely to cause a decline in the species.
g) Result in invasive species that are harmful to the species becoming established in the species' habitat?	The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.
h) Introduce disease that may cause the species to decline?	The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on the spotted-tailed quoll.

Dasyurus maculatus

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a critically endangered or endangered species with a real chance or possibility that it would:

<p>i) Interfere with the recovery of the species?</p>	<p>Whilst the proposed road upgrade would lead to the loss of /indirect impacts to 9.87 ha of potential habitat, this represents less than 0.8% of the total available potential habitat in the study area. It is unlikely that spotted-tailed quoll occurs regularly in the study area. Recovery of the species in urban Sydney will require the species to be tolerant of disturbances such as road works and small-scale habitat clearance. It is unlikely that the proposed road upgrade would interfere substantially with the recovery of the species.</p>
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13.2 Conclusion

The spotted-tailed quoll has been recorded in the study area previously, although most of the records are more than 10 years old (OEH 2014a). One of the records is within the proposed road footprint while others are 2.5 kilometres south. The proposed road upgrade would require the removal of approximately 9.87 hectares of potential foraging and denning habitat for the spotted-tail quoll. Current habitat in the survey area is in poor condition, and is highly disturbed due to its close proximity to an existing arterial road and the associated anthropogenic impacts. The removal of a small amount of potential spotted-tailed quoll habitat for this proposed road upgrade is unlikely to increase the likelihood of local extinction of this species, or have an adverse effect on the life cycle of this species.

The increased carriageway width and traffic volume will contribute to a movement barrier for individuals that may persist in the study area. Without mitigation, this could further isolate individuals from mating and foraging opportunities as well as increase the risk of vehicle strike mortality. However, the installation of fauna fencing at strategic locations along the road and the new underpass at Narrabeen Creek existing fauna underpass will reduce this impact to the point where it is unlikely to have a significant impact on the viability of the local population. It is therefore considered unlikely that the proposed road upgrade and associated loss of habitat will have a significant impact on the spotted-tailed quoll.

14 Southern brown bandicoot (*Isoodon obesulus*)

14.1 Background

The southern brown bandicoot (*Isoodon obesulus*) is found in NSW, Victoria and South Australia. The species is listed as endangered under the EPBC Act. The subspecies *Isoodon obesulus obesulus* is also listed as endangered in NSW under the TSC Act. The primary reason for the species conservation listing is a severe contraction in its geographic distribution, and subsequently a severe reduction in numbers (Threatened Species Scientific Committee (TSSC) 2001).

The southern brown bandicoot is a medium-sized, ground terrestrial marsupial that inhabits a variety of forest, woodland, and shrub and heath communities (Paull 2008; TSSC 2014). In NSW, the subspecies is predominately found in two areas, including Ku-ring-gai Chase and Garigal National Parks (outside of the study area), and on a variety of land types in the far south (eg national parks, state forests, nature reserves and private land) (DEC 2006). This species can be active diurnally or nocturnally and typically occupies a home-range size of between 0.5 and five hectares (Paull 2008). Preferred food sources include invertebrates, although fungal material can form a supplementary food source (Paull 2008).

The southern brown bandicoot typically nests in a shallow depression in the ground covered by leaf litter, grass or other plant material, which forms a hollow chamber with no distinct entrance or exit (Gordon 1974; DEC 2006; Paull 2008). Females have the ability to reproduce multiple times annually; however the breeding season has been strongly linked to environmental factors such as food availability or photoperiod (Stoddart and Braithwaite 1979). Litter size can range between one and six (Braithwaite 1983; Paull 2008), although juvenile mortality is considered high (Copley et al. 1990; Paull 2008). The gestation period is short, and lasts for an estimated 15 days before neonates enter the pouch for a further two months (Stoddart and Braithwaite 1979; Lobert and Lee 1990). Juvenile bandicoots are independent immediately after leaving the pouch (Stoddart and Braithwaite 1979) and weigh approximately 105-140 grams (Lobert and Lee 1990).

Southern brown bandicoots face multiple threats to their survival. These can include: predation by introduced carnivores (eg foxes, dogs, cats) (Claridge et al. 1991; Paull 1999; Ecotone 2003), habitat loss and modification (Seebeck 1977; Moloney 1982; Aitken 1983; Menkhorst and Seebeck 1990), inappropriate fire regimes (Kemper 1990; DEC 2006), vehicle strikes (DEC 2006), and low genetic diversity and small population sizes (Johnston et al. 2002 *in* DEC 2006).

Potential habitat for this species occurs throughout the survey area, but no individuals or evidence of occurrence were found during surveys, nor were they located during targeted surveys in Garigal National Park, approximately three kilometre to the west of the survey area, but within the study area.

Isoodon obesulus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of a population?</p>	<p>There are almost 290 previous records from OEH (2014a) within the study area (10 km from the centre of the footprint). Within a 5 km radius there are only 29 records. These include records from 1980, with the last record within the study area in 2010 (road kill to west of the survey area) (OEH 2014a). Preliminary habitat searches and nocturnal spotlight surveys found no direct or indirect evidence (sightings or sign) of the southern brown bandicoot. Intensive trapping to the south in Garigal National Park has not located the southern brown bandicoot since 2000, and while it has been trapped in Ku-ring-gai Chase National Park, this has been predominately near Bobbin Head (discussed in Ecosure 2014b). The relatively small home-range size of southern brown bandicoots suggests that individuals found outside of the study area are unlikely travel to the survey area. These results indicate that although potential habitat occurs and the southern brown bandicoot may be occasionally encountered, the survey area is unlikely to support a viable population.</p>
<p>b) Reduce the area of occupancy of the species</p>	<p>Potential southern brown bandicoot habitat was located in parts of the survey area (woodland and heath areas). However, the absence of any direct or indirect evidence to indicate the presence of southern brown bandicoot suggests that the survey area does not form part of the area of occupancy for this species.</p>
<p>c) Fragment an existing population into two or more populations</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal National Park and Ku-ring-gai National Park. Southern brown bandicoots are negatively impacted by vehicle strikes. While southern brown bandicoots are considered unlikely to be present in the survey area, proposed fauna connectivity structures and exclusion fencing will reduce the likelihood of road mortality for individuals that may use the survey area in the future.</p>
<p>d) Disrupt the breeding cycle of a population</p>	<p>While records are present within the study area, the relatively small home-range size of southern brown bandicoots suggests that individuals in these areas are unlikely to disperse into the survey area and therefore there is unlikely to be a breeding population within the survey area.</p>

Isoodon obesulus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>e) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The proposed road upgrade will result in the removal of or indirect impact to approximately 6.59 ha of potential southern brown bandicoot habitat (woodland and sandstone heath). The extent of this removal is considered small compared to the availability of these habitat types in the study area, where there OEH (2014) note there is approximately 12,678 ha.</p> <p>The absence of any direct or in-direct evidence of southern brown bandicoots in the survey area or recent records nearby indicates that the potential habitat being removed is unlikely to be important for the long-term survival of the species in the study area. This is also supported by the greater frequency of records in areas outside of the study area (eg Bobbin Head in Kuringai National Park). Also, given the relatively small home-range size of southern brown bandicoots they are unlikely to disperse long distances to enter the survey area. It is therefore considered that the habitat to be removed is not significant for any local viable population.</p>
<p>f) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</p>	<p>The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.</p>
<p>g) Introduce disease that may cause the species to decline</p>	<p>The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a negative impact on the southern brown bandicoot.</p>
<p>h) Interfere with the recovery of the species</p>	<p>The proposed road upgrade will directly and indirectly impact on 6.59 ha of potential habitat for the southern brown bandicoot, however there are no records of this species within the survey area. Although the southern brown bandicoot may occasionally be encountered, the survey area is unlikely to support a viable population and therefore the proposed road upgrade is unlikely to interfere with the recovery of the species.</p>

14.2 Conclusion

There are limited historical records of the southern brown bandicoot within the study area; however close to the study area (eg Bobbin Head in Ku-ring-gai Chase) are identified key locations for southern brown bandicoots in NSW (B. Hope pers. comm. 2013 *in* Ecosure 2014b). While the southern brown bandicoot has been the subject of intensive trapping to the south in Garigal National Park, it is naturally rare and has not been located there since 2000. It has been trapped in Ku-ring-gai Chase National Park, particularly near Bobbin Head; however, the relatively small home-range size of southern brown bandicoots suggests that individuals in these areas are unlikely to disperse into the survey area. As a result, the study area is unlikely to support a viable southern brown bandicoot population, although they may be occasionally encountered (B. Hope pers. comm. 2013). This is further supported by recent preliminary habitat searches and nocturnal spotlight surveys of the survey area, which found no direct or indirect evidence of the southern brown bandicoot in the survey area.

The proposed road upgrade will increase the width of the existing road, decrease potential connectivity and subsequently increase the risk of vehicle strike. Southern brown bandicoots are negatively impacted by vehicle strikes; however this species is considered unlikely to be present in the survey area and if they are, proposed fauna connectivity structures and strategic exclusion fencing will reduce the risk of road kill to the population. In summary, a referral is not considered to be necessary for this species.

15 Koala (*Phascolarctos cinereus*)

15.1 Background

The koala (*Phascolarctos cinereus*) is an iconic Australian marsupial and as such has been the focus of nationwide survey effort (Phillips 1990), including state-wide surveys in New South Wales and Queensland (Kikkawa and Walter 1968; Gall 1978; Patterson 1996; Lunney et al. 2009). Analyses of historical koala records are increasingly being used to inform planning outcomes at the local government area level (Lunney et al. 1998; Biolink 2007; Phillips and Hopkins 2009; Ecosure 2013). In Queensland, NSW and the Australian Capital Territory, the koala is listed as vulnerable under the EPBC Act. The koala is also listed as vulnerable in NSW under the TSC Act and as an endangered population in the Pittwater Local Government Area (LGA).

The koala is a folivorous arboreal marsupial restricted to forests which contain their preferred food tree species (Lee and Martin 1988). Koalas exhibit strong preferences between individual trees species, with species of the genus *Eucalyptus* consumed as a primary source of food, while other genera such as *Corymbia*, *Lophostemon* and *Melaleuca* may also be incorporated into the diet as supplementary browse and/or utilised for other purposes (Lee and Martin 1988; Hindell and Lee 1990; Phillips 1990; Phillips, Callaghan and Thompson 2000; Phillips and Callaghan 2000). Specifically, swamp mahogany (*E. robusta*) and grey gum (*E. propinqua*) are recognised as the most preferred koala food trees, which are found throughout the study area. Due to their highly specialised diet, food availability is thought to be a key determinant of high quality koala habitat (Moore and Foley 2000). High nutrient soils affecting palatability of the leaves (Reed et al. 1988), forest area and landscape configuration are also considered to be involved in the overall desirability of koala habitat (McAlpine et al. 2006).

Koalas are solitary animals with a highly defined social structure at the local aggregation level. Juveniles disperse at around 18 to 36 months to sustain healthy social and mating systems and food availability (Dique et al. 2003). Home range reflects the resource ability for required food, shelter and space for successful reproduction. Therefore an abundance of healthy large food and shelter trees would allow koalas to have smaller home ranges than would an area with fewer resources (Callaghan et al. 2011). Generally, the breeding and primary dispersal seasons for koalas are in spring and summer (Martin and Handasyde 1999).

Key threats to koalas throughout its range are well documented and include road mortality, habitat loss, dog attack and disease. Roads pose a significant threat to koala populations due to habitat loss and fragmentation, as well the high vulnerability of koalas to vehicle collisions (Canfield 1987; Backhouse and Crouch 1990; Kraschnefski, 1999; Dique et al. 2003; DECC 2008; Preece 2009). Koalas are also considered susceptible to low genetic diversity which may be exacerbated by road barriers (DECC 2008; Australian Museum Business Services (AMBS) 2012). In a recent study in south-east Queensland, roads were found to be a key barrier to genetic flow in the koala population (Dudaniec et al. 2013). The

impacts of roads may be reduced by implementing appropriate mitigation measures, which include connectivity structures and exclusion fencing. Historically, there are few records of the koala within the Pittwater and Warringah local government areas; however there are no previous records within the study area (OEH 2014a).

Phascolarctos cinereus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of an important population of a species</p>	<p>From 1980 onwards, there are no previous records in BioNet for koalas within a 5 km radius from the centre of the footprint) (OEH 2014a). There are 13 records in the same period within the 10 km radius study area, of which five were within the Pittwater LGA. Targeted searches by Ecosure of preferred koala food trees using the Spot Assessment technique (SAT), found no direct (observation) or indirect (faecal pellets) evidence of koalas in the survey area.</p> <p>In addition, no evidence of koala activity was found during detailed SAT surveys as part of the adjacent upgrade to Mona Vale Road (west), nor was there any evidence recorded during targeted searches of preferred food trees in Ku-ring-gai Chase National Park and West Head. These results indicate that the survey area and nearby connected habitat are unlikely to support an important population.</p> <p>The proposed road upgrade will impact 5.95 ha of potential koala habitat (this excludes disturbed and heath only vegetation types). Detailed surveys indicate that koalas are unlikely to persist in the survey area. Combined with the absence of koala records from the study area, or from nearby surveys (Mona Vale Road Upgrade West and Ku-ring-gai Chase National Park (Ecosure 2014a)), this indicates that the road upgrade is unlikely to lead to a long-term decrease in the size of an important population.</p>
<p>b) Reduce the area of occupancy of an important population</p>	<p>Detailed surveys indicate that koalas are unlikely to persist in the survey area. Combined with the absence of koala records from the study area, or from nearby surveys (Mona Vale Road Upgrade West and Ku-ring-gai Chase National Park (Ecosure 2014a)), this indicates that the road upgrade is unlikely to reduce the area of occupancy of an important population.</p>
<p>c) Fragment an existing important population into two or more populations</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Kur-ring-gai National Park (via Katandra Bushland Sanctuary) and Ingleside Chase Reserve; however will not newly fragment an existing population into two or more populations. Koalas are negatively impacted by increased traffic volumes and subsequent increases to vehicle strike mortalities. While koalas are considered unlikely to be present in the survey area, the implementation of mitigation measures (including fauna connectivity structures and exclusion fencing) would assist in delivering safe passage for koalas (if present) traversing the survey area in the future.</p>

Phascolarctos cinereus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>d) Adversely affect habitat critical to the survival of a species</p>	<p>i. Extent of impact on habitat</p> <p>The proposed road upgrade will result in the removal of/indirect impacts to 5.95 ha of potential koala habitat and preferred koala food trees (PKFTs). The extent of habitat removal (including PKFTs) is considered small compared to the availability in the region. For example, ridge top woodland constitutes 40% of the vegetation of Warringah local government Area, while there is 350 ha of Hornsby Sandstone Exposed Bloodwood Woodland within Pittwater local government area, the primary community that is to be removed as part of the proposed road upgrade. There is more than 10,000 ha of similar habitat exists within the study area.</p> <p>ii. Importance of habitat to be impacted</p> <p>The absence of direct or indirect evidence of koala in the study area, or in nearby contiguous habitat (Ku-ring-gai Chase National Park), indicates that the potential koala habitat being removed is unlikely to be critical for the long-term survival of the species in the study area. This is also supported by the lack of previous records.</p>
<p>e) Disrupt the breeding cycle of an important population</p>	<p>Preferred koala food trees were located in parts of the survey area. However, the absence of any direct or indirect evidence of koalas indicates that the survey area does not support a resident population, and as such does not provide an important breeding place for koalas.</p>
<p>f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The absence of direct or indirect evidence of koala in the study area, or in nearby contiguous habitat (Ku-ring-gai Chase National Park), indicates that the potential koala habitat being removed/indirectly impacted (5.95 ha) is unlikely to result in a decline of any population.</p>
<p>g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</p>	<p>Domestic and wild dogs are a threat to the survival of koalas. Despite this, the proposed road upgrade is unlikely to increase the presence and/or abundance of dogs to that currently present in the survey area. As a result, the proposed road upgrade is unlikely to further decrease the potential future establishment of koalas in the survey area due to invasive species.</p>
<p>h) Introduce disease that may cause the species to decline, or</p>	<p>Disease will be present in any koala population that may persist in the region. Although it is considered unlikely that koalas persist in the survey area, the proposed road upgrade would not introduce any new diseases that may cause this species to decline.</p>

Phascolarctos cinereus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

<p>i) Interfere substantially with the recovery of the species.</p>	<p>There is a recovery plan for the koala under the TSC Act (DECC 2008). This recovery plan uses seven specific objectives that align with those outlined in the National Koala Conservation Strategy (ANZECC 1998):</p> <ul style="list-style-type: none"> · Objective 1: To conserve koalas in their existing habitat · Objective 2: To rehabilitate and restore koala habitat and populations · Objective 3: To develop a better understanding of the conservation biology of koalas · Objective 4: To ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale · Objective 5: To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care · Objective 6: To manage over-browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat · Objective 7: To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW. <p>The absence of any previous records within 5 km of the study area, coupled with no direct or indirect evidence of koala during recent preliminary surveys, indicates that the proposed road upgrade will not interfere with these objectives or their actions.</p>
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15.2 Conclusion

The proposed road upgrade will result in the removal of a small amount of potential koala habitat and preferred koala food trees, as well as an increase in the width of the existing road and a decrease in potential connectivity. Koalas are negatively impacted by increased traffic volumes through consequent increases in vehicle strike mortality. Although historically there are a few records of the koala within the Pittwater and Warringah local government areas, there are no previous records within a five kilometre radius from the centre of the footprint (OEH 2014a). In addition, preliminary targeted searches of preferred koala food trees found no direct (observation) or indirect (faecal pellets) evidence of koalas in the survey area. Additional detailed surveys as part of the adjacent upgrade to Mona Vale Road (west) found no evidence of koala activity, nor were there any evidence recorded during targeted searches of preferred food trees in Ku-ring-gai Chase National Park and West Head. These results indicate that the survey area and nearby connected habitat are unlikely to support a viable local population.

Koalas are considered unlikely to be present in the survey area in sufficient numbers for a viable local population (there may however be the occasional transient individual). As such, any impacts relating to the proposed road upgrade are unlikely to have an adverse effect on any local koala population. Nonetheless, mitigation measures implemented into the proposed road upgrade, such as fauna underpass and strategically placed exclusion fencing, will contribute to connectivity if individuals traverse the survey area in the future. Owing to the lack of evidence for koalas in the study area, and assuming the aforementioned mitigation measures are implemented, the proposed road upgrade is unlikely to have a significant impact on this species, and it is recommended that a referral is not required.

16 New Holland mouse (*Pseudomys novaehollandiae*)

16.1 Background

The New Holland mouse (*Pseudomys novaehollandiae*) is listed as vulnerable under the EPBC Act. It is also listed as vulnerable internationally, in the IUCN Red List of Threatened Species (Menkhorst et al. 2008). However, this species is not listed as threatened in NSW under the TSC Act.

The New Holland mouse is predominately restricted to small fragmented populations in Tasmania, Victoria, NSW and Queensland. The largest known population occurs in central and northern NSW. It is found in coastal sandstone areas comprising open heathland and woodland, with an understorey dominated by heath or vegetated sand dunes (Van Dyck and Strahan 2008). Soil types are apparently important, with deeper top soils and softer substrates (deep siliceous podsoles, sandy clay, loamy sands, sand dunes and coastal dunes) preferred for digging burrows (DoE 2014).

This species is primarily granivorous, although they will also consume leaves, fungi and invertebrates. It generally occurs at sites with high floristic diversity (DoE 2014).

The breeding season of the New Holland mouse is late winter to early summer; but the timing of breeding is typically influenced by abundance and quality of food (DoE 2014). Females reach sexual maturity at 13 weeks of age. Gestation takes 32-39 days, and young are born in burrows that are shared with other individuals and are constructed in soft substrates (eg sandy soils). Litter size is usually 1-6 and young are suckled for 3-4 weeks before they become independent (DoE 2014).

The species is particularly susceptible to predation due to the large amount of time it spends foraging above ground. Other threats to the species include loss of habitat, weed invasion, inappropriate fire regimes and competition from other rodents (DoE 2014).

No historical records exist for this species in the study area (OEH 2014a) and it was not detected during field surveys.

Pseudomys novaehollandiae

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

<p>a) Lead to a long-term decrease in the size of an important population of the species?</p>	<p>Since 1980, there have been no records of this species within the study area (10 km from the centre of the footprint) (OEH 2014a) and it was not detected during field surveys. Outside of the study area, there are two records from 2001 and 2002 in Ku-ring-gai Chase National Park 9.3 km north of the survey area (within the study area). Given the known records in the area are more than 10 years old and the survey area is highly disturbed, it is unlikely that there is a viable population in the survey area.</p>
<p>b) Reduce the area of occupancy of an important population?</p>	<p>No historical records exist for this species in the study area (OEH 2014a) and it was not detected during field surveys. The study area is not part of the area of occupancy of this species, although EPBC Act database searches show it as predicted to occur and potential habitat does occur within the survey area.</p> <p>The species' area of occupancy is estimated to be around 420 km² (DoE 2014). The proposed road upgrade would remove or indirectly impact only 6.59 ha of potential habitat, which is <00015% of the area of occupancy.</p>
<p>c) Fragment an existing important population into two or more populations?</p>	<p>No historical records exist for this species in the study area (OEH 2014a) and it was not detected during field surveys. It is unlikely that a population of the species exists in the study area that could be impacted upon by habitat fragmentation. The proposed road upgrade would increase the width of the existing road and decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood Escarpment. However, the existing road corridor would already act as a significant barrier to movement of this species, and the widening of the road would therefore not increase any barrier effects on this species.</p>
<p>d) Adversely affect habitat critical to the survival of the species?</p>	<p>No historical records exist for this species in the study area (OEH 2014a) and it was not detected during field surveys. It is unlikely that a population of the species exists that relies on habitat critical for survival in the study area. Habitat currently present is highly disturbed, and is subject to weed incursion, increased noise, frequented walking trails and regular management activities (slashing of grass, track maintenance, etc). Introduced predators are likely to be in higher abundance due to the close proximity of urban areas, causing an increase in mortality on this species. Soils are probably too shallow and rocky. Therefore, It is unlikely that the 6.59 ha of potential heath and woodland habitat that would be removed/indirectly impacted is critical to the survival of the species.</p>
<p>e) Disrupt the breeding cycle of an important population?</p>	<p>The species is unlikely to breed in the vicinity of the study area.</p>
<p>f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?</p>	<p>Approximately 6.59 ha of heath or woodland with a heath understory would be removed/indirectly impacted by the proposed road upgrade, but these areas are unlikely to be inhabited by New Holland mouse. The area of potential habitat to be cleared/indirectly impacted represents less than 0.8% of the total potential habitat in the study area.</p>

Pseudomys novaehollandiae

Assessment of Significance using EPBC Act significant impact criteria

Is the proposed action likely to have a significant impact on a vulnerable species with a real chance or possibility that it would:

<p>g) Result in invasive species that are harmful to the species becoming established in the species' habitat?</p>	<p>The proposed road upgrade does not include any intended activities involving invasive species. The CEMP will include specifications for supply and handling of construction materials (sand, soil, gravel, etc.) that would minimise the risk of inadvertently introducing invasive species into the study area.</p>
<p>h) Introduce Disease That May Cause The Species To Decline?</p>	<p>The proposed road upgrade does not include any involvement with diseases that could be introduced into the location that would have a deleterious impact on the New Holland mouse.</p>
<p>i) Interfere substantially with the recovery of the species?</p>	<p>Whilst the proposed road upgrade would lead to the loss of 6.59 ha of potential habitat, this represents less than 0.8% of the total potential habitat in the study area. It is unlikely that New Holland mouse occurs in the study area, so it is unlikely that the proposed road upgrade would interfere substantially with the recovery of the species.</p>

16.2 Conclusion

The proposed road upgrade will result in the removal/indirect impact of 6.59 hectares of sandstone heath, or woodland with a heath understorey, which could be suitable for the New Holland mouse. However, given the absence of deep soft soils, a presumed high abundance of predators in the area, the lack of recent records, and the high amount of disturbance currently, it is very unlikely that this species persists in the study area. Therefore, it is unlikely that the proposed road upgrade will have a significant impact on the long-term survival of the species.

17 Grey-headed flying-fox (*Pteropus poliocephalus*)

17.1 Background

The grey-headed flying fox (*Pteropus poliocephalus*) is listed as vulnerable under the TSC Act and the EPBC Act. It primarily occurs in the coastal belt from central Queensland to Victoria, however, it occasionally ranges into South Australia and is frequently observed west of the Great Dividing Range (Tidemann 1998). The relative abundance of this species varies widely within its distribution between seasons and from year to year (Eby and Lunney 2002).

The grey-headed flying-fox typically roosts near water on exposed branches, and can form aggregations (camps) ranging from a few individuals to over 70,000. The species utilises a range of vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. It is often found in highly modified vegetation in urban and suburban areas (van der Ree 2006).

Mating occurs in early autumn and females give birth to a single young each year in September/October after a six month gestation (Van Dyck and Strahan 2008). Initially the young are carried around by the mother, but after several weeks they are left in the camp while the mother forages. The young remain in the camp until January/February when they leave to forage for themselves (Churchill 2008). The grey-headed flying-fox has a diverse diet of nectar, pollen and fruit which is derived from native and introduced plants. The species usually forages within 15 kilometres of roost sites but will migrate over greater distances in response to the availability of food resources (Eby and Lunney 2002). Sedentary individuals form the core population of continuously occupied camps. However, the majority are highly nomadic and move several hundred kilometres each year in largely unpredictable patterns (DoE 2013). The key threats to this species include (DoE 2013):

- Habitat loss and fragmentation
- Culling for orchard protection
- Competition and hybridisation
- Pollutants, electrocution and pathogens.

BioNet (OEH 2014a) lists 28 records of grey-headed flying-fox within a five kilometre radius, and 60 records since 1980 in the study area. However, hundreds of grey-headed flying-fox were counted flying west over the proposed footprint at dusk during the field surveys conducted by Ecosure in May 2014 (main report). Many individuals were also observed foraging in the trees along the roadside. No camps were recorded within the survey area, but two known camps occur in the study area. A camp containing this species occurs less than two kilometres from the proposed impact area in Warriewood. At a count in May 2014 the camp contained between 5,000 and 10,000 grey-headed flying-fox (DoE 2014).

Pteropus poliocephalus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

<p>a) Lead to a long-term decrease in the size of an important population of a species</p>	<p>The grey-headed flying-fox has been recorded by Ecosure foraging within the survey area. A camp for this species occurs about 2 km (in Warriewood) (although this is not an important population as defined under the EPBC Act) from the survey area but no camps were recorded within the survey area itself. A total of 6.59 ha of woodland and heath which could be used for foraging will be removed or indirectly impacted by the proposed road upgrade.</p> <p>This species communally roosts and it is likely that the roost at Warriewood is also used as a natal site. This species is highly nomadic and travels large distances in response to flowering eucalypts and fruiting trees. Juveniles are born in September/October and are carried with the females for several weeks and then left in the maternity camp. No camps will be impacted during the proposed road upgrade and only a small amount of foraging habitat (6.59 ha of the 12,678 ha available in the study area) will be removed or indirectly impacted, so it is unlikely that the proposed road upgrade will lead to a long-term decrease in the size of an important population.</p>
<p>b) Reduce the area of occupancy of an important population</p>	<p>The proposed road upgrade will impact 6.59 ha of potential grey-headed flying-fox foraging habitat (this excludes disturbed habitats) which is less than 0.11% of the available foraging habitat within the study area. Detailed surveys indicate that no roosting camps occur within the survey area. A large amount of potential foraging habitat (around 12,600 ha) would remain within 10 km of the survey area so it is unlikely that the removal of 6.59 ha of foraging would reduce the area of occupancy of an important population.</p>
<p>c) Fragment an existing important population into two or more populations</p>	<p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal and Ku-ring-gai National Parks; however will not newly fragment an existing population into two or more populations. Grey-headed flying-fox are a highly mobile species that travel large distances to access resources so the increase in the road width is unlikely to fragment the population.</p>
<p>d) Adversely affect habitat critical to the survival of a species</p>	<p>Critical habitat for the grey-headed flying-fox is defined when the roost meets particular criteria. No roosts occur within the proposed road footprint so it is unlikely that the proposed road upgrade will directly or indirectly impact critical habitat.</p>
<p>e) Disrupt the breeding cycle of an important population</p>	<p>This species is known to communally roost around 2 km from the survey area. It is likely that this roost is also used as a natal site. Juveniles are born in September/October and are carried with the females for several weeks and then left in the maternity camp. Adults of this species are highly nomadic and travel large distances in response to flowering eucalypts and fruiting trees. No roosting habitat occurs within the direct impact area so there is unlikely to be any direct impact on the breeding cycle of this species. During the breeding season adults will forage in and near the direct impact area. A small amount of this foraging habitat (6.59 ha) will be removed or indirectly impacted, but around 12,600 ha of similarly suitable foraging habitat will remain within a 10 km radius so it is unlikely that the proposed road upgrade will have any impact on the species breeding cycle.</p>

Pteropus poliocephalus

Assessment of Significance using EPBC Act significant impact criteria

Is the action likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

<p>f) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The survey area contains potential foraging habitat for the grey-headed flying-fox. Flowering eucalypts and fruiting trees within the study area will provide a seasonal food resource for the population. Some potential foraging trees will be directly removed by the proposed road upgrade, which will reduce the number of trees available for food in the local area. However, the number of trees to be removed will be small compared to the large area of suitable foraging habitat which will remain within the study area (around 12,678 ha). This species is highly mobile and can travel large distances for food resources. The removal of some food trees is unlikely to significantly impact the local population to the point that they are risk of extinction.</p> <p>Traffic, traffic noise and artificial lighting will all increase under the proposed road upgrade and this could impact grey-headed flying-fox indirectly through a decrease in habitat quality. Traffic on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026) following the road upgrade, although the majority of this increase will occur during the day when flying-foxes are not typically mobile. The small reduction in habitat quality along the road verge is unlikely to significantly impact grey-headed flying-fox to the point where the species would decline.</p>
<p>g) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</p>	<p>Invasive species are not considered a threat to this species but it is unlikely that the proposed road upgrade will result in an increase in abundance of invasive species (such as dogs, foxes and cats).</p>
<p>h) Introduce disease that may cause the species to decline, or</p>	<p>There are no known bat diseases that could potentially be spread by the proposed road upgrade.</p>
<p>i) Interfere substantially with the recovery of the species.</p>	<p>The draft national recovery plan for the grey-headed flying-fox (DECCW 2009) lists the following objectives:</p> <ul style="list-style-type: none"> · To reduce the impact of threatening processes on grey-headed flying-foxes and arrest decline throughout the species' range · To conserve the functional roles of grey-headed flying-foxes in seed dispersal and pollination · To improve the standard of information available to guide recovery of the grey-headed flying-fox, in order to increase community knowledge of the species and reduce the impact of negative public attitudes on the species. <p>The proposed road upgrade is inconsistent with the objectives of the recovery plan, as it does not contribute to conservation of this species.</p>

17.2 Conclusion

The proposed road upgrade will result in the removal of, or indirect impacts to, approximately 6.59 hectares of foraging habitat for grey-headed flying-fox; however, no roosting habitat will be impacted by the proposed road upgrade. The removal of the small amount of disturbed foraging habitat for this species is unlikely to increase the likelihood of local extinction of this species, or have an adverse effect on the life cycle of the species.

TSC Act Assessments of Significance (seven part tests)

Section 5A of the *Environmental Planning and Assessment Act 1979* lists those matters which must be taken into consideration when determining if there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats, as listed under the *Threatened Species Conservation Act 1995* (TSC Act).

Thirty-one (31) assessments of significance have been carried out with consideration of the Environmental Planning and Assessment Act and TSC Act. Assessments of significance follow guidelines provided by DECC (2007). The outcomes of these assessments are summarised in Table 1 and Table 2, and follow the format required in *Biodiversity Assessment – Practice Note* (RTA 2012).

18 Port Jackson heath (*Epacris purpurascens* var. *purpurascens*)

18.1 Background

Port Jackson heath (*Epacris purpurascens* var. *purpurascens*, Epacridaceae) is listed as a vulnerable species under the NSW TSC Act, and is not listed under the Commonwealth EPBC Act.

Port Jackson heath is found within a range of habitat types including stringybark and ironbark woodlands on shale/sandstone associations and sclerophyll forest and scrub and near creeks and swamps (Harden 1993 – 2002; Robinson 2003). It is found from Gosford in the north, Narrabeen in the east, Silverdale in the west down to the Avon Dam vicinity in the south (Harden 1993 – 2002; OEH 2012).

Peak flowering period occurs from July to September on the coast and October to November on the tablelands (Harden 1993 – 2002; NWPS 2002). *Epacris purpurascens* var. *purpurascens* differs from *Epacris purpurascens* in the appearance of the leaves and flowers (RBG 2014a and 2014b). *Epacris purpurascens* has leaves that are appressed near the base of the stem and which spread and are recurving at the top, whereas the Port Jackson heath has an aristate tip that is up to 1.4 millimetres long. Port Jackson heath is known to start producing seed at 2-4 years and has a lifespan of 5-20 years (Benson and McDougall 1995; OEH 2012).

OEH (2012) list the following threatening processes for this species:

- The increased threat of habitat loss or modification of remaining habitat due to urban or rural development
- Loss of existing populations due to urban run-off that leads to flooding, erosion, nitrification of soil substrates and altered pH, introduction of weeds and plant pathogens
- Altered and inappropriate fire regimes, uncontrolled vehicular access, compaction of soil, slashing for power line easements, illegal dumping and trampling by walkers and the general public that may threaten the species' viability
- The potential for inappropriate vegetation management activities at known sites that may impact the species
- The competition and impact from weeds (such as African lovegrass *Eragrostis curvula*, whiskey grass, *Andropogon virginicus* and Coolatai grass *Hyparrhenia hirta*) along power line easements
- Species confirmation at sites (to confirm that individuals are *Epacris purpurascens* var. *purpurascens*)
- Extent of threats to the population of *Epacris purpurascens* var. *purpurascens* is unknown.

Port Jackson heath was not recorded during the field survey. The desktop survey revealed one record within a five kilometre radius of the survey area, and 31 records from the study area since 1980 (OEH 2014a). Potential habitat for this species does not occur in the study area.

Epacris purpurascens var. purpurascens

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There is a record of a single individual of Port Jackson heath within a 5 km radius of the centre of the survey area (OEH 2014a), with the individual recorded 2 km south-east of the direct impact area at Elanora Heights (accuracy of 100 m). More broadly within the study area, there are 31 records (OEH 2014a). Potential habitat exists for the species within the study area however the species was not detected within the survey area during the field surveys conducted by Niche and Ecosure in spring 2013 and spring 2014 (main report). For this reason and given the distance of the record from the survey area, it is considered that a viable local population is unlikely to be affected within the direct impact area.</p> <p>Life cycle factors</p> <p>Peak flowering period of Port Jackson heath is July to September on the coast and October to November on the tablelands (Harden 1993 - 2002). The first seed production occurs between 2-4 years (OEH 2012). It grows quickly after low intensity fire if light is available, and the plant is known to live 5-20 years (Benson and McDougall 1995).</p> <p>Assessment</p> <p>A viable local population of Port Jackson heath is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Epacris purpurascens var. purpurascens

Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>Port Jackson heath has previously been found within urban exotic/native vegetation community however the record was made in 1994 (OEH 2014a) and is likely not to have occurred in a developed area. Potential habitat includes exotic/native vegetation (described above) as well as sandstone dry sclerophyll forest and the heath vegetation found within the broader study area. Approximately 9.19 ha of this potential habitat (sandstone dry sclerophyll, sandstone heath and urban exotic/native) within the survey area would be removed or modified as a result of the proposed road upgrade, which is considered negligible compared to the extent of sandstone dry sclerophyll forest and heath within the broader locality (13 003 ha - most of which is well-reserved in national parks).</p> <p>ii. Habitat fragmentation</p> <p>The proposal constitutes the widening and realignment of Mona Vale Road, and will not result in the fragmentation of potential habitat for the Port Jackson heath.</p> <p>iii. Importance of habitat to be impacted</p> <p>The species has not been previously recorded within the direct impact area and any impact on potential habitat for the species within the locality is considered to be negligible. For these reasons, it is considered that the habitat affected by the proposal is of relatively low importance to the long-term survival of Port Jackson heath in the locality.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>No Recovery Plan or Threat Abatement Plan is known for the Port Jackson heath and therefore, the proposed road upgrade is no inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p> <p>A draft amendment strategy of a Priorities Action Statement (PAS) is available for this species (OEH 2013). The aim of this PAS is to conserve the species in the long term whereby site-based management is required “in order to secure it from extinction in NSW for 100 years” (OEH 2013). Four management sites are discussed, including Ku-ring-gai High School, Western Hornsby Plateau, Woronora and Upper Nepean Sydney Catchment Authority. Management actions for all these sites include tracking species abundance and condition over time, assess and minimise threatening processes and minimising impacts of recreational activities, maintaining appropriate fire regimes as well as reducing and maintaining weed levels.</p> <p>The action proposed is therefore unlikely to have a significant impact on Port Jackson heath and is consistent with recovery actions for the species.</p>

Epacris purpurascens var. purpurascens

Assessment of Significance criterion (Seven Part Test)

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

The NSW listed key threatening processes (KTPs) (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:

1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
2. Bushrock removal
3. Clearing of native vegetation
4. Infection of native plants by *Phytophthora cinnamomi*
5. Invasion and establishment of exotic vines and scramblers
6. Invasion, establishment and spread of *Lantana*
7. Invasion of native plant communities by exotic perennial grasses
8. Loss of hollow-bearing trees
9. Removal of dead wood and dead trees.

Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation).

18.2 Conclusion

The species has not been previously recorded within the survey area and any impact on potential habitat for the species within the locality is considered to be negligible. The habitat affected by the proposal is of relatively low importance to the long-term survival of Port Jackson heath in the locality. The proposed road upgrade is considered unlikely to have a significant impact on Port Jackson heath, and therefore a Species Impact Statement (SIS) is not recommended.

19 Camfield's stringybark (*Eucalyptus camfieldii*)

19.1 Background

Camfield's stringybark (*Eucalyptus camfieldii*, Myrtaceae) is listed as a vulnerable species under the NSW TSC Act and as a vulnerable species under the Commonwealth EPBC Act.

Camfield's stringybark is restricted to the Royal National Park, Middle Harbour and Ku-ring-gai Chase National Park (Robinson 2003) where it occurs in poor (low nutrient) coastal country in shallow sandy and poorly drained soils overlying Hawkesbury sandstone, associated with coastal heath mostly on exposed sandy ridges. It is found mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas (OEH 2012; Robinson 2003).

The flowering period is irregular with flowering recorded throughout the year, especially from April to December (Benson and McDougall 1998; OEH 2012; DoE 2008; DoE 2014).

OEH (2012) list the following threatening processes for this species:

- The loss of habitat through clearing for urban development
- Inappropriate fire regimes threatening the ability of trees to recover following a series of frequent fires and reducing its ability to reach full maturity
- Invasion of weeds and plant pathogens including myrtle rust and *Phytophthora cinnamomi*
- The possibility of in-breeding due to isolation of populations
- The increased risk of local extinction due to prolonged dry periods as a result of climate change and plant pathogens
- The physical damage to plants caused by trampling from recreational vehicles.

Camfield's stringybark was not recorded during the field survey. The desktop survey revealed four records within a five kilometre radius, and 25 records within the study area since 1980 (OEH 2014a). Potential habitat occurs in the study area.

Eucalyptus camfieldii

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population BioNet contains four records of Camfield’s stringybark within a 5 km radius of the centre of the survey area (OEH 2014a), with the closest three individuals occurring approximately 4 km north of the concept design within the Ku-Ring-Gai Chase National Park. More broadly, there is 25 records within the study area (OEH 2014a). The species was not detected within the direct impact area during the field surveys conducted by Niche and Ecosure in spring 2013 and spring 2014 (main report) despite being a conspicuous species. For this reason and given the distance of known records from the survey area, it is considered that a viable local population is unlikely to be affected within the direct impact area.</p> <p>Life cycle factors Camfield’s stringybark flowering period is irregular, with flowering recorded throughout the year, especially between April and December (Benson and McDougall 1998; OEH 2012; DoE 2014). Seed is dispersed by wind or gravity and no dormancy mechanism has been recorded. Camfield’s stringybark also has an extensive lignotuber that can grow up to 25 m across and which is known to resprout after fire (Benson and McDougall 1998, DoE 2014). The species is also sensitive to frequent fires, however the lack of fire has also been recorded to affect survival and reproduction rates (DoE 2014). Camfield’s stringybark is reported to be long-lived (>100 years; Benson and McDougall 1998).</p> <p>Assessment A viable local population of Camfield’s stringybark is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

<i>Eucalyptus camfieldii</i>	
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>Camfield's stringybark has previously been found within Hornsby sandstone dry sclerophyll forest and heath. Approximately 6.59 ha of this potential habitat for Camfield's stringybark within the concept design will be removed or modified as a result of the proposed road upgrade, which is considered negligible compared to the extent of similar habitat within the broader locality (12,678 ha - much of which is well-reserved in national parks). As a viable population is unlikely to occur within the direct impact area, a substantial soil seed bank is also considered unlikely to occur. Therefore, any impact on habitat for the species is likely to be negligible.</p> <p>ii. Habitat fragmentation</p> <p>The proposal constitutes the widening and realignment of Mona Vale Road, and therefore is unlikely to result in the further fragmentation or isolation of potential habitat for Camfield's stringybark.</p> <p>iii. Importance of habitat to be impacted</p> <p>A viable local population of Camfield's stringybark is unlikely to exist within the direct impact area and potential habitat for the species is considered to be of limited value to the local existence of the species. For these reasons, it is considered that the habitat affected by the proposal is of relatively low importance to the long-term survival of Camfield's stringybark in the locality.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>

Eucalyptus camfieldii

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>No Recovery Plan or Threat Abatement Plan is known for Camfield’s stringybark. Therefore, the proposed road upgrade is likely to be inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p> <p>An Approved Conservation Advice under the EPBC Act for the species is available (DoE 2008) and includes the following regional and local priority actions:</p> <ul style="list-style-type: none"> · Monitor known populations to identify key threats and the progress of recovery of the species · Identify populations of high conservation priority · Implement a management plan to control Bitou bush and boneseed and undertake weed control in priority areas · Ensure mechanisms to eradicate weeds do not adversely impact Camfield’s stringybark · Ensure infrastructure and development activities such as road widening and maintenance work that results in vegetation disturbance does not impact on known populations · Develop and implement a suitable fire management strategy · Undertake seed collection and storage of the species as well as implement national translocation protocols · Raise awareness of Camfield’s stringybark within the local community <p>The proposed action is therefore unlikely to affect the recovery of the Camfield’s stringybark.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The NSW listed KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation).</p>

19.2 Conclusion

The proposed road upgrade is unlikely to have an adverse effect on the life cycle of Camfield's stringybark such that a viable local population of the species is likely to be placed at risk of extinction. The potential habitat for Camfield's stringybark affected by the proposal is considered unlikely to be important to the long-term survival of the species within the locality. The proposed road upgrade is considered unlikely to have a significant impact on Camfield's stringybark, and a Species Impact Statement is not recommended.

20 Bauer's midge orchid (*Genoplesium baueri*)

20.1 Background

Bauer's midge orchid (*Genoplesium baueri*, Orchidaceae) is listed as an endangered species under the NSW TSC Act and as an endangered species under the Commonwealth EPBC Act.

Bauer's midge orchid grows in sparse sclerophyll forest and in microhabitats that have moss gardens over sandstone. It has been recorded within coastal areas between Port Stephens on the mid north coast to Ulladulla in the south coast (OEH 2014d; Robinson 2003). It prefers sandy dry eucalypt habitat and mainly occurs in isolated populations which flower after fires (Fairley 2004).

The flowering period ranges from December to May (OEH 2012; OEH 2014d; Robinson 2003), however peak flowering occurs from December to March (Benson and McDougall 2005). Seeds are shed 6-12 weeks after pollination by insects (Drosophilids or Chironomids) (Benson and McDougall 2005).

OEH (2014c) list the following threatening processes for this species:

- The loss of habitat through clearing for urban, rural residential and infrastructure development
- Physical damage to the habitat where Bauer's midge orchid occurs caused by recreational users (mountain bike riders and walkers) at one site within Ku-ring-Gai Chase National Park
- Changed habitat conditions due to changes in hydrology. Water leakages at one site within Ku-ring-Gai Chase National Park resulted in habitat becoming too wet for the species to survive
- The potential of damage to and degradation of habitat through maintenance activities of utilities such as power line easements
- The damage to individual plants (removal of flowering and fruiting stems) due to browsing of native and exotic animal species at the site in Ku-ring-Gai Wildflower Garden. This damage will unfavourably impact the future recruitment potential of the species but not necessarily kill it.

Bauer's midge orchid was not recorded during the recent field surveys. In the period since 1980, only one record has been found within a five kilometre radius of the survey site, with another 32 records between five and 10 kilometres of the survey area (within the study area), all of which were recorded in 2010 (OEH 2014a). Potential habitat occurs in the study area, however shaded, damp sandstone overhangs (required microclimate) are unlikely to occur in the direct impact area. The proposed road upgrade is considered unlikely to have a significant impact on Bauer's midge orchid.

Genoplesium baueri

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population There is one individual record of Bauer’s midge orchid within a 5 km radius of the survey area, just south of Newport (OEH 2014a). There are an additional 32 records from between five and 10 km of the survey area (within the study area), all of which occurred in 2010 (OEH 2014). The bulk of the Sydney population occurs in a strip from Gladesville to Lane Cove, Wahroonga and Hornsby. Given this historic distribution and the fact that the species has not been previously recorded within the direct impact area, it is considered unlikely that a local population of the species exists within the survey area.</p> <p>Life cycle factors Bauer’s midge orchid peak flowering period occurs from December to March (Benson and McDougall 2005; PlantNet 2014). Fire seems to be important in the life cycle of the plant as it is most frequently seen soon after fire (OEH 2012).</p> <p>Assessment A local population of Bauer’s midge orchid is unlikely to exist within the survey area, therefore, the proposed road upgrade is unlikely to remove any individuals of a viable local population. The proposed road upgrade is unlikely to have an adverse effect on the life cycle of Bauer’s midge orchid such that that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Genoplesium baueri

d) In relation to the habitat of a threatened species, population or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

i. Extent of impact on habitat

Bauer’s midge orchid was previously recorded along the coast just south of Newport (BioNet 2014) potentially within coastal headland clay heath or beach spinifex grassland vegetation communities (accuracy is 20 m however location has been withheld on restricted data). These habitats do not occur within the survey area. Potential habitat is considered to exist within the study area in the form of sandstone heath and sandstone rocky heath. Approximately 0.64 ha of sandstone heath and rocky heath native vegetation will be impacted by the proposed road upgrade. Substantial areas of moss on sandstone were not detected during the surveys by Niche and Ecosure. Potential habitat affected by the proposed road upgrade is considered to be negligible compared to the extent of potential habitat within the broader locality (2341 ha - most of which is well-reserved in local natural areas and national parks).

ii. Habitat fragmentation

The proposal constitutes the widening and realignment of Mona Vale Road, and will not result in the fragmentation or isolation of habitat for Bauer’s midge orchid.

iii. Importance of habitat to be impacted

Habitat for Bauer’s midge orchid is unlikely to exist within the survey area and the effect of the proposed road upgrade on potential habitat for the species is likely to be negligible. The habitat for Bauer’s midge orchid affected by the proposed road upgrade is considered unlikely to be important to the long-term survival of the species in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

To date, critical habitat has not been declared for this species under the TSC Act.

<i>Genoplesium baueri</i>	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	<p>No Recovery Plan or Threat Abatement Plan is known for the Bauer's midge orchid. Therefore, the proposed road upgrade is not inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p> <p>A targeted strategy for managing the orchid is available (OEH 2014d). It shows that the species will be managed at four sites including Ku-ring-gai Chase National Park, Ku-ring-gai Wildflower Garden, Bomaderry Creek and Callala. The management actions detailed in this plan include:</p> <ul style="list-style-type: none"> · Minimise the impacts of slashing on the species/habitat · Minimise the impacts of recreational activities · Minimise impacts of development · Prevent access of recreational users to site · Restrict access to native browsers · Maintain suitable drainage/hydrological regime · Track species abundance/condition over time <p>The proposed action is therefore unlikely to affect the recovery of Bauer's midge orchid.</p>
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	<p>The NSW listed KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation).</p>

20.2 Conclusion

The species has not been previously recorded within the survey area. Additionally, any potential habitat affected by the proposal is unlikely to be important to the survival of the species within the locality. The proposed road upgrade is considered unlikely to have a significant impact on Bauer's midge orchid, and therefore a Species Impact Statement is therefore not recommended.

21 Caley's grevillea (*Grevillea caleyi*)

21.1 Background

Caley's grevillea (*Grevillea caleyi*, Proteaceae) is listed as a critically endangered species under the NSW TSC Act and as an endangered species under the Commonwealth EPBC Act.

Caley's grevillea is a medium to tall shrub confined to a few lateritic ridges in association with the Duffys Forest EEC dominated by *Eucalyptus sieberi*, *Corymbia gummifera* and local stringybarks (OEH 2014d; Fairley 2004). It is found only in an 8 square kilometre area around Frenchs Forest, Belrose, Terrey Hills and Duffys Forest, approximately 20 kilometres north of Sydney within the Ku-ring-gai, Pittwater and Warringah LGAs (OEH 2014a).

The flowering period is sporadic throughout the year (particularly around July-November) however a definite flowering period occurs in spring (Robinson 2003). Seeds are dispersed by gravity at maturity. It has a high seed viability of 69-95 per cent with a dormancy of 93 per cent (Benson and McDougall 2000). The seed germinates after heat or mechanical damage and responds best to high intensity fires (Benson and McDougall 2000).

OEH (2014c) list the following threatening processes for this species:

- The loss of habitat and fragmentation of existing habitat through clearing for urban and industrial development
- The degradation of habitat through the invasion weeds and plant pathogens
- The degradation of habitat through inappropriate fire regimes and illegal dumping
- The loss of genetic integrity
- The collection of seed and cuttings by the public
- The small population sizes due to highly fragmented sites
- The degradation of critical habitat and substrate and the loss of individuals due to recreational use of remnant bushland by the public.

Caley's grevillea was not recorded during the field survey. The desktop survey revealed 142 records from the study area since 1980, with some records consisting of up to 2000 individual plants (OEH 2014a). Potential habitat for this species does not occur within the survey area.

Grevillea caleyi

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are 142 previous records of Caley’s grevillea within a 10 km radius of the centre of the survey area (OEH 2014a). Most of these local records occur within Duffys Forest EEC and in bloodwood-scribbly gum woodland vegetation (OEH 2014a; main report). There are no records within the survey area, and the closest record is approximately 1 km to the west of the survey area (OEH 2014a). Field surveys conducted by Niche and Ecosure in spring 2013 and spring 2014 (main report) did not record Caley’s grevillea within the survey area.</p> <p>Based on the large number of records in the study area, a local population could be present within the survey area. However targeted surveys to prescribed guidelines did not detect this species, which is conspicuous and would have been flowering during the survey period. It is considered that a viable local population is unlikely to be affected within the direct impact area.</p> <p>Life cycle factors</p> <p>Caley’s grevillea is reproductively mature at 2-5 years of age (DEC 2004). The peak flowering period occurs in late winter and spring and fruit maturation occurs in November and December (OEH 2014d). The plant has a low fecundity with only 3% of flowers resulting in a single, wingless seed. Caley’s grevillea is killed by fire and relies on regeneration of the seed that is stored in the soil (DEC 2004). The species readily germinates after fire, as seen from the response in 1994 within the locality and also more recently in the burnt areas at the intersection of Mona Vale and Booralie Road, Terrey Hills (N. Smith pers. comm. Aug 2014). Very little of the habitat for the species within the direct impact area has been burnt since 1994, but soil seed bank may still be present.</p> <p>Assessment</p> <p>A local population of Caley’s grevillea is unlikely to exist within the direct impact area and, therefore, the proposed road upgrade would not remove any adult individuals of the local population. It is also unlikely that a soil seed bank of this species exist within the survey area, as the preferred habitat, Duffys Forest EEC, is not present. Therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of Caley’s grevillea such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

<i>Grevillea caleyi</i>	
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The individuals found within the study area occur on sandstone ridges of ironstone laterite in association with Duffys Forest EEC (Ecosure 2014). However, this habitat does not occur within the direct impact area and thus will not be removed or modified as a result of the proposed road upgrade.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade constitutes the widening and realignment of Mona Vale Road. Furthermore, habitat for the species is unlikely to exist within the survey area. Therefore, impacts of the proposed road upgrade on the survey area are unlikely to result in the fragmentation or isolation of potential habitat for Caley's grevillea.</p> <p>iii. Importance of habitat to be impacted</p> <p>Known habitat for Caley's grevillea is unlikely to exist within the direct impact area and is therefore unlikely to be affected by the proposed road upgrade. Therefore, it is considered that the habitat affected by the proposed road upgrade is of relatively low importance to the long-term survival of the Caley's grevillea in the locality.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>

<i>Grevillea caleyi</i>	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	<p>The overall recovery objective as per the species recovery plan (DEC 2004) is to “...minimise human imposed disturbance to <i>Grevillea caleyi</i> populations and to maintain viable wild populations into the foreseeable future. The objective is to minimise the risk of local extinction, not necessarily to maximise the number of aboveground <i>G. caleyi</i> plants.” Other objectives of the recovery plan include:</p> <ol style="list-style-type: none"> 1. Community education and awareness – inform land managers and owners of the presence of <i>G. caleyi</i> 2. Fire management – implement an appropriate fire management strategy 3. Threat and habitat management – ensure the conservation of all sites through appropriate management 4. Reservation and/or protection of remnant sites – ensure and increase level of protection to locations of the species outside existing national parks 5. Ecological research – increase knowledge of the biology of the species for management purposes 6. Locate and protect new sites – identify and protect new locations of the species 7. Identify critical habitat – identify critical habitat for the species. <p>As habitat for Caley’s grevillea does not occur within the direct impact area, this species is unlikely to be affected by the proposed road upgrade and it is unlikely that the action proposed would be inconsistent with the recovery plan of the species.</p>
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	<p>The NSW listed KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of Lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation).</p>

21.2 Conclusion

The species has not been previously recorded within survey area. Similarly, known or potential habitat for this species is unlikely to occur within the survey area and therefore a substantial soil seed bank is also unlikely to be affected. The proposed road upgrade is unlikely to have an adverse effect on the life cycle of Caley's grevillea such that a viable local population of the species is likely to be placed at risk of extinction. Thus, the proposed road upgrade is considered unlikely to have a significant impact on Caley's grevillea and a Species Impact Statement is not recommended.

22 Angus's onion orchid (*Microtis angusii*)

This assessment of significance is based on a scenario where the proposed road upgrade is able to avoid the known occurrences of Angus's onion orchid (*Microtis angusii*, Orchidaceae) within the survey area.

22.1 Background

Angus's onion orchid (*Microtis angusii*) is listed as an endangered species under the TSC and EPBC Acts.

Angus's onion orchid is a terrestrial orchid with affinities to *M. parviflora* and *M. unifolia* but is more robust, with a number of small morphological differences in the inflorescence. It is about 25-60 centimetres tall, flowering between May and October (NSW Scientific Committee 1997).

Surveys by Niche and Ecosure detected Angus's onion orchid at two locations within the Mona Vale Road East survey area (Figure 4). The first occurrence of six individuals (i.e., stems) was located on the north side of Mona Vale Road, approximately 170 metres east of the Lane Cove Road intersection. Whilst this occurrence does not occur in the area of direct impact, it does occur within a five metre buffer of indirect impact. The second occurrence within the survey area was a single individual located at the end of the unmade portion of Ingleside Road, also north of Mona Vale Road (approximately 650 metres east of the Lane Cove Road intersection with Mona Vale Road). This second location does not occur within either the area of direct or indirect impact. These two occurrences are a significant and important extension of the previously known distribution of the species to the east by approximately 1.3 kilometres, the nearest other occurrence being at Addison Road.

Until recently, the Angus's onion orchid was only known in northern Sydney from a single population opposite the intersection of Mona Vale Road and Kimbriki Road, Terrey Hills (the 'Kimbriki site'). An additional five occurrences (sub-populations) were recorded by Ecosure and Niche as part of biodiversity investigations for the upgrade of Mona Vale Road West. Each of these occurrences, including the two detected within the survey area (seven stems), constitute the known extent and distribution for the species both locally and regionally. It has been estimated that the current population size constitutes 1,738 stems (main report). Note that, due to the difficulties associated with field identification, sampling and the clonal nature of the species, stem counts are only indicative of population size.

Habitat occupied by the species is highly disturbed road and track edges, usually associated with an adjacent sealed surface and diffuse drainage (ie no kerb and guttering). This severely degraded habitat exhibits no ecosystem resilience, ie, it does not resemble native bushland and has no capacity for regeneration to locally occurring native vegetation types. The species appears to have an association with exotic perennial grasses such as *Hyparrhenia hirta* (Coolatai grass). No plants were detected within the locally occurring

native vegetation types as mapped (Figure 4 in main report), although it is assumed that hanging swamps or moist heath are potential habitat.

RMS is currently supporting research by the RBG on the breeding biology, genetics, propagation and translocation in order to provide information on the best mitigation strategies for this species (RBG 2014).

The potential impacts of the proposal on Angus's onion orchid are assessed in the following Seven Part Test.

Microtis angusii

Assessment of Significance Criterion (Seven Part Test)

- a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

Prior to surveys conducted by Ecosure and Niche within the broader locality (Reference), Angus's onion orchid was only known from a single population opposite the intersection of Mona Vale Road and Kimbriki Road, Terrey Hills in northern Sydney (referred to as the 'Kimbriki site'). Population estimates vary from year to year but 1,240 stems were counted by the RBG in 2014/15. The exact number of individuals cannot be determined due to its clonal nature, but it is assumed here that the number of stems is representative of the number of individuals.

Surveys for the species, conducted by Niche and Ecosure in October 2013 and September 2014 (main report and Ecosure 2014b), demonstrated that the species actually occurs in a number of other locations along Mona Vale Road from the intersection with McCarrs Creek Road at Terrey Hills to Ingleside (where the unmade portion of Ingleside Road meets Mona Vale Road). Although the exact population size is unknown due to the clonal nature of the species and the variability in counts from season to season, an estimated 491 stems exist within the broader locality (79 *M. angusii* confirmed along Wirreanda Road in September 2014).

Within the current survey area, two additional occurrences (one of six and the other of a single stem), were confirmed in an area of exotic vegetation where the unmade portion of Ingleside Road meets Mona Vale Road on its northern side and along the road verge on the far western part of the direct impact area. Combining historical records (OEH 2014), surveys by Niche and Ecosure and historical counts by RBG at the Kimbriki site, it is clear that a viable population of Angus's onion orchid exists within the locality, and is currently estimated at 1,738 stems (1,240 + 491 + 7).

Life cycle factors

Angus's onion orchid exists largely as subterranean tubers for most of the year, producing leaves and then flowering stems in late winter and spring, with the above ground parts withering over summer (OEH 2014d). *Microtis* spp. are known to reproduce vegetatively by the formation of "daughter" tubers from the main tuber (OEH 2014d), whilst germination is reliant on soil fungal relationships (RBG 2014). The species is likely to be predominantly self-pollinated; however wasp, ant and fly pollination is evident in other *Microtis* taxa (RBG 2014). Apomixis, the ability for plants to reproduce asexually from sexual parts without fertilisation, is evident in other *Microtis* species (RBG 2014). Flowering is likely to be related to rainfall during flower development, but also in the 12 months prior to the flowering season and higher soil moisture increases the rate at which later stages of germination are reached (RBG 2014). Insects of the order Hemiptera, or true bugs, were observed on the flowers and may be damaging plants (RBG 2014).

Assessment

No individuals of *Microtis angusii* will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures will reduce indirect impacts such as changes to drainage, dust, inadvertent trampling, construction exclusion zones and sediment control. Therefore, the proposed road upgrade is unlikely to lead to a long-term decrease in the size of the population. Further, none of the life cycle factors described above will be affected by the proposal.

Therefore, the action proposed is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species will be placed at risk of extinction. .

Microtis angusii

Assessment of Significance Criterion (Seven Part Test)

<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>Potential habitat for Angus’s onion orchid within the survey area includes exotic and disturbed environments that are affected by diffuse drainage, clearing and weed infestation (approximately 3.28 ha within the survey area). Further, two extensive and in-season field surveys have targeted the species and only found the two occurrences of the species as assessed in this report. Therefore, it is considered unlikely that further occurrences exist within the survey area.</p> <p>Due to the degraded nature of the potential habitat for the species, the proposed road upgrade is unlikely to result in a net decrease the extent of this habitat and no individuals will be removed within the two known areas of habitat.</p> <p>ii. Habitat fragmentation</p> <p>No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures will reduce indirect impacts such as changes to drainage, dust, inadvertent trampling, construction exclusion zones and sediment control. The proposal constitutes the widening and realignment of Mona Vale Road, and does not isolate or fragment known or potential habitat for the species.</p>

Microtis angusii

Assessment of Significance Criterion (Seven Part Test)

	<p>iii. Importance of habitat to be impacted</p> <p>Significant occurrences of <i>Microtis angusii</i> will be conserved as a result of the two Mona Vale Road upgrades and no known occurrences of will be impacted by the current proposal. Further, extensive field survey has demonstrated that potential habitat is unlikely to support further individuals or be fragmented or isolated. Therefore the habitat to be removed, modified, fragmented or isolated is considered of relatively low importance to the long-term survival of the species in the locality.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>A National Recovery Plan for Angus’s onion orchid exists (DECCW 2010) and the overall objective The overall objective of this recovery plan is to prevent the extinction of Angus’s onion orchid through maintaining self-sustaining populations in the wild in the long term.</p> <p>The recovery objectives and actions detailed in DECCW (2010) include to:</p> <ol style="list-style-type: none"> 1. Co-ordinate recovery of the species 2. Protect the known population by minimising the loss and fragmentation of habitat using conservation planning mechanisms 3. Conduct research into the genetics, ecology and biology of the species in order to provide information to assist future management decisions 4. Develop and implement a survey program that will provide information on the extent and viability of <i>Microtis angusii</i> populations and habitat 5. Identify and minimise threats to <i>Microtis angusii</i> 6. Raise awareness of the species with public authorities, and provide public authorities with information to assist conservation 7. Implement a monitoring program for <i>Microtis angusii</i> and 8. Consider of the need for ex situ conservation. <p>No individuals of <i>Microtis angusii</i> will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures to will reduce indirect impacts such as changes to drainage, dust, inadvertent sampling trampling, construction exclusion zones and sediment control. Further, RMS are currently providing funding to the RBG to carry out objectives (3), (4), (7) and (8). Therefore, the proposed road upgrade is unlikely to interfere with any of the objectives of the Recovery Plan.</p>

Microtis angusii

Assessment of Significance Criterion (Seven Part Test)

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

The KTPs that are likely to be exacerbated by the proposed road upgrade include (OEH 2014c):

1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
2. Bushrock removal
3. Clearing of native vegetation
4. Infection of native plants by *Phytophthora cinnamomi*
5. Invasion and establishment of exotic vines and scramblers
6. Invasion, establishment and spread of Lantana
7. Invasion of native plant communities by exotic perennial grasses
8. Loss of hollow-bearing trees, and
9. Removal of dead wood and dead trees.

Other than (3) and (8) above it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation). The creation of new edges and disturbances has the capacity to create recipient sites for the translocation of Angus's onion orchid where it is impacted.

22.2 Conclusion

No individuals of *Microtis angusii* will be removed as a result of the proposal (based on the concept design) and on-site management safeguards and measures to will reduce indirect impacts such as changes to drainage, dust, inadvertent sampling trampling, construction exclusion zones and sediment control. Measures to minimise indirect impacts will be implemented as part of the CEMP for the proposed road upgrade.

As demonstrated above:

- The proposal is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species will be placed at risk of extinction
- The proposal is unlikely to result in a net decrease the extent of this habitat and no individuals will be removed within the two known areas of habitat
- The proposal is unlikely to isolate or fragment known or potential habitat for the species
- No known habitat will be removed and the potential habitat affected is considered of relatively low importance to the long-term survival of the species in the locality
- The proposal is unlikely to interfere with any of the objectives of the Recovery Plan
- The proposal is unlikely to substantially affect any KTPs, as listed on the TSC Act, as they relate to the survival of *Microtis angusii*.

Therefore, the proposal is considered unlikely to have a significant impact on the endangered plant, *Microtis angusii*.

23 Hairy geebung (*Persoonia hirsuta*)

23.1 Background

The hairy geebung (*Persoonia hirsuta*, Proteaceae) is listed as endangered under the TSC Act and also as endangered under the Commonwealth EPBC Act.

The hairy geebung is restricted to the Greater Sydney district and can be found on ridge tops in sandy soils in dry sclerophyll open forest, woodland and heath with a shrubby understorey on sandstone (OEH 2013; Robinson 2003). It is usually present as isolated individuals or very small populations in disturbed areas such as track edges (OEH 2013; DoE 2014; Fairley 2004).

The flowering period generally occurs over summer months with peak flowering from November to January (DoE 2014; Robinson 2003). The diaspore fruit is dispersed by large birds and possibly large mammals, and is stored in a seedbank (Benson and McDougall 2000).

The hairy geebung was not recorded during the field surveys carried out by Niche/Ecosure. The desktop survey revealed one record from within a five kilometre radius, and 30 records from the broader study area since 1980 (OEH 2014). A limited amount of potential habitat occurs in the study area.

Persoonia hirsuta

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population A single individual of hairy geebung has been previously recorded within a 5 km radius of the centre of the survey area (OEH 2014a), well north of the direct impact area in the vicinity of Elvina Bay. There are 30 records since 1980 from the broader study area. No individuals have been recorded within the direct impact area and none were detected during the field surveys conducted by Niche and Ecosure in 2013-2015. This species is not known to occur in the survey area, and a viable local population is unlikely to occur within the direct impact area.</p> <p>Life cycle factors The peak flowering period for hairy geebung is November to January (DoE 2014; Robinson 2003) and the fruit is likely dispersed by large birds and possibly fruit-eating mammals (Benson and McDougall 2000). The species does not reproduce vegetatively and is probably killed by fire (Benson and McDougall 2000). In general the <i>Persoonia</i> genus relies on insects for pollen transfer and heat or mechanical disturbance for germination (DoE 2014), however the seed of hairy geebung persists in a soil stored seed bank (Benson and McDougall 2000).</p> <p>Assessment Preliminary survey and assessment suggest that this species is unlikely to occur within the survey area. This assessment will be confirmed in spring/summer. While there is some possibility that there is seed stored within the soil, it is considered that any soil stored seed bank would be marginal in terms of maintaining the existence of the species within the study area. Therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the hairy geebung such that a viable local population of the species is placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

<i>Persoonia hirsuta</i>	
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The hairy geebung was previously found within Sydney coastal dry sclerophyll forests on sandstone, which includes a number of vegetation communities that occur within the study area (OEH 2014d). The area of potential habitat affected (directly or indirectly = 9.87 ha) is considered negligible compared to that available for the species within the study area (14,392 ha). For these reasons, it is considered that the habitat affected by the proposed road upgrade is of relatively low importance to the long-term survival of hairy geebung in the study area</p> <p>ii. Habitat fragmentation</p> <p>The proposal constitutes the widening and realignment of Mona Vale Road, however will not result in the fragmentation of potential habitat for the hairy geebung.</p> <p>iii. Importance of habitat to be impacted</p> <p>A viable local population of hairy geebung is unlikely to extend to within the direct impact area and any potential soil stored seed bank is likely to be marginal for maintaining the existence of such a population. The area of potential habitat affected is considered negligible compared to that available for the species within the study area. For these reasons, it is considered that the habitat affected by the proposal is of relatively low importance to the long-term survival of hairy geebung in the study area.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>

<i>Persoonia hirsuta</i>	
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	<p>No Recovery Plan or Threat Abatement Plan is known for the hairy geebung.</p> <p>Hairy geebung has been included in a species conservation project by OEH (2014d) which has nominated management actions such as minimising the impacts of recreational activities, maintaining appropriate fire regimes and tracking species abundance and condition over time within the population within the Pittwater local government area.</p> <p>It is unlikely that the proposed road upgrade would affect the hairy geebung and will therefore not affect the recovery of the species. The action proposed is thus consistent with management actions of this species.</p>
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	<p>The KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of Lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg drainage design, weed management and habitat translocation). The clearing of native vegetation is unavoidable but will be offset through implementation of a Biodiversity Offset Strategy consistent with NSW offsetting guidelines and principles.</p>

23.2 Conclusion

Hairy geebung has not been previously recorded within the survey area. A viable local population of hairy geebung is unlikely to exist for within the study area or in close proximity to the direct impact area.

Similarly, the preferred habitat for this species is unlikely to occur within the direct impact area and therefore a substantial soil seed bank is also unlikely to be affected. The proposal is unlikely to disrupt the breeding cycle of any hairy geebung population. Thus, a Species Impact Statement is not recommended

24 Curved rice-flower (*Pimelea curviflora* var. *curviflora*)

24.1 Background

Curved rice-flower (*Pimelea curviflora* var. *curviflora*, Thymelaeaceae) is listed as a vulnerable species under the NSW TSC Act and as a vulnerable species under the Commonwealth EPBC Act.

Curved rice-flower is restricted to the coastal area of Sydney and is known from about 20 locations from northern Sydney to Maroota (OEH 2012; DoE 2014). The species occurs in woodlands on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes. It often grows amongst dense grasses and sedges and responds well to disturbance such as fire or grazing (OEH 2012). It has also been observed in heath and woodland on sandstone (Robinson 2003).

Pimelea curviflora var. *curviflora* differs from *Pimelea curviflora* by having sparsely hairy narrow-elliptic to elliptic or oblanceolate leaves 5-10 millimetres long and 2-4 millimetres wide; *Pimelea curviflora* has oblong to elliptic or oblanceolate leaves that are longer (5-20 millimetres) and wider (2-8 millimetres) (Royal Botanic Gardens and Domain Trust 2014). The peak flowering period occurs between October and January but this species has also been observed in flower as late as May (OEH 2012; DoE 2014).

OEH (2012) list the following threatening processes for this species:

- The loss of habitat through clearing for urban development
- The degradation of habitat due to recreational and maintenance activities as well as bush rock removal surrounding the species
- High frequency or high intensity fires may restrain growth or reproduction of individuals
- The introduction and competition of weed species including African lovegrass (*Eragrostis curvula*) and lantana (*Lantana camara*).

Curved rice-flower has not been recorded during recent field assessment within the survey area. The desktop survey revealed ten records within a five kilometre radius, and 36 records within a 10 kilometre radius since 1980 (OEH 2014a). Potential habitat occurs in the study area.

Pimelea curviflora var. curviflora

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>Ten records of curved rice-flower exist within a 5 km radius of the centre of the survey area, with 36 records between 5-10 km of the survey area (within the study area) (OEH 2014a). Within those records, many hundreds of individuals are present, particularly on the fringes of the Duffys Forest and Terrey Hills localities (N. Smith, pers. comm. 20 Aug. 2014). The closest record was taken in 2007 and occurred approximately 100 m north of the direct impact area. The species has not been detected during detailed field surveys.</p> <p>Life cycle factors</p> <p>Curved rice-flower flowering occurs between October and January but has also been observed as late as May (OEH 2012; DoE 2014). The species is likely to be tolerant to fire due to the presence of a tap root and has also been observed sprouting after fire (OEH 2012).</p> <p>Assessment</p> <p>A single record for the species (OEH 2014a) exists within close proximity of the direct impact area, approximately 100 m to the north in vegetation mapped as Hornsby sandstone heath-woodland - heath form vegetation community. OEH (2014a) records this species as being accurate to 50 m, and therefore it may occur within 50 m of the direct impact area. Despite this, ideal habitat for the species does not exist within the survey area, and the species was not detected by Niche and Ecosure in 2013/14 surveys (main report). Therefore, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of the species, such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Pimelea curviflora var. *curviflora*

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat</p> <p>Curved rice-flower has previously been found within multiple vegetation communities including Duffys Forest endangered ecological community (EEC), sandstone heath and Hornsby sandstone heath-woodland – heath form. From these communities, only Hornsby sandstone heath-woodland – heath form occurs within the direct impact area. Therefore, approximately 0.51 ha of potential habitat for curved rice-flower within the survey area is likely to be removed or modified as a result of the proposed road upgrade. This amount of habitat is considered negligible compared to the extent of Hornsby sandstone heath woodland within the broader locality (2244 ha - much of which is well-reserved in national parks and other reserves).</p> <p>ii. Habitat fragmentation</p> <p>The proposal constitutes the widening and realignment of Mona Vale Road, and will not result in the fragmentation of potential habitat for curved rice-flower.</p> <p>iii. Importance of habitat to be impacted</p> <p>Curved rice-flower has not been detected within the survey area. The proposed road upgrade will remove a negligible amount of habitat which is already disturbed, and will not result in fragmentation of that habitat. The habitat to be removed is considered of little importance to the long-term survival of the species in the locality.</p>
<p>h) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>

Pimelea curviflora var. *curviflora*

Assessment of Significance criterion (Seven Part Test)

<p>e) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>No Recovery Plan or Threat Abatement Plan is known for the curved rice-flower for NSW under the TSC Act. Therefore, the proposed road upgrade is not inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p> <p>However, an Approved Conservation Advice is available for this species under the EPBC Act (DoE 2008). The regional and local priority actions nominated in DoE (2008) include:</p> <ul style="list-style-type: none"> · Identify populations of high conservation priority · Monitor known populations to identify key threats and the progress of recovery of the species · Identify and remove weeds in the area and manage sites to prevent introduction of invasive weeds · Manage threats to areas of vegetation that contain the species and ensure chemicals used in weed management do not significantly impact the curved rice-flower · Ensure an infrastructure and development activity such as road widening and maintenance work that results in vegetation disturbance does not impact on known populations · Control introduced pests (rabbits, pigs and goats) to manage threats at known locations · Undertake seed collection and storage of the species as well as implement national translocation protocols · Raise awareness of the curved rice-flower within the local community.
<p>f) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The NSW listed KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above it is anticipated that each of these KTPs will be mitigated through on-site management (eg drainage design, weed management and habitat translocation).</p>

24.2 Conclusion

The proposed road upgrade is unlikely to have an adverse effect on the breeding cycle of curved rice-flower such that it may lead to a long term decrease in the local population of the species. The potential habitat for curved rice-flower affected by the proposed road upgrade is considered unlikely to be important to the long-term survival of the species within the locality. The proposed road upgrade is considered unlikely to have a significant impact on curved rice-flower and a Species Impact Statement is not recommended.

25 Glandular pink-bell (*Tetratheca glandulosa*)

25.1 Background

Glandular pink-bell (*Tetratheca glandulosa*, Tremandraceae) is listed as a vulnerable species under the NSW TSC Act and is not listed under the Commonwealth EPBC Act.

Glandular pink-bell is endemic to NSW and often associated with a shale-sandstone transition habitat (OEH 2013; DoE 2014). This species is found in association with heaths, scrub to woodlands/open woodlands, and open forest (OEH 2013; Robinson 2003; Fairley 2004). Glandular pink-bell is found in multiple LGAs surrounding Mona Vale Road including Duffys Forest in Warringah and Ingleside in Pittwater, as well as Hornsby and Ku-ring-gai LGAs (DoE 2014).

Peak flowering period is between July and November with some flowers persistent until late December; seeds are released soon after flowering ends (OEH 2013; RBG 2014). Native bees are likely to be required for pollination (Benson and McDougall 2001).

OEH (2013) list the following threatening processes for this species:

- The degradation and loss of habitat through clearing for development
- The fragmentation of habitat at small and isolated populations
- High frequency fire control activities including mechanical fuel reduction as well as construction and maintenance activities of fire access tracks
- The introduction and competition of weed species including African lovegrass (*Eragrostis curvula*), kikuyu (*Pennisetum clandestinum*) and possibly Coolatai grass (*Hyparrhenia hirta*)
- The unknown extent of the population of glandular pink-bell.

Glandular pink-bell was not recorded during the field survey. The desktop survey revealed 41 records from within a five kilometre radius of the survey area, and approximately 170 records within the study area since 1980 (OEH 2014a). Approximately 6.59 hectares of potential habitat (heath and woodland) occurs in the study area.

Tetratheca glandulosa

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are 41 records of glandular pink-bell within a 5 km radius of the centre of the survey area, and 171 from a 10 km radius (OEH 2014a). Some records contain as many as 170 individual plants (OEH 2014a); however numbers of individuals could vary greatly between years. The closest record occurred approximately 350 m to the south of the direct impact area within Hornsby Sandstone Heath Woodland – Heath form vegetation community, although this habitat differs from the shale-sandstone transition habitat this species is often associated with. No records occurred within the direct impact area and the species was not detected during field surveys conducted by Niche and Ecosure in spring 2013 and spring 2014 (main report). The species is known to occur at the Kimbriki Resource Recovery Centre that is located south-west of the direct impact area within the study area (GHD 2011). It is therefore considered that a viable local population of the species is likely to exist within the study area, however is unlikely to be affected within the survey area.</p> <p>Life cycle factors</p> <p>The life span and breeding system of the glandular pink-bell are poorly known (DoE 2014). Recent surveys and research have shown that the life expectancy of the glandular pink-bell is approximately six to ten years and that the minimum time to produce seed is about three to four years (DoE 2014). Glandular pink-bell is likely to be clonal and is also known to resprout from a woody root after fire. The role of fire in seed germination and persistence of the soil in the seedbank are unclear (OEH 2013; DoE 2014). Peak flowering is between July and November and native bees are likely to be required for pollination (Benson and McDougall 2001; DoE 2008).</p> <p>No specific studies of glandular pink-bell fecundity have occurred and the seed bank dynamics are poorly known (OEH 2013). Bellairs et al. (2006) suggests that <i>Tetratheca</i> spp. generally display short-term seed viability in the soil seed bank and rely on annual seed set for seedling recruitment.</p> <p>Assessment</p> <p>The proposed road upgrade is unlikely to remove any individuals of the viable local population of glandular pink-bell. Due to the short-term seed viability in the soil seed bank of the genus and the lack of previous records, it is unlikely that a viable soil seed bank of this species occurs within the survey area. As such, the proposed road upgrade is unlikely to have an adverse effect on the life cycle of glandular pink-bell such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Tetratheca glandulosa

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>No records of glandular pink-bell exist within the survey area (OEH 2014a). Within the study area, glandular pink-bell was previously recorded within Duffys Forest EEC, Hornsby sandstone heath - heath and woodland vegetation communities. Approximately 6.59 ha of potential habitat for the glandular pink-bell within the concept design will be removed or modified as a result of the proposed road upgrade. This amount of habitat is considered negligible compared to the extent of sandstone dry sclerophyll forest and heath within the broader locality (12,678 ha - much of which is well-reserved in national parks and other reserves).</p> <p>ii. Habitat fragmentation</p> <p>The proposal constitutes the widening and realignment of Mona Vale Road. Furthermore, habitat for the species is unlikely to exist within the direct impact area. Therefore, the direct impact area is unlikely to result in the fragmentation or isolation of potential habitat for glandular pink-bell.</p> <p>iii. Importance of habitat to be impacted</p> <p>Glandular pink-bell was not detected during the field surveys conducted by Niche and Ecosure (main report). The proposed road upgrade will not remove any individuals of the species and only remove or modify a small amount of habitat (6.59 ha) for glandular pink-bell and will not result in fragmentation of that habitat. Therefore, the habitat for glandular pink-bell affected by the proposal is considered unlikely to be important to the long-term survival of the species.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>To date, critical habitat has not been declared for this species under the TSC Act.</p>

Tetratheca glandulosa

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no Recovery Plan or Threat Abatement Plan for the glandular pink-bell for NSW under the TSC Act. Therefore, the proposed road upgrade is not inconsistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p> <p>However, an Approved Conservation Advice is available for this species under the EPBC Act (DoE 2008). The regional and local priority actions nominated in DoE (2008) include:</p> <ul style="list-style-type: none"> · Identify populations of high conservation priority · Monitor known populations to identify key threats and the progress of recovery of the species · Identify and remove weeds in the area and manage sites to prevent introduction of invasive weeds · Ensure chemicals and other weed control mechanisms do not significantly impact the glandular pink-bell · Ensure infrastructure and development activities such as road widening and maintenance work that results in vegetation disturbance does not impact on known populations · Manage any changes in hydrology that may affect water table levels and other flow on effects · Investigate formal conservation arrangements such as covenants, conservation agreements or inclusion in reserve tenure · Develop minimum fire frequency guidelines and implement a suitable fire management strategy · Undertake seed collection and storage of the species as well as implement national translocation protocols · Raise awareness of the glandular pink-bell within the local community.
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The NSW listed KTPs (OEH 2014c) that are likely to be exacerbated by the proposed road upgrade include:</p> <ol style="list-style-type: none"> 1. Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands 2. Bushrock removal 3. Clearing of native vegetation 4. Infection of native plants by <i>Phytophthora cinnamomi</i> 5. Invasion and establishment of exotic vines and scramblers 6. Invasion, establishment and spread of lantana 7. Invasion of native plant communities by exotic perennial grasses 8. Loss of hollow-bearing trees 9. Removal of dead wood and dead trees. <p>Other than (3) and (8) above, it is anticipated that each of these KTPs will be mitigated through on-site management (eg, drainage design, weed management and habitat translocation). The clearing of native vegetation is unavoidable but will be offset through implementation of a Biodiversity Offset Strategy, consistent with NSW offsetting guidelines and principles.</p>

25.2 Conclusion

A viable local population of glandular pink-bell is unlikely to be affected by the direct impact area. Only 6.59 hectares of potential habitat will be removed or modified, and no known individuals of glandular pink-bell will be impacted as a result of the proposed road upgrade. As such, the proposed road upgrade is considered unlikely to have a significant impact on glandular pink-bell within the locality and a Species Impact Statement is not recommended.

26 Giant burrowing frog (*Heleioporus australiacus*)

26.1 Background

The giant burrowing frog (*Heleioporus australiacus*) is listed as vulnerable under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*. It is a large, burrowing frog that is found in south-eastern Australia in a range of habitats including heath, woodland, open dry sclerophyll forest and tall montane forest and on a variety of soil types, except for clay-based soils (OEH 2012). They are not known to inhabit cleared environments (Lemckert and Brassil 2004; Penman et al 2004).

Two distinct populations have been suggested to occur: a northern population confined to the sandstone geology of the Sydney Basin and extending south to Ulladulla, and a southern population found in a wider range of habitats from Narooma in southern NSW to Walhalla in Victoria (Penman et al 2004; OEH 2012). The genetics of these two populations are not clearly understood and they may represent different genetic units (most probably subspecies).

The species calls and breeds sporadically from spring to autumn; with a peak period in NSW of November to February (Lemckert and Mahony 2008). Individuals remain at the breeding site for no more than a few days before moving back into the adjacent forested lands (Penman et al 2008). Eggs are usually laid outside of water in a moist burrow in the banks of small creeks, dams or ephemeral pools in woodland (Anstis 2013). Breeding within the northern population generally occurs along smaller ephemeral to semi-permanent creek lines, although individuals have been occasionally reported calling at permanent ponds in forests. Tadpoles have a long pond life and can be observed at any time of the year and so permanent pools within the breeding streams appear to be essential for the survival of the species (Penman et al 2004).

The giant burrowing frog is difficult to observe outside of the breeding season as it is active above ground only after rain (Penman et al 2004). Individuals occupy activity areas that are usually 50-200 m from the breeding site with larger males having activity areas closer to the breeding site than smaller males, and males tending to have activity areas closer to the breeding site than females (Lemckert and Brassil 2004; Penman et al 2008). These activity areas are occupied for months at a time and frogs use several very specific burrowing points on a regular basis. Burrowing itself is undertaken in areas of loose soil and frogs usually remain just below the surface, depending on the availability of moisture. Burrows are not permanent holes (Lemckert and Brassil 2004). Individuals are opportunistic foragers and eat most invertebrates' small enough to consume (Rose 1974; Webb 1983). The movements and behaviour of sub-adult and juvenile frogs is not known. They are presumably willing and able to move more distantly from water bodies/drainage lines, but it is not clear if there are features of the landscape that are important for them.

Heleioporus australiacus

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are nine records of this species within 5 km of the centre of the footprint since 1980 (OEH 2014a) and 361 records within the study area. There were two individuals recorded in February 2014 approximately 1.4 km to the west. Targeted surveys for this species are scheduled for this summer (February to April 2015) in warm, wet conditions. In the absence of detailed records, it is assumed that a viable local population exists within the study area, although adult frogs are unlikely to use habitats close to the road for breeding. But they may forage or shelter in this area and juveniles are more likely to do so. Breeding habitat is likely to be concentrated around a large drainage line approximately 1.4 km to the south in Garigal National Park. Records have also been found around Mullet and Fern Creeks approximately 600 m to the south-east of the survey area.</p> <p>Life cycle factors</p> <p>This is a large, species that is long lived in areas with low predation rates and does not breed every year. This species spends up to 95 per cent of its time in non-breeding habitat (OEH 2012). Calling occurs only for one or two nights at a time and sporadically and relatively unpredictably over a long breeding season (February-April). Giant burrowing frogs are generalist foragers, targeting invertebrates such as cockroaches, scorpions and beetles (Rose 1974; Webb 1983; OEH 2012). Foraging may occur within the survey area, but breeding is likely to take place further down gullies in Garigal National Park where permanent pools would be located along a major drainage channel.</p> <p>Assessment</p> <p>The proposed road upgrade will remove approximately 6.59 ha of potential foraging habitat, with breeding habitat (located in gullies surrounding the survey area) potentially affected by changes in hydrological processes associated with the upgrade of the road. An increase in roadkill risk on nights of high activity is possible as this species has been recorded to be killed on roads before (Webb 1983; B. Smith pers. comm. 2014), however appropriately designed fauna fencing has been shown to be effective in preventing roadkill in other species of frogs. This species is a poor climber and jumper and it is expected that this type of fencing will form a complete barrier where it is erected, as long as the fence is modified to form a barrier to frogs and located strategically. An initial assessment of the habitat for this species carried out as part of the preliminary biodiversity surveys of the survey area suggests that this section of Mona Vale Road has low value for this species and is too far (more than 1 km) from appropriate breeding habitat to be important for this species. Detailed surveys scheduled for February - April 2015 will confirm this. It is considered at this stage that the proposed road upgrade will not place a viable population at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Heleioporus australiacus

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The survey area is likely to contain only very limited foraging habitat given that adults have been not been recorded moving more than 300 m from the breeding sites on a stream and suitable breeding habitat is located only further down in the gullies to the south. Surveys for tadpoles are scheduled for September 2014, but suitable breeding habitat appears to be absent from the survey area. It is likely that breeding occurs closer to Mullet or Fern Creeks, more than 500 m south of the direct impact area. The potential impact on giant burrowing frog habitat is considered to be minor.</p> <p>ii. Habitat fragmentation</p> <p>The current road may represent a minor barrier to occasional migration of this species from north to south during rare migratory events by juveniles. Migration may also occur during periods of environmental stress (eg drought or flood). The fauna underpass and drainage culverts will be designed to be able to be utilized by this species for these rare events. The proposed road upgrade will not significantly increase isolation or fragmentation of existing populations.</p> <p>iii. Importance of habitat to be impacted</p> <p>Individual giant burrowing frogs were identified just to the south west of the survey area, approximately 1.4 km away from the survey area. Approximately 6.59 ha of potential foraging habitat for this species will be removed. The area to be cleared does not contain breeding habitat, being further away from potential breeding habitat than has been recorded for foraging activities in this species. The value of the habitat to be removed will be further quantified after final field investigations to be concluded in December 2014. However, it is likely that the habitat is of minor importance for the species. In addition, the habitat to be removed is primarily along the road side and likely to be of lower quality compared with nearby areas such as Garigal National Park. Taken together, the habitat to be removed is not considered important for the long term survival of the local population.</p>

Heleioporus australiacus

Assessment of Significance criterion (Seven Part Test)

<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, but 20 priority (PAS 2) actions have been developed by OEH for this species (OEH 2012b) and a Species Action Statement has placed this species into the landscape species management stream under the <i>Saving our Species</i> program. Relevant priority actions to the study area include:-</p> <ul style="list-style-type: none"> · Develop a list of key populations of the giant burrowing frog to focus recovery actions; prepare and implement site specific management plans to protect key giant burrowing frog populations from identified threats · Source funding to implement these plans. Assess the threat of changed hydrological regimes on the habitat of this species · Include the impacts of increasing urbanisation, groundwater extraction, and climate change into this assessment · Develop habitat management guidelines that can be used by land managers to protect local populations and habitats across the landscape (OEH 2012b). <p>Surveys used to inform the assessment of the proposed road upgrade may add to information on this species, but overall the action is not consistent with the priority actions for this species. However, any negative impacts will be minor.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change · Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. <p>Alteration to natural flow regimes is likely to be minimal if good sediment and erosion control is carried out.</p>

26.2 Conclusion

The giant burrowing frog occurs within close proximity to the survey area, and there appears to be a viable local population within a five kilometre radius of the centre of the proposed direct impact area, given recent records less than two kilometres from the survey area. Approximately 6.59 ha of potential foraging habitat will be removed as part of vegetation clearing for the proposed road upgrade. This represents a small amount of disturbed potential habitat that may be used, and only irregularly, by this species. No breeding habitat will be directly affected, and although there is a small risk of indirect impacts from changes to hydrological regimes and runoff, appropriate sediment and erosion control and drainage management will reduce this impact to negligible. Further fragmentation of habitat is unlikely given that Mona Vale Road is already present, and fauna-proof fencing and appropriate fauna crossing structures will be set in place to reduce the risk of fatalities from collisions with cars and increase connectivity.

It is therefore unlikely that the action will cause a significant impact, and a Species Impact Statement is not recommended.

27 Red-crowned toadlet (*Pseudophryne australis*)

27.1 Background

The red-crowned toadlet (*Pseudophryne australis*) is listed as vulnerable under the TSC Act. It has a restricted distribution, occurring only within the Sydney Basin from Pokolbin in the north, to Nowra in the south and west to Mt Victoria (OEH 2012). Red-crowned toadlets are restricted to the Triassic Hawkesbury and Narrabeen sandstones of the Sydney Geological Basin within steep escarpment and plateau areas, as well as low undulating ranges and outcroppings (NPWS 2001).

The main vegetation community that this species occurs in is Sydney Sandstone Ridgetop Woodland, which occurs throughout the study area. Calling and breeding can occur at any time during the year (Anstis 2013; Lemckert and Mahony 2008). The red-crowned toadlet has an unusual breeding habit compared to most frogs. Small nests (cavities) are formed near or within ephemeral water courses in damp leaf litter or in cavities under rocks or logs into which clutches of 20-24 large eggs are laid. The eggs remain in the nest through the early stages of tadpole development with the male in attendance. The tadpoles develop within a water-filled membranous capsule until they reach an advanced development point and then the tadpoles enter a state of diapause and will not develop further until subsequent rains fill the nest chamber and cause them to hatch (NPWS 2001). Development is completed as a free living tadpole within pools in the drainage line, but often pools become dry before metamorphosis can be achieved (Thumm and Mahony 1999). Development needs to occur in acidic conditions and the species is often lost in areas of housing development, presumably as a result of changes in water quality (Thumm and Mahony 1999). Foraging is considered to usually occur within 50 m of breeding habitat (OEH 2012).

This species has not been detected within the survey area, but has been detected nearby (less than two kilometres to the west). Targeted searches are scheduled for February- April 2015 and will be reported on separately (main report)

Pseudophryne australis

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are eight previous records within 5 km radius of the centre of the survey area since 1980 and 293 records in the study area for the same period (OEH 2014a). This species was also recorded approximately 2 km west of the survey area (at four locations over two different time periods; December 2013 and February 2014, see Ecosure 2014b). It is also known from Ingleside Chase Reserve, part of which is within the survey area (ELA 2010). Preliminary surveys have detected habitat for this species, but observations of calling individuals have yet to be made within the survey area. However, detailed surveys are scheduled for spring/summer 2014/15. Given the proximity of a relatively large number of records and the occurrence of habitat, it is assumed that a viable local population exists.</p> <p>Life cycle factors</p> <p>Re-crowned toadlet is reliant on ephemeral water flow and is sensitive to changes in pH, outside of the range 5.5 to 6.5. It has not been recorded in even mildly polluted areas, nor does it occur in or near permanently flowing watercourses (NPWS 2001). This species spends much of its life under some form of cover, such as rocks, deep leaf litter or in rock crevices. Taken together, this species' life cycle makes it particularly sensitive to changes to the hydrology and alterations to its habitat (Thumm and Mahony 1999).</p> <p>Assessment</p> <p>This species is known to occur in close proximity to the survey area and 6.59 ha of potential habitat will be removed (12,678 ha of similar habitat occurs within the study area). It is unlikely that this amount of habitat clearing will place the local population at risk of extinction, but it may impact on some individuals within and adjacent to the direct impact area (if present), and may have a minor impact on local hydrology immediately adjacent to Mona Vale Road. It is not expected that this will be a significant impact on the local population, such that it would be put at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Pseudophryne australis

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The action will remove or modify up to 6.59 ha of potential foraging habitat (heath and woodland), it is not known if this habitat is currently utilised; surveys are scheduled February to April 2015 to investigate this further.</p> <p>ii. Habitat fragmentation</p> <p>Red-crowned toadlet populations exist within a series of fragmented areas throughout their distribution, usually within 100 m of the ridgetop (NPWS 2001). Although the existing road alignment is a barrier to red-crowned toadlet movement, this species has a small home range, preferring to forage within 50 m of breeding habitat. It is therefore unlikely that populations on either side of the road would need to regularly exchange genetic material for their survival. Fauna fencing that includes design to prevent frog crossings will assist in preventing road fatalities. It is noted that Mona Vale Road itself is likely to have been a barrier to dispersal for decades already.</p> <p>iii. Importance of habitat to be impacted</p> <p>The habitat to be cleared or modified occurs throughout much of the study area, including large tracts of suitable habitat within Garigal and Kuringai Chase National Parks. There will be 6.59 ha of potential habitat removed or modified. Taking a precautionary approach it is assumed that this habitat is utilised by this species and so red-crowned toadlet would be impacted by the clearing (upcoming surveys will be used to confirm this assumption in suitable survey conditions). However, there will be more than 5,000 ha of suitable habitat retained within the study area. It is not expected that the long-term survival of the species within the locality will be significantly impacted.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

Pseudophryne australis

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, but it is included under the <i>Saving our Species</i> program as a landscape species management stream (OEH 2014b. OEH is currently developing a targeted approach for managing landscape species. In the interim, relevant priority actions to the study area and proposed road upgrade include:</p> <ol style="list-style-type: none"> 1) Develop best practice management strategies that buffer and protect important headwater/ridge top breeding sites from changes to water flow, flow regimes and water quality changes 2) Prepare a guideline to creating, rehabilitating or augmenting habitat for the species; this might include provision of rock/log ground cover, diversion of water, provision of breeding/nesting sites and material 3) Maintain and support Declining Frog Working Group 4) Develop preferred mitigation measures to minimize impacts of wildfire and/or suppression operations 5) Assess the threat of changed hydrological regimes on the habitat of this species; include the impacts of increasing urbanisation, groundwater extraction, and climate change into this assessment <p>Mitigation measures to reduce the impact of the road on the ecology of the area may contribute to a number of these measures, including 1) and 5), it is therefore consistent with the intent of the recovery plan.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change <p>In addition, the following key threatening processes are possibly exacerbated, if not sufficiently mitigated</p> <ul style="list-style-type: none"> · Bushrock removal · Alteration to the natural flow regime of rivers, streams, floodplains and wetlands.

27.2 Conclusion

The red-crowned toadlet is a habitat specialist found mainly in Sydney Sandstone Ridgetop Woodland which occurs throughout the study area. There are eight previous records from within the study area and this species has previously been recorded within Ingleside Chase Reserve (part of which is within the survey area). The proposed road upgrade will remove up to 6.59 hectares of potential foraging and breeding habitat. The occurrence of this species within the direct impact area is unknown, but detailed surveys are scheduled for February – April 2015 to investigate this further, these surveys will be reported on separately. In the interim, a precautionary approach is taken and this species is assumed to occupy the habitat to be removed. Given the extent of existing suitable habitat (approximately 12,678 hectares within the study area), the fraction of habitat to impacted is likely to be very small and protective measures to minimise run-off will be installed to minimise impacts on surrounding populations. Taken together, it is considered unlikely that the action will place the local population at risk. As such, a Species Impact Statement is not recommended for this species.

28 Rosenberg's goanna (*Varanus rosenbergi*)

28.1 Background

Rosenberg's goanna (*Varanus rosenbergi*) is listed as vulnerable under the *TSC Act*, but is not listed under the EPBC Act. It is similar to, but generally smaller than the more common lace monitor (*Varanus varius*) and has different colouring of its lips, eyes and a different arrangement of tail banding (OEH 2014d).

Within New South Wales (NSW), Rosenberg's goanna occurs on Sydney sandstone elements in Wollemi National Park, extending down through to Goulburn and Cooma in the south. However its distribution is patchy through this range in NSW, with disjunctions occurring between populations. The reasons as to why this occurs are not clear as Rosenberg's goanna also occurs in South Australia and Western Australia where it is much more widespread and common (Cogger 2014; OEH 2014d). In NSW, the species occurs in heath, open forest and woodland. Its presence is associated with the presence of termites which build mounds on the ground, as these are essential breeding structures for this species. Female Rosenberg's goannas dig into terrestrial termite mounds in spring in order to excavate a nest cavity within the core of the mound where they lay up to 14 eggs. The termites seal the hole after nesting, thus providing a protected incubation site for the eggs. Eventually the nest is opened up again by the female, allowing the hatched juveniles to escape (Ehmann et al. 1991; King and Green 1999).

Individuals are very mobile and require large tracts of habitat for sufficient foraging opportunities and appear to be essentially opportunistic feeders, taking whatever presents itself as edible. This species, unlike the lace monitor, does not climb and instead relies on terrestrial shelters in the form of hollow logs, rock crevices and burrows (OEH 2014d). Given that this species is often misidentified as a lace monitor, its true range and status in any given area is potentially underestimated.

The survey area contains habitat for this species (woodland and heath) and it has been previously recorded as road kill within the survey area (main report). Along with this record, there are an additional 107 previous records of this species within the study area. Approximately 6.59 hectares of habitat for this species will be directly or indirectly impacted by the proposed road upgrade.

Varanus rosenbergi

Assessment of Significance criterion (Seven Part Test)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

There are 26 records within 5 km radius of the centre of the direct impact area since 1980 and 108 within the study area (OEH 2014b). Evidence of occurrence and breeding of this species was found on the northern side of the existing road (see main report) (This species was also recorded approximately 3 km to the west of the survey area, near Kimbriki Road as part of surveys for Mona Vale Road West) (Ecosure 2014b). This represents a current viable population that is both foraging and breeding within the study area and utilises the survey area.

Life cycle factors

There is evidence that a local viable population exists within the study area and utilizes the survey area. This population is breeding within the survey area and is almost certainly foraging there as well. One nest (within a termite mound) was located with evidence of breeding by Rosenberg's goanna, and another termite mound providing potential breeding habitat was located (main report).

Assessment

Estimates of home range have been made for this species for the Kangaroo Island population, where individuals maintain home ranges of up to 100 ha and are territorial and highly mobile from October through to April (Rismiller et al. 2007). Similar studies have not been undertaken for the local population or any population within NSW, but many characteristics are similar between NSW and Kangaroo Island species (eg breeding behaviour, foraging) and it has been shown to be the same species genetically, although there are evolutionary differences between five geographically separated populations (Smith, et al. 2007). In the absence of local data, population parameters are inferred from Kangaroo Island data.

Densities of animals on Kangaroo Island are high and it is likely that such pressure, as well as having restricted habitat will result in smaller home ranges there than in the study area. Taken together this suggests that only a small number of Rosenberg's goanna would potentially be using the survey area and surrounds at any time, and would not rely on this small area that will be removed by the proposed road upgrade. It is therefore unlikely that a viable population will be placed at risk of extinction since there are numerous records throughout the study area. The proposed road upgrade will involve the widening of an already existing road and so it will not create a new type of impact on Rosenberg's goanna and individuals are likely to already be accustomed to having to cope with the presence of the road. The upgrade of the road will involve the removal or modification of up to 6.59 ha of potential habitat which is primarily a narrow (14-20 m) strip either side of the current Mona Vale Road alignment and so will not significantly change the available suitable habitat for resident Rosenberg's goannas. Therefore, it is not expected to significantly impact current movement and foraging activities of the species, provided that termite mounds are avoided by the road and protected from damage during construction.

As well as the termite mound with evidence of breeding by this species, several other termite mounds were found within the survey area. The small area of potential habitat to be removed, presence of numerous records of the species throughout the broader study area and confinement of impacts to a strip of habitat immediately

Varanus rosenbergi

Assessment of Significance criterion (Seven Part Test)

	<p>adjacent to the current Mona Vale Road. In addition, 12,000 ha of similar habitat is available within the study area, and fauna fencing proposed as part of the road upgrade will protect this species against road kill. Taken together the proposed road upgrade is unlikely to impact a viable local population such that it will be placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat Rosenberg's goanna occupies all habitats on the Sydney sandstone and as such the proposed road upgrade would remove or modify approximately 6.59 ha of potential habitat. Similar habitat exists throughout the study area including in the surrounding Garigal and Kuringai National Parks.</p> <p>ii. Habitat fragmentation The existing road alignment is a barrier to Rosenberg's goanna and road kill has been recorded for this species within the survey area (SMEC 2011). The proposed road upgrade will increase the width of the current barrier, however the retention and improvement of the culvert at Narrabeen Creek as a fauna underpass will provide a safer link to habitat on each side of the road.</p> <p>iii. Importance of habitat to be impacted There will be 6.59 ha of potential foraging and breeding habitat removed, this habitat contains termitaria suitable for breeding, but these will be retained and protected.</p>

Varanus rosenbergi

Assessment of Significance criterion (Seven Part Test)

<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, but it is included under the <i>Saving our Species</i> program as a landscape species management stream (OEH 2014b). Relevant priority (PAS 2) actions to the study area and proposed road upgrade include:-</p> <ul style="list-style-type: none"> · Undertake investigations into general biology and ecology of the species, particularly movement patterns and tree use, rock crevice use and termitaria use · Undertake investigations into taxonomic distinctions/genetic (DNA) differences between the various forms of the 'species' · Develop habitat identification, management and enhancement guidelines. <p>The proposed road upgrade may interfere with the objectives of the program, although only at a local level.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change <p>In addition, the following KTP's are possibly exacerbated, if not sufficiently mitigated, note though that mitigation has been successfully implemented elsewhere</p> <ul style="list-style-type: none"> · Removal of dead wood and dead trees

28.2 Conclusion

Evidence of use of the survey area was detected during detailed surveys and several termitaria suitable for breeding were also marked. This species has been located to the west of the survey area and it is likely that a viable local population exists. Approximately 6.59 ha of potential foraging and breeding habitat will be removed or modified. Terrestrial termitaria will be retained and protected during construction and passage under Mona Vale Road at Narrabeen Creek will be retained and improved, with the installation of fauna fencing. Larger tracts of more suitable vegetation occur to the north, south and west of the survey area and it is considered that there is little risk of a significant impact to the local population and as such, a Species Impact Statement is not recommended.

29 Regent honeyeater (*Anthochaera phrygia*)

29.1 Background

The regent honeyeater (*Anthochaera phrygia*) is listed as critically endangered under the *TSC Act*. It is also listed as endangered under the *EPBC Act*. It is sometimes known by the synonym *Xanthomyza phrygia*.

The regent honeyeater is a rare species that may number only about 1500 individuals spread thinly across south-eastern Australia (Menkhorst et al. 1999). It mainly inhabits temperate woodlands and open forests of the inland slopes between north-eastern Victoria and south-eastern Queensland (Menkhorst et al. 1999; OEH 2014d). It is also found in drier coastal woodlands and forests, during eucalypt flowering events in these areas. The species' range has contracted considerably in recent decades, and there are only three key breeding regions known, all on the inland slopes: the Chiltern-Albury region in Victoria; Capertee Valley in central New South Wales (NSW) and the Bundarra-Barraba region in northern NSW (Menkhorst et al. 1999; OEH 2014d). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands (NPWS 1999). In some years flocks converge on flowering coastal woodlands and forests (OEH 2014d), although coastal records in central NSW are scattered and infrequent (Higgins et al. 2001). Swamp mahogany forests in coastal NSW are important refuge areas when conditions on the inland slopes are unfavourable (Menkhorst et al. 1999). However, there appear to be no specific reports of breeding in coastal NSW.

Regent honeyeater occurs in eucalypt woodlands and open forests. Most records of the species are from box-ironbark eucalypt forest and woodland including mugga ironbark *Eucalyptus sideroxylon*, lowland coastal forests that are dominated by *Eucalyptus robusta* (swamp mahogany) and *Corymbia maculata* (spotted gum) and riparian forests of *Casuarina cunninghamiana* (river she-oak) (OEH 2014d). These woodlands have large numbers of mature trees, high canopy cover and an abundance of mistletoes (OEH 2014d). The seasonal movements of regent honeyeater are thought to be dependent on spatial and temporal patterns of flowering and other resources (OEH 2014d).

Nectar is the main component of the diet of regent honeyeater, with at least 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: *Eucalyptus sideroxylon*, *E. albens* (white box) and *E. melliodora* (yellow box) (Webster and Menkhorst 1992; Menkhorst et al. 1999; Higgins et al 2001). Lerp and honeydew comprise a large proportion of the diet when nectar is scarce. Insects comprise a smaller dietary component but are important for nestlings (Menkhorst et al. 1999).

Breeding occurs between July and January in box-ironbark and other temperate woodlands and riparian gallery forest dominated by *Casuarina cunninghamiana* (OEH 2014d). Nests are frequently located in *E. sideroxylon* and *E. camaldulensis* (river red gum), but may also be in other eucalypts, mistletoe clumps and *Casuarina* species (OEH 2014d). In the Bundarra-

Barraba breeding area, the presence of regent honeyeater is correlated with linear remnants, small habitat patch sizes and good local connectivity (Oliver and Lollback 2010).

The regent honeyeater was recorded in the study area during bird surveys in May and June 2014, on the Chiltern Trail, approximately one kilometre from the survey area. The desktop survey identified two other records within five kilometres of the centre of the direct impact area since 1980 and eight records within the study area (OEH 2014a). Potential non-breeding habitat may occur throughout the survey area.

Anthochaera phrygia

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>The regent honeyeater was recorded in the study area, 1 km from the survey area during bird surveys on 27 May and 18 June 2014 on the Chiltern Trail in Ku-ring-gai Chase National Park. These observations involved up to three birds (two adults and an immature bird) that were recorded in the same vicinity by many bird watchers in the period 24 May to 17 July 2014 (Eremaea Birdline NSW 2014). They were not located during bird surveys on 6 August 2014. The desktop survey identified two other records within 5 km since 1980:</p> <ul style="list-style-type: none"> · Terrey Hills in September 1988 · Warriewood Wetlands in May 1998 (OEH 2014d). <p>The pattern suggests that the regent honeyeater is a very rare non-breeding visitor to the area in the winter and spring, where it seeks highly productive food concentrations. There is unlikely to be a resident or migratory population reliant on the study area.</p> <p>Life cycle factors</p> <p>The regent honeyeater is not known to breed in coastal districts of NSW. Wintering in the study area is highly exceptional and not likely to be repeated for many years, if past patterns hold true.</p> <p>Assessment</p> <p>The proposed road upgrade is unlikely to impact on the regent honeyeater in a way that would cause a decline in the species or any local viable population.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Anthochaera phrygia

Assessment of Significance criterion (Seven Part Test)

- d) In relation to the habitat of a threatened species, population or ecological community:
- i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

i. Extent of impact on habitat

At the Chiltern Trail site the birds were occupying Bloodwood Scribbly Gum Woodland; 3.28 ha of similar habitat (Hornsby Sandstone Exposed Bloodwood Woodland) will be removed as part of the proposed road upgrade. The total area of woodland habitats that would be removed by the proposed road upgrade is about 5.95 ha. Some of these woodland sites adjacent to Mona Vale support colonies of noisy miners, which are known to exclude regent honeyeaters, so these areas are probably not good habitat. Field observations at the Chiltern Trail indicated that the regent honeyeaters were feeding on lerp infestations and associated honeydew in grey gum (*Eucalyptus propinqua*). There were no significant levels of flowering in any local eucalypt species at the time of survey. Potential food sources may have included flowers of *Banksia* spp. and insects in the dense understorey. Bird diversity and abundance were very high at the Chiltern Trail site when the regent honeyeaters were observed, and this diversity was not matched at any of the other sites surveyed in the same or different habitats on the same days. On 6 August (after the regent honeyeaters had departed) the site had lower bird diversity and abundance than sites within or adjacent to the survey area. These data suggest that a localised lerp infestation was responsible for a peak in food sources that temporarily attracted a large number of woodland bird species and individuals – including three regent honeyeaters – to the Chiltern Trail site. This is not unusual: a large aggregation at Howes Valley in May 1994 was feeding mainly on insects and lerp for several months (Oliver in Menkhorst et al. 1999).

ii. Habitat fragmentation

The proposed road upgrade would increase the width of the existing road and has potential to decrease the connectivity between Ku-ring-gai Chase and Garigal national parks. However, the regent honeyeater is capable of flying over linear clearings such as roads and utilising habitat in fragmented landscapes. It has been shown to favour small connected remnants in highly fragmented landscapes (Oliver and Lollback 2010). The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on any regent honeyeater population.

iii. Importance of habitat to be impacted

About 5.95 ha of potential wintering or stopover habitat is in the survey area. However, lerp infestations like the one that apparently attracted the birds to the Chiltern Trail site are an unpredictable event – both spatially and temporally – that can change ordinary habitat into bountiful habitat. The chances of such an event occurring in the survey area are completely unknown, but probably very low. Loss of that habitat may deprive wintering or wandering regent honeyeaters of finding a lerp infestation in the survey area in the future, but this is not likely to be significant to the species. No resident regent honeyeaters would be displaced from habitat that they currently occupy or that they might potentially colonise in the future. Taken together, the habitat to be removed is not considered to be important to a local population.

Anthochaera phrygia

Assessment of Significance criterion (Seven Part Test)

<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no NSW recovery plan of the regent honeyeater. There is (an expired) national recovery plan jointly managed by the Commonwealth Government and the States of NSW, Victoria and Queensland (Menkhorst et al. 1999). It has six objectives:</p> <ul style="list-style-type: none"> · Effectively organise and administer the recovery effort · Maintain and enhance habitat · Monitor trends in population size and range · Facilitate strategic research · Maintain and increase community awareness and involvement · Maintain the captive population. <p>The most relevant to the proposed road upgrade is to maintain and enhance habitat and maintain and increase community awareness. The action will remove a small amount of habitat for this species which is contrary to the second objective. It does not impact on other objectives.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>Of the 37 key threatening processes listed in NSW, two are relevant to the proposed road upgrade and the regent honeyeater:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change. <p>The proposed road upgrade involves the clearing of approximately 2.4 ha of timbered habitats and therefore would exacerbate the above KTPs.</p>

29.2 Conclusion

There is unlikely to be a resident population or regular wintering population of regent honeyeaters in the Sydney region. The recent occurrence of three regent honeyeaters in the study area is a rare and unusual event apparently triggered by a localised lerp infestation. The proposed road upgrade would not displace any resident population or prevent a population from becoming established in the future, and therefore a Species Impact Statement is not recommended.

30 Gang-gang cockatoo (*Callocephalon fimbriatum*)

30.1 Background

The gang-gang cockatoo (*Callocephalon fimbriatum*) is listed as vulnerable under the TSC Act and is not listed under the EPBC Act. Within the region, there is a gang-gang cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas listed as endangered under the TSC Act, but the study area is outside the range of that listed population (NSW Scientific Committee 2001). It is largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east (OEH 2014d). This is entirely within the Lane Cove River catchment, to the west of the Pacific Highway. It does not include birds within Kuringai Chase National Park (OEH 2014d).

The gang-gang cockatoo is endemic to south-eastern Australia, from the Victoria - South Australia border to central NSW, and is found on the coast, ranges and inland slopes (Forshaw and Cooper 1981; Higgins 1999). A population on King Island is now extinct, and a population on Kangaroo Island is introduced (Higgins 1999). In New South Wales, it is distributed from the south-east coast to the Upper Hunter Valley, and inland to the Central Tablelands and South West Slopes (OEH 2014d). It is rare at the extremities of its range (Forshaw and Cooper 1981; OEH 2014d). There are scattered records outside the usual range, such as Ebor (1967), Coffs Harbour (1987), Moonee (1987) and Mudgee (Forshaw and Cooper 1981; Higgins 1999). In Sydney and surrounding areas, the gang-gang cockatoo was once widespread and numerous, but has declined due to loss of habitat (OEH 2014d).

The gang-gang cockatoo is variously considered sedentary or seasonally nomadic, or partly migratory. There is some seasonal movement, but the details are poorly understood. In high altitude areas of the species' range (eg the Snowy Mountains) its abundance increases in summer and decreases in winter. However, there does not appear to be any corresponding seasonal change in abundance at mid and low altitude sites, and it can be found in many areas all year-round (Higgins 1999). Nesting mostly occurs in the mountains and tablelands (Forshaw and Cooper 1981), but it nested on the central coast in 1977 (Morris et al 1981). Also, the gang-gang cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas (outside the study area) is the only known breeding population of the species in the Sydney Metropolitan area (NSW Scientific Committee 2001).

The species occurs in heavily timbered, eucalypt dominated forests and woodlands. In the mountains it is found in tall, moist forests and woodlands, especially mature wet sclerophyll forests. At lower altitudes it occupies drier, more open eucalypt forests and woodlands (particularly box-ironbark assemblages or dry coastal forest) and urban areas (OEH 2014d). Vegetation with old growth elements is required for nesting. The gang-gang nests in large hollows in the trunk or limbs of living or dead eucalypt trees (Forshaw and Cooper 1981; Higgins 1999). Hollows of sufficient size generally do not form in eucalypt trees less than

150 to 200 years old (Mackowski 1984). Sites are apparently used year after year (Higgins 1999). Breeding usually occurs between October and January, and individuals first breed at 3-4 years of age (Higgins 1999).

The gang-gang cockatoo feeds mainly on the seeds of eucalypts and acacias but will feed on flowers, seeds and fruit such as *Callitris*, *Callistemon*, garden fruits, berries (eg hawthorn) and nuts, as well as some insects and their larvae (Forshaw and Cooper 1981; Higgins 1999).

The gang-gang cockatoo was not recorded during the field surveys. The desktop survey revealed two records from within the study area since 1980 (the same two records occur within five kilometres). Approximately 5.95 hectares of potential foraging habitat will be removed or severely modified as part of the proposed road upgrade. Within this vegetation to be cleared there are no trees with hollows large enough for this species.

Callocephalon fimbriatum

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>The gang-gang cockatoo was not recorded during preliminary field surveys see attached report, or during detailed threatened bird surveys as part of investigations for Mona Vale West (Ecosure 2014b). The desktop survey revealed two records from the study area since 1980. These were from Deep Creek in Garigal National Park in April 1992 and Walana Crescent Mona Vale in November 2004 (OEH 2014a). Pittwater Council (2011) states that “There are a couple of records for Pittwater from Avalon, Mona Vale and Ku-ring-gai Chase National Park”, but gives no further details. The evidence indicates that individuals or small flocks reach the study area very occasionally, but there is no resident population in the study area. Whether such visitors derive from the Kuringai- Hornsby population or from the mountains west of Sydney is not clear.</p> <p>Life cycle factors</p> <p>Some members of the species migrate to coastal areas in the winter, where they are reliant on coastal forests to complete their annual cycle. However, the existence of two or perhaps three historical records from the study area indicates that this is not a favoured wintering area.</p> <p>In Sydney, the gang-gang cockatoo only breeds in the Ku-ring-gai and Hornsby Local Government Areas (NSW Scientific Committee 2001). Perhaps potential breeding habitat occurs in the study area, but breeding does not.</p> <p>Assessment</p> <p>There is no local viable population breeding in the study area or visiting the study area in the winter. Therefore the proposed road upgrade will not place a local population at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species,</p>	<p>i. Extent of impact on habitat</p>

Callocephalon fimbriatum

Assessment of Significance criterion (Seven Part Test)

<p>population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>Potential foraging habitats are scattered within the natural habitat areas of the study area. Virtually any eucalypt-dominated woodland or forest in south-eastern NSW is potential foraging habitat. Breeding habitat however does not occur in the survey area. The survey area contains a low density of hollow bearing trees, due primarily to the shallow sandy soils (Ecosure 2014a).</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Ku-ring-gai Chase and Garigal national parks. The gang-gang is a strong flyer (Forshaw and Cooper 1981). Any gang-gang cockatoos occurring in the study area would reach it by crossing a large existing urban landscape that is highly fragmented. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on this species.</p> <p>iii. Importance of habitat to be impacted</p> <p>The near absence of local records of gang-gang cockatoo indicates that the habitat is not important to the species.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for the gang-gang cockatoo.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, but it is included under the <i>Saving our Species</i> program as a landscape species management stream. Eleven priority actions for this species have been proposed:-</p> <ul style="list-style-type: none"> · Provide input to National Park and local bushfire mgt. plans to minimise impacts of fire on critical resources · Determine the status of representative local populations distributed across the species range · Investigate the impacts of wildfire and hazard reduction burns on foraging and nesting resources · Investigate the breeding biology of selected populations to improve understanding of threatening processes · Model the impact of global warming and develop mitigation strategies · Identify important nesting habitat on public lands · Negotiate management agreements and covenants over important areas of habitat · Prepare and distribute information to decision makers · Determine the disease status of selected populations · Increase landholder and public awareness of status, threats and priority actions · Investigate movement patterns of selected populations. <p>The proposed road upgrade will not interfere with the fulfilment of these objectives.</p>

Callocephalon fimbriatum

Assessment of Significance criterion (Seven Part Test)

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

Of the 37 key threatening processes listed in NSW, two are relevant:

- Clearing of native vegetation
- Loss of hollow-bearing trees.

The proposed road upgrade involves the clearing of approximately 5.95 ha of timbered habitats. The proposed road upgrade would contribute to the key threatening process, but would not have a significant impact on any local population of the gang-gang cockatoo.

30.2 Conclusion

It is unlikely that there is a local population of the gang-gang cockatoo in the study area. The proposed road upgrade would lead to the loss of approximately 5.95 hectares of potential foraging habitat, but this is not favoured habitat because the species does not reside in or visit the study area with regularity. There is unlikely to be any favourable breeding habitat in the survey area, and the species does not breed in the Pittwater LGA or Narrabeen catchment. Increased fragmentation would likely not affect this mobile species. One key threatening process would be exacerbated by the proposed road upgrade, but would not have a serious impact on the species. It is unlikely that this action would have a significant impact on the species such that any local population would decline. Therefore, a species impact statement is not recommended for this species.

31 Little eagle (*Hieraaetus morphnoides*)

31.1 Background

The little eagle *Hieraaetus morphnoides* is listed as vulnerable under the *TSC Act* and is not listed under the EPBC Act. The little eagle is endemic to the Australian mainland, occurring over most of the continent (Marchant and Higgins 1993). It occurs throughout NSW, but is less common on the coast than inland, and avoids the most densely forested parts of the Great Dividing Range (Marchant and Higgins 1993; NSW Scientific Committee 2010; Cooper et al. 2014). It occurs as a single population throughout NSW (NSW Scientific Committee 2010; OEH 2014d). It is partially migratory or nomadic, although some populations are apparently resident (Marchant and Higgins 1993; Cooper et al. 2014).

The little eagle occurs in forests, woodlands, and open country (including agricultural lands), and particularly mosaic landscapes (Marchant and Higgins 1993). It is tolerant of many major land uses, with the exception of urbanization, provided there are wooded remnants for nesting in (Marchant and Higgins 1993). Nests are located in mature living trees, in open forest or woodland, or in remnant clumps in open country. Isolated trees are not suitable for nesting (Marchant and Higgins 1993). Breeding territories are large, in the order of 7 to 16 square kilometer (Marchant and Higgins 1993).

This species' diet is mostly rabbits where they occur, and other small vertebrates. They also catch insects and feed on carrion. Birds and reptiles may be more important in the diet in areas where rabbits are scarce (Marchant and Higgins 1993).

The little eagle may have benefited from the early clearing of forests and creation of a more open and patchwork landscape, and has certainly benefitted from the introduction of rabbits. Conversely, the ongoing loss of woodlands, the extensive extinction of medium-sized native mammals and urbanisation of coastal areas have probably been detrimental (Marchant and Higgins 1993; Cooper et al. 2014). When the release of calicivirus induced a reduction of their rabbit prey, the species is thought to have declined greatly, although accurate figures are not available (NSW Scientific Committee 2010; Cooper et al. 2014). Reporting rates in the NSW Bird Atlasers database declined by 70% from 1986 to 2006, and it is considered to be a real decline (Cooper et al. 2014). Habitat clearing, decline of rabbits and secondary poisoning (poisons targeting rabbits) may all been implicated in the decline (Cooper et al. 2014).

The little eagle was recorded in the survey area, incidentally during the field survey on 6 August 2014 and during targeted threatened bird surveys on 17 October 2014. The Bionet wildlife database (OEH 2014d) contains three records of little eagle from the study area, and two within five kilometres of the centre of the design footprint. Birdline NSW (2014) contains six records reported by birdwatchers in the study area since 2006, as follows:

Katandra Bushland Sanctuary	11/06/2007	Warriewood Wetlands	6/10/2010
Chiltern Trail, Ingleside	3/01/2008	Warriewood Wetlands	12/04/2014
Chiltern Trail, Ingleside	19/09/2009	Warriewood wetlands	14/06/2014

Hieraaetus morphnoides

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>The little eagle was recorded in the survey area, incidentally during the field survey on in August and October 2014, and there are three historical records from the study area. These scattered records (<1 per year) suggest the occasional occurrence of migrants or nomads, rather than a resident population. Potential foraging habitat probably occurs along the survey area. Suitable roosting habitat was also located in and immediately adjacent to the survey area. The proximity of the survey area to an existing major road, and the extensive native bushland surrounding the study area make it highly unlikely that the species breeds in the survey area.</p> <p>Life cycle factors</p> <p>The little eagle nests in large mature trees, few of which occur in the survey area. No large stick nests typical of this species were detected in the survey area during bird surveys, other fauna surveys and habitat assessments. The little eagle feeds mostly on rabbit, (which were commonly recorded in the Mona Vale Cemetery and rural residential lands surrounding the survey area). The proposed road upgrade is not likely to affect the abundance of rabbits in the study area.</p> <p>The little eagle is known to take carrion from roadsides, and potentially could be hit by traffic at this time. However, The existing roadway is generally too busy during daylight hours to allow birds of prey to settle and secure carrion. Anyway, the proposed road upgrade includes roadkill mitigation measures (fauna fencing and an upgraded fauna underpass) that would reduce the incidence of roadkill and would therefore make it less likely for little eagle to forage along the road.</p> <p>Assessment</p> <p>The proposed road upgrade is not likely to have a significant impact on the little eagle. Little eagles have large territories that contain lots of habitat, and the proposed road upgrade will affect only a small amount of habitat, and no important life cycle factors would be impacted.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the</p>	<p>n/a</p>

<i>Hieraaetus morphnoides</i>	
Assessment of Significance criterion (Seven Part Test)	
<p>ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The proposed road upgrade would require the clearance or modification of up to 9.87 ha of potential foraging habitat for the little eagle.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade would increase the width of the existing road and has potential to decrease the connectivity between Ku-Ring-Gai Chase and Garigal national parks. However, the little eagle is easily capable of flying over linear clearings such as roads and utilising habitat in fragmented landscapes. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on any little eagles.</p> <p>iii. Importance of habitat to be impacted</p> <p>It is unlikely that habitats in the survey area are critically important to the survival of the species. Habitat currently present is highly disturbed through weed incursion, traffic noise, frequented walking trails and management activities (slashing of grass, track maintenance). By contrast, there are extensive areas of surrounding woodland, especially in the national parks, that are much less disturbed.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

<i>Hieraaetus morphnoides</i>	
Assessment of Significance criterion (Seven Part Test)	
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for the little eagle.</p> <p>The OEH (2014d) profile lists the following actions to assist the recovery of the species:</p> <ul style="list-style-type: none"> · Buffer habitat areas from the impacts of other activities · Protect known populations and areas of potential habitat from clearing, fragmentation or disturbance · Rehabilitate known and potential habitat · Retain and protect nesting and foraging habitat. <p>The proposed road upgrade would contribute only slightly to clearing of habitat and would be unlikely to have any significant impact on the species.</p> <p>The proposed road upgrade would not involve any activities that are inconsistent with any threat abatement plans.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>Of the 37 key threatening processes listed in NSW, three are relevant to the proposed road upgrade and the little eagle:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Loss of hollow-bearing trees · Removal of dead wood and dead trees. <p>The proposed road upgrade involves the clearing of approximately 5.95 ha of woodland habitats. This relatively small area represents just 0.14% of the potential habitat within 5 km of the survey area, and a very small area relevant to the typical territory size of the little eagle. In addition, the little eagle is somewhat tolerant of small-scale landscape modification. The proposed road upgrade would be unlikely to lead to habitat loss that would have a significant impact on the little eagle.</p>

31.2 Conclusion

The proposed road upgrade would lead to the loss of up to 9.87 hectares of potential foraging and roosting habitat for the little eagle, but it is unlikely that any breeding habitat would be lost. Probably only vagrants occur in the survey area on rare occasions, so important life cycle factors (such as breeding) are unlikely to be impacted. Increased fragmentation would likely not affect this highly mobile species. Three key threatening processes would be exacerbated by the proposed road upgrade, but would not have a serious impact on the species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that the local population would decline. A Species Impact Statement is not recommended for the little eagle.

32 Glossy black-cockatoo (*Calyptorhynchus lathamii*)

32.1 Background

The glossy black-cockatoo *Calyptorhynchus lathamii* is listed as vulnerable under the New South Wales *Threatened Species Conservation Act 1995*. It occurs in a wide coastal band from central Queensland to the Victorian border, with an isolated population occurring in South Australia on Kangaroo Island (NPWS 1999). In NSW, the species has a patchy and localised distribution centred on moist and dry sclerophyll forest habitat. This species is locally nomadic, with small family parties (seldom more than ten individuals) roaming in search of feeding areas (NPWS 1999). It prefers woodland dominated by she-oaks (*Allocasuarina* spp.) or open sclerophyll forest, or woodlands with a middle stratum of *Allocasuarina*, but it also occurs in bushland remnants in agricultural and urban areas (Higgins 1999). However, the species appears to occur in peak abundance in old growth forest.

Glossy black-cockatoo is considered to be an ecological specialist, feeding almost exclusively on the seeds of *Allocasuarina* species including *A. torulosa*, *A. littoralis*, *A. verticillata*, *A. diminuta* and *A. gymnanthera*, although it occasionally eats the seeds of *A. distyla*, *Casuarina glauca* and *C. cristata* (Higgins 1990; Cameron and Cunningham 2006; OEH 2014d). In eastern NSW, black she-oak (*A. littoralis*) is the main dietary component (Chapman 1999). It is highly selective about which trees it feeds from, selecting only about 25% of available cone-bearing trees in one study (Higgins 1999). Mature, sparse trees between 2-10 metres tall are favoured for foraging (Higgins 1999), with birds showing a preference for trees with lots of cones, large seeds and high seed mass yields per cone (Pepper 2000; Cameron and Cunningham 2006). Although trees are selected on the basis of the number of cones, feeding activity is unevenly distributed between trees, with birds settling for sustained feeding (> 4 hrs) in some trees and remaining for only a few minutes in others (Higgins 1999; Cameron and Cunningham 2006). It prefers to forage at sites where food is abundant and avoids open sites where the predation risk may be greater (Cameron and Cunningham 2006).

The glossy black-cockatoo must forage for many hours every day to obtain sufficient food and apparently suitable habitat will not always provide adequate food to support the cockatoos, in particular during the breeding season (Garnett and Crowley 2000). Breeding birds forage for about 80% of daylight hours, consuming seeds from up to 140 cones during this period. Non-breeding birds forage for about half the daylight hours and eat half as many cones (Chapman 1999).

Large hollows in the trunk or limbs of living or dead eucalypt trees are required for nesting. The glossy black-cockatoo prefers deep (40-120 centimetres) nest hollows with wide entrances (approximately 21 centimetres) located 10-28 metres above the ground (Higgins 1999). Vertical spouts in large trees are preferred, mostly high in senescent or dead trees

(Cameron 2006). Hollows of sufficient size for nesting generally do not form in eucalypt trees less than 150-200 years old (Mackowski 1984).

The glossy black-cockatoo forms strong pair bonds and is thought to pair for life (Chapman 1999). Adults breed during the autumn and winter (NPWS 1999), mainly between February and April but as early as January and as late as August if earlier nesting attempts fail (Chapman 1999). Incubation of eggs lasts for about 30 days and chicks fledge around 90 days after hatching. Only one young is raised per season (Higgins 1999).

This species is mainly sedentary or locally nomadic, but is capable of travelling large distances to locate suitable foraging habitat. Permanent groups of up to ten individuals are formed. Roosting is usually communal in the canopy of live leafy trees (Higgins 1999) and groups may form aggregations at food and water sources.

The glossy black-cockatoo was recorded three times during detailed field surveys, approximately one kilometre from the survey area. The desktop review revealed 41 records from the study area since 1980 (OEH 2014d). Potential foraging habitat has been recorded in timbered areas within the study area.

Calyptorhynchus lathami

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	<p>Viable local population</p> <p>Glossy black-cockatoos were recorded on two occasions in November 2014 within the survey area and once in June 2014 at the Chiltern Trail in Ku-ring-gai Chase National Park, when a single bird was recorded flying eastwards over the site, approximately 1 km from the survey area.</p> <p>The desktop survey revealed 41 records 5 km from the centre of the direct impact area since 1980 and 199 within the study area (10 km from centre of the direct impact area) (OEH 2014a). These are spread all around this area, but the specific locations of records are withheld to protect against illegal egg-collection. It has been recorded in all months (except January) with little seasonal pattern. It has been widely recorded in the Pittwater Council area including Barrenjoey Peninsula, as well as Ku-ring-gai Chase and Garigal national parks. Potential foraging habitat in the survey area is present where shrub she-oak (<i>Allocasuarina distyla</i>) occurs in the open woodland communities (small section near the western portion of the survey area, see main report).</p> <p>Life cycle factors</p> <p>As a specialist feeder on the seeds of <i>Allocasuarina</i> species, the glossy black-cockatoo must spend most of the daylight hours feeding (Chapman 1999). Nesting occurs in large hollows and it appears that suitable breeding is unlikely to occur in the survey area.</p> <p>Assessment</p> <p>Whilst the study area evidently supports a viable population of the glossy black-cockatoo, it is probable that the survey area contains no breeding habitat and very limited favourable foraging habitat. For this reason, the proposed road upgrade is not likely to have an adverse impact that would cause the local population of the glossy black-cockatoo to decline.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Calyptorhynchus lathami

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat Potential foraging habitats in the survey area are present where shrub she-oak (<i>Allocasuarina distyla</i>) occurs in the open woodland communities. Although open woodland accounts for slightly under 1 ha of the construction footprint of the proposed road upgrade, the occurrence of <i>A. distyla</i> is scarce and patchy. Further surveys are required to determine how much potential foraging habitat is present in the survey area, but it is expected to be less than 0.5 ha. Breeding habitat will not be removed as part of proposed road upgrade. The survey area contains a low density of hollow bearing trees, due primarily to the shallow sandy soils (Ecosure 2014a). The number of hollow-bearing trees serves as a good index for the availability of suitable hollows (ie nesting habitat) for the glossy black-cockatoo (Cameron 2006).</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Ku-ring-gai Chase and Garigal national parks. The glossy black-cockatoo is generally a resident and locally nomadic species, but is also a strong flyer and is capable of utilising fragmented landscapes. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on this species.</p> <p>iii. Importance of habitat to be impacted There is only a very small area of potential habitat for this species that will be impacted, and the <i>Allocasuarina distyla</i> where this species was observed on Lane Cove Road will not be impacted.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for the glossy black-cockatoo.</p>

Calyptorhynchus lathami

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for the glossy black-cockatoo in NSW. This species has been assigned to the site-managed species management stream under the <i>Saving our Species</i> program (OEH 2014b). Two sites have been identified for management actions, one in the central west area of NSW and one on the North Coast. Neither will be impacted by the proposed road upgrade.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>Of the 37 key threatening processes listed in NSW, three are relevant to the proposed road upgrade and the glossy black cockatoo:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Loss of hollow-bearing trees · Removal of dead wood and dead trees. <p>The proposed road upgrade will exacerbate the above KTPs.</p>

32.2 Conclusion

The proposed road upgrade would lead to the loss less than one hectare potential foraging habitat. It is not known if any of this is favourable habitat, since the species found within the survey area were found outside of the direct impact area on Lane Cove Road. Breeding habitat will not be removed as result of the proposed road upgrade. Increased fragmentation would likely not affect this mobile species. Three key threatening processes would be exacerbated by the proposed road upgrade but would not have a serious impact on the species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that the local population would decline. A Species Impact Statement is not recommended for this species at this stage.

33 Swift parrot (*Lathamus discolor*)

33.1 Background

The swift parrot (*Lathamus discolor*) is listed as endangered under the *TSC Act* and the *EPBC Act*. The swift parrot is also listed as endangered internationally, on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2004).

This species breeds only in Tasmania in spring and summer, migrating to the mainland in autumn and winter months, where it occurs in south-eastern Australia from Victoria and the eastern parts of South Australia up to south-east Queensland (Tzaros 2002).

Swift parrots have been recorded throughout New South Wales (NSW), except for the north western parts of the state, although they mostly occur on the central and southern inland slopes and along the coast. On the slopes they mainly inhabit dry open eucalyptus forests and woodlands, usually box-ironbark communities. On the coast, forests and woodlands dominated by spotted gum (*Corymbia maculata*), red bloodwood (*C. gummifera*) blackbutt (*Eucalyptus pilularis*) and/or swamp mahogany (*E. robusta*) are important, particularly in years when the dryer box-ironbark woodlands fail to produce adequate food resources (Higgins 1999; Tzaros 2002). However, they are fussy and occupy only a small proportion of the apparently suitable habitats available. They seek trees growing on the most fertile soils, probably because such trees produce more reliable quantities and/or higher nutrient quality foods (Tzaros 2002). Swift parrots feed mainly on nectar from eucalypts but also take psyllids, lerp (a protective cover produced by psyllid insect larvae), seeds and fruits. They are typically seen feeding in the canopy of flowering trees or flying high overhead. They often flock with small lorikeets and honeyeaters at abundant food sources (Higgins 1999).

The swift parrot was not recorded during winter surveys of the survey area and surrounds. There are six records from the study area since 1980 (OEH 2014a). Potential foraging habitat occurs in the study area.

Lathamus discolor

Assessment of significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are six records of swift parrot within 5 km from the centre of the survey area, and 46 records within 10 km of the centre of the direct impact area. This species is seasonally recorded during localised flowering events. It has been recorded approximately 850 m from the survey area, but most records are around Narrabeen Lagoon (OEH 2014a), where they were attracted to flowering swamp mahogany (<i>E. robusta</i>). The last recorded sightings in OEH (2014a) were in 2009 with two recorded on the same day in April 2009 in the suburb of Mona Vale and one in May 2009 at Warriewood Wetlands, to the north east of the survey area. In addition, two were reported by birdwatchers on Birdline NSW (2013) on 1 June 2014, in swamp mahoganies at Warriewood Wetlands. It is likely that the study area provides resources that are utilised by the nomadic swift parrot. This meets the criteria within the threatened species assessment guidelines (DECC 2007) of a viable local fauna population.</p> <p>Life cycle factors</p> <p>This species spends less than half of the year on the mainland, with breeding only occurring in Tasmania. Within its range on the mainland, its movement patterns are not well understood, but it appears to be nomadic and irruptive, responding to the abundance of lerp, nectar and non-aggressive competitors. A study into the habitat use of this species on the mainland found high site fidelity between years, with more than half of the sites surveyed revisited the next year (Saunders and Heinhsohn 2008). The study area provides occasional foraging opportunities for this nomadic species, but the study area is not considered to be a favoured site for this species because it does not contain their favoured preferred eucalypt species. This is demonstrated by the absence of records since 2009 and the intermittent nature of previous records from 1980.</p> <p>Assessment</p> <p>This species occasionally utilises parts of the study area during autumn and winter for foraging, and the proposed road upgrade may slightly reduce the amount of potential habitat available for this species during its infrequent migrations to the region. However it is unlikely to impact significantly on this species such that a viable local population would be at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Lathamus discolor

Assessment of significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The proposed road upgrade will result in the removal or modification of approximately 5.95 ha of timbered habitat, which represents potential foraging and roosting habitat. Breeding habitat will not be impacted.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal and Ku-ring-gai Chase National Parks. Given the high-flying behaviour and long distances regularly travelled by this species, including across the Tasman Sea each year, it is not expected that widening of the road will significantly increase fragmentation or isolation.</p> <p>iii. Importance of habitat to be impacted</p> <p>Habitat to be removed by the proposed road upgrade is suitable for this species; it is a small amount of disturbed habitat along the ridge line, which may be less suitable than riparian or coastal habitat with richer soils that can support more abundant flowering events. There will be 5,000 ha of potential habitat retained within the broader study area, the majority of which is protected within national parks. In summary, it is unlikely that the habitat to be removed is of significance to this species.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

Lathamus discolor

Assessment of significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>Given that this species spends time in a number of different states in Australia, there is a National Recovery Plan (Saunders and Tzaros 2011) for this species. There are four objectives to aid the recovery of the swift parrot:-</p> <ol style="list-style-type: none"> 1. To identify and prioritise habitats and sites used by the species across its range, on all land tenures 1. To implement management strategies to protect and improve habitats and sites on all land tenures 2. To monitor and manage the incidence of collisions, competition and beak and feather disease 3. To monitor population trends and distribution throughout the range. <p>Given the low use of the study area by this species, and small area of habitat removal, the proposed road upgrade, while not promoting the objectives of the recovery plan, will not interfere with the recovery of the species.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ol style="list-style-type: none"> 1. Clearing of native vegetation 2. Anthropogenic climate change.

33.2 Conclusion

The proposed road upgrade would lead to the loss of approximately 5.95 hectares of potential foraging and roosting habitat for the swift parrot, but there will be no loss of breeding habitat. Increased fragmentation would not be likely to affect this mobile species. Two key threatening processes would be exacerbated by the proposed road upgrade, but would not have a serious impact on the species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that a local population would decline. A Species Impact Statement is not recommended for this species.

34 Little lorikeet (*Glossopsitta pusilla*)

34.1 Background

The little lorikeet (*Glossopsitta pusilla*) is listed as vulnerable under the TSC Act and is not listed under the EPBC Act.

The little lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs (OEH 2014d). NSW breeding records are mostly from the Western Slopes and north coast and breeding does not occur in the vicinity of Sydney (Higgins 1999).

The little lorikeet forages primarily in the canopy of open forest and woodland. It feeds on nectar from *Eucalyptus*, *Corymbia*, *Angophora*, *Melaleuca* and other tree species when they flower profusely. It also feeds on abundant lerp infestations. Favoured feed trees that may occur in the study area include winter flowering species such as swamp mahogany (*Eucalyptus robusta*), spotted gum (*Corymbia maculata*) red bloodwood, and (*C. gummifera*).

The little lorikeet occasionally feeds on native fruits such as mistletoe. Riparian habitats are often used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (eg paddocks, roadside remnants and urban trees) can help to sustain viable populations of the species. This gregarious species travels and feeds in small flocks, usually of less than 10, but also associates with other species of lorikeets. Flocks numbering hundreds are occasionally observed (OEH 2014d).

The little lorikeet roosts in treetops, often some distance from feeding areas. It nests in small hollows and knotholes, usually high above the ground (2–15 m), in trees such as *Eucalyptus* and *Casuarina* species. Nest trees are often riparian or on river flats, and in close proximity to feeding areas. The nest sites may be used repeatedly for decades, suggesting that preferred sites are limited. The nesting season extends from May to September. In years when flowering is prolific, little lorikeet pairs can breed twice, producing three to four young per brood (Higgins 1999).

The movements of the little lorikeet are poorly understood. In some areas it can be resident, but some seasonal movements are recorded, and across much of its range it is nomadic and irregular. On the NSW coast its arrival is often correlated with the seasonal flowering or fruiting of trees, although the patterns can vary substantially from year to year (Higgins 1999).

The little lorikeet was recorded during surveys in June 2014, approximately one kilometre from the survey area. Approximately 5.95 hectares of marginal potential foraging habitat (woodland) will be removed by the proposed road upgrade, no potential breeding habitat will be impacted.

Glossopsitta pusilla

Assessment of Significance criterion (Seven Part Test)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

The little lorikeet was recorded in study area during targeted threatened bird surveys on 27 May 2014 and 18 Jun 2014 on the Chiltern Trail in Ku-Ring-Gai Chase National Park, approximately 1 km from the survey area. On both occasions approximately ten individuals were recorded flying eastwards in pairs and groups of three within two hours of dawn. They were very high but could be identified by their distinctive calls that are much higher and sharper than those of musk and scaly-breasted lorikeets. Their behaviour suggested that they were commuting to feeding trees on the coastal plain.

There are three records for the study area since 1980 (OEH 2014a). These are from the coastal plain, one from Warriewood (Irrawong Reserve) and two from Narrabeen Lagoon. Pittwater Council (2011) lists three records for the Pittwater LGA that probably match these records.). The species has not been recorded breeding in or near the survey area, and is unlikely to.

Since the little lorikeet feeds on eucalypt blossom and lerps any eucalypt woodland within its range is potential foraging habitat. Thus the open woodland habitat that will be removed is potential foraging habitat, although it is ridge and not riparian so it is not primary habitat. Little lorikeet is a rare, non-breeding visitor to the area.

Life cycle factors

The little lorikeet is highly mobile and/or nomadic. It is a strong flyer and is able to disperse through fragmented landscapes.

Assessment

The proposed road upgrade is unlikely to impact on the breeding ecology, migration or nomadic movements of this species such that any local population declines.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

n/a

Glossopsitta pusilla

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 5.95 ha of potential foraging habitat would be removed or modified under the proposed road upgrade. This is a small area compared with the extensive habitat in the study area (approximately 10,246 ha).</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road, however, the little lorikeet is a powerful flyer that disperses widely and is not restricted by fragmentation of the small scale that would result from the proposed road upgrade</p> <p>iii. Importance of habitat to be impacted Approximately 5.95 ha of habitat would be removed as part of the proposed road upgrade. This habitat is potential foraging habitat but not breeding or roosting habitat. It is on the ridge, so may be less important than riparian and coastal plain habitats for foraging</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for the little lorikeet.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species; a Species Action Statement has placed this species into the landscape species management stream under the <i>Saving our Species</i> program. A targeted approach is currently being developed, but in the meantime, two management actions have been identified:</p> <ul style="list-style-type: none"> · Encourage retention of old-growth and hollow-bearing trees through community engagement and other mechanisms including PVPs, BioBanking and EIA · Avoid burning woodland with old-growth and hollow-bearing trees. <p>The proposed road upgrade does not interfere with the completion of these actions, and therefore is not inconsistent with the objectives and actions.</p>

Glossopsitta pusilla

Assessment of Significance criterion (Seven Part Test)

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

Of the 37 key threatening processes listed in NSW, one is relevant to the proposed road upgrade and little lorikeet:

- Clearing of native vegetation.

The proposed road upgrade involves the clearing of approximately 5.95 ha of timbered habitats containing flowering eucalypts. However, since this is a small fraction of the local habitat and is not likely to be favoured foraging habitat (given the species is a rare non-breeding visitor) it would be unlikely to impact directly on the little lorikeet such that the viability of any population was threatened.

34.2 Conclusion

The proposed road upgrade would lead to the loss of approximately 5.95 hectares of potential foraging habitat for the little lorikeet, but no loss of roosting or breeding habitat. Increased fragmentation would likely not affect this mobile species. One key threatening process would be exacerbated by the proposed road upgrade, but would not have a serious impact on the species. It is unlikely that proposed road upgrade would have a significant impact on the species such that the local population would decline. A Species Impact Statement is not recommended for this species.

35 Barking owl (*Ninox connivens*)

35.1 Background

The barking owl (*Ninox connivens*) is listed as vulnerable under the TSC Act. It is not listed under the EPBC Act. It is widely distributed in Australia except for the central arid regions and Tasmania (Higgins 1999). It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution in NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains and is rarely recorded in the far west or in coastal and escarpment forests (OEH 2014d).

The barking owl usually inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses, but can also utilise denser forests and open areas (OEH 2014a). During the day it roosts in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large eucalypts, often along water courses. It feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. The barking owl lives alone or in pairs. Breeding territories are small compared with other large forest owls, ranging from 30-200 ha (Higgins 1999) but foraging territories are probably much larger at about 2000 ha (OEH 2014a). The species is resident with no seasonal movements. Breeding occurs during late winter and early spring. Three eggs are laid in nests in hollows of large, old eucalypts (Higgins 1990; NPWS 2003; OEH 2014d).

The main threats listed to this species by OEH (2014c) are:

- Clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures
- Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees
- Firewood harvesting resulting in the removal of old trees
- Too-frequent fire which causes degradation of understorey vegetation and reduces habitat and foraging substrate for prey species
- Disturbance of nesting and excessive disturbance of foraging by inappropriate use of call-playback surveys.

The barking owl was not recorded during the field survey. Potential foraging habitat could occur throughout the entire survey area. Potential breeding habitat does not occur along the ridge, but might occur in the headwaters of Narrabeen Creek adjacent to the survey area. The desktop survey identified that this species has previously been recorded in the study area.

Ninox connivens

Assessment of Significance criterion (Seven Part Test)

- a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

The desktop survey identified that barking owl has been recorded eight times within 5 km of the centre of the direct impact area since 1980 (OEH 2014d). Six of these records are from east of the survey area on the shores of Narrabeen Lake in 2012-2013. The other two are from above the coastal escarpment, adjacent to the survey area in 2000 and 2012. However, these may be unreliable records (both have matching records in the Atlas that are identical in all parameters except the species is identified as the powerful owl). Pittwater Council (2011) list the following additional regional records:

- 1978 – Calls at Avalon and Deep Creek in September/October
- 1993 – Sighted in eucalypt woodland near Pittwater Council nursery at Ingleside in December
- 1998 – Sighted numerous times on Scotland Island from January to March
- 1999 – Sighted at Palm Beach in April, Scotland Island in late winter, Warriewood Wetland and south of Taylors Point
- 2003-2007 – Numerous records in Church Point/Bayview
- 2008 – Recorded in Elanora Heights.

There are 23 previous records within the study area (10 km from centre of direct impact area)

Records from elsewhere in northern Sydney are much scarcer. The pattern indicates a fairly local population established (and perhaps expanding) in the Pittwater LGA associated with Narrabeen Lake and surrounding wetland and forest reserves. Members of the population potentially forage up the escarpment in the vicinity of the survey area, although this would not be common and is not confirmed.

Life cycle factors

The survey area contains suitable roosting and breeding habitat either side of Mona Vale Road around the headwaters of Narrabeen Creek. Two large smooth-barked apples (*Angophora costata*) downstream of the road (and below the waterfall) contain hollows large enough for this species to nest in.

Potential foraging habitat occurs along most of the survey area. A variety of potential prey items including possums, rodents and birds (especially parrots) occur in habitat right up to the edge of the existing roadway, even where it is disturbed by power line easements or residential development. Thus approximately 9.87 ha of potential foraging habitat would be lost. In context however, this is a very small amount of (marginal) foraging habitat along the ridge. Considerably greater amounts of habitat exist in the numerous and vast surrounding reserves (eg, Ku-ring-gai Chase and Garigal National Parks and Irrawong Reserve) that provide habitat for the local population.

Ninox connivens

Assessment of Significance criterion (Seven Part Test)

	<p>Assessment</p> <p>The proposed road upgrade would likely not impact directly on breeding activities of the barking owl; it was not detected during preliminary or detailed surveys. Potential breeding habitat occurs just outside of the survey area on Narrabeen Creek, but this will not be impacted. The loss of foraging habitat may have impacts on individuals or pairs foraging or dispersing westwards from Pittwater LGA. This would be unlikely to have an impact that would cause extinction of the local population.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>Approximately 9.87 ha of potential foraging habitat would be removed or modified under the proposed road upgrade. This is a small area compared with the extensive habitat in the study area.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and has potential to decrease the connectivity between Ku-ring-gai Chase and Garigal National Parks. However, barking owl is capable of flying over linear clearings such as roads and utilising habitat in fragmented landscapes. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on any barking owls.</p> <p>iii. Importance of habitat to be impacted</p> <p>The 9.87 ha of habitat that would be lost is suitable potential foraging habitat but not breeding or roosting habitat. It is on the ridge, so may be less important than gully and coastal plain habitats for foraging.</p>

Ninox connivens

Assessment of Significance criterion (Seven Part Test)

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat has been declared for the barking owl.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	<p>The draft NSW recovery plan for the barking owl (NPWS 2003) has the primary objective to recover the species to a position of viability in nature in NSW. The proposed road upgrade may impact on one or more pairs of owls in the survey area, but it is unlikely to lead to a significant impact on or loss of the local population in the study area or wider region.</p> <p>Objective 3 of the recovery plan seeks to undertake threat abatement and mitigation. Specifically the plan seeks to protect nest sites and surrounding habitats, and to protect habitats from developments and activities. The proposed road upgrade would lead to the loss of a small amount of potential foraging habitat, which is not consistent with the objectives of the recovery plan.</p>
g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	<p>Of the 37 key threatening processes listed in NSW, three are relevant to the proposed road upgrade and barking owl:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Loss of hollow-bearing trees · Removal of dead wood and dead trees. <p>The proposed road upgrade involves the clearing of 5.95 ha of timbered habitats (the remaining clearing is heath or disturbed habitat). This will likely involve some large hollow-bearing trees and dead trees. However, since these would not be in favoured breeding habitats it would not impact directly on the barking owl. However, as noted above, the action would potentially reduce habitat for favoured prey species in the survey area.</p>

35.2 Conclusion

The proposed road upgrade would lead to the loss of approximately 9.87 hectares of potential foraging habitat for the barking owl, but no loss of roosting or breeding habitat. Increased fragmentation would likely not affect this mobile species. Three key threatening processes would be exacerbated by the proposed road upgrade, but this would not have a serious impact on the species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that the local population would decline. Therefore, a Species Impact Statement is not recommended for this species.

36 Powerful owl (*Ninox strenua*)

36.1 Background

The powerful owl (*Ninox strenua*) is listed as vulnerable under the New South Wales TSC Act. It is not listed under the EPBC Act. It is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range. It occurs continuously from Mackay Queensland to south-western Victoria at low densities (OEH 2014d). In NSW it is widely distributed throughout the eastern forests from the coast inland to the tablelands, with scattered (and mostly historical) records on the western slopes and plains (OEH 2014a).

Powerful owl occurs in a variety of vegetation types including woodlands, open sclerophyll forests, tall wet forests and rainforests (OEH 2014a). It primarily roosts and nests in densely vegetated gullies of open and tall open forest, but forages in a wider range of habitats, including forests and woodlands within the metropolitan regions of cities (Cooke et al. 2002) and fragmented landscapes (OEH 2014a). It nevertheless requires large tracts of forest or woodland habitat, including a tall shrub layer and abundant hollows supporting high densities of arboreal marsupial prey species (DECC 2006).

The powerful owl roosts in dense mid-canopy trees or tall shrubs (eg turpentine *Syncarpia glomulifera*, black she-oak *Allocasuarina littoralis*, blackwood *Acacia melanoxylon*, rough-barked apple *Angophora floribunda*, cherry ballart *Exocarpos cupressiformis* and rainforest trees (OEH 2014d). These are usually located in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines (DECC 2006). Nesting occurs in large hollows (greater than 450 mm wide and 1 m deep) in eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DECC 2006). Nest trees are typically emergent, and are often the largest and oldest in a stand (Debus and Chafer 1994). Powerful owl is faithful to traditional nesting hollows but can also use other hollows within the nesting gully.

Pairs occupy large home ranges of approximately 300-1500 hectares (Higgins 1999; DECC 2006), utilising various portions of this area at different times, depending on the local abundance of food (Debus and Chafer 1994). Powerful owl preys predominantly on arboreal mammals, particularly the greater glider (*Petauroides volans*) and common ringtail possum (*Pseudocheirus peregrinus*), sugar glider (*Petaurus breviceps*), brushtail possum (*Trichosurus vulpecula*) and flying-foxes (*Pteropus* spp). However, virtually all mammals up to the size of small macropods can be taken, including insectivorous bats, rodents, feral cat (*Felis catus*) and European rabbit (*Oryctolagus cuniculus*), as well as birds and insects (Debus and Chafer 1994; Higgins 1999; DECC 2006).

Powerful owl can breed within urban areas, but the degree of urbanisation that it can tolerate is not known (Cooke et al. 2002). Habitat fragments less than 200 ha are generally not large enough to provide significant habitat for powerful owl in south-eastern NSW (Higgins 1999).

This species is threatened by a number of processes including loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural

development, which also affects the populations of arboreal prey species (OEH 2014d). Other threats include loss of hollow-bearing trees suitable for nesting, disturbance around nest sites (particularly during pre-laying, laying and downy chick stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats (OEH 2014d).

Powerful owl was recorded during the field survey in the study area but not in the survey area. Suitable roosting and nesting habitat was also located in and immediately adjacent to the survey area. Potential foraging habitat occurs within the survey area. The desktop survey identified 36 records within five kilometres of the centre of the direct impact area and 118 within the study area since 1980 (OEH 2014a).

Ninox strenua

Assessment of Significance criterion (Seven Part Test)

- a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

Powerful owl was surveyed for during May 2014 within the within approximately 5 km of the survey area. It was recorded during targeted surveys on 16 and 17 May 2014 to the north of the survey area at two points along Cicada Glenn Creek and Chiltern Road, and north of the end of Chiltern Road near McCarrs Creek in the national park. On 27 May it was recorded calling at dawn from a presumed roost site on private property along Cicada Glenn Creek, approximately 750 m north of the survey area. Suitable roosting and nesting habitat was located in the study area on the south side of Mona Vale Road at the head of Narrabeen Creek (opposite the end of Lane Cove Road). It was also recorded on both the north and south side of Mona Vale Road around Narrabeen Creek.

Approximately 6.59 ha of potential foraging habitat occurs within the survey area. The desktop survey identified 36 records within 5 km from the centre of the footprint since 1980 (OEH 2014a). Records are from all months with no seasonal pattern. Whilst there are records scattered from all around the study area, the majority are clustered east of the study area and below the escarpment at Narrabeen Lake and Irrawong Reserve. There have been over 30 sightings of powerful owls from the Pittwater local government area since 1993 and 2000 from suburbs including Ingleside, Warriewood, Bayview and Church Point (Pittwater Council 2011). The pattern suggests a viable population of powerful owls exists in the study area, which is part of a much larger population in north-eastern Sydney, and is currently tolerant of existing fragmentation and disturbance levels.

Life cycle factors

The survey area contains some suitable breeding habitat at the head of Narrabeen Creek where two large, emergent smooth-barked apples (*Angophora costata*) downstream of the road (and below the waterfall) contain hollows large enough for this species to nest in, it was recorded as occurring within this area during detailed surveys in November 2014. Suitable roosting habitat occurs in moist forest at the head of Narrabeen Creek and on the north side of the road in turpentine trees (*Syncarpia glomulifera*) around the head of Katandra Creek. Suitable habitat also occurs in the study area east of the survey area at the head of Cicada Glenn Creek).

Potential foraging habitat occurs throughout most of the survey area. A variety of potential prey including several possums, grey-headed flying-fox (*Pteropus poliocephalus*), eastern long-nosed bandicoot (*Perameles nasuta*) and birds (especially sulphur-crested cockatoo *Cacatua galerita*) occur in habitat right up to the edge of the existing roadway, even where it is disturbed by power line easements or residential development. During field survey a powerful owl was observed trying to catch common brushtail possum (*Trichosurus vulpecula*) crossing Chiltern Road in the survey area.

Approximately 6.59 ha of potential foraging habitat would be lost due to the proposed road upgrade. More than 12,000 ha of similar habitat occurs throughout the study area and so the proposed road upgrade will result in a very small area being removed (0.0004%). Considerably greater amounts of habitat exist in the numerous and vast surrounding reserves (eg Kuringai Chase and Garigal national parks and Irrawong Reserve) that provide habitat for the local population.

Ninox strenua

Assessment of Significance criterion (Seven Part Test)

	<p>Assessment</p> <p>The proposed road upgrade will not impact on breeding habitat; will a small area downstream of the survey area at Narrabeen Creek. The road upgrade occurs approximately 100 m from this area. The loss of 6.59 ha of foraging habitat is relatively minor compared with the large areas of suitable habitat in surrounding reserves. As such, it is considered unlikely that the proposed road upgrade would have a significant impact on the local population of this species.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>Approximately 6.59 ha of potential foraging habitat would be removed or modified as part of the proposed road upgrade. This is a small area compared with the extensive protected habitat in the study area. Potential nest trees at Narrabeen Creek are outside the construction footprint and would not be lost.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Kuringai Chase and Garigal national parks. However, powerful owl is capable of flying over linear clearings such as roads and utilising habitat in fragmented landscapes. The limited scale and linear nature of habitat fragmentation that would be caused by the proposed road upgrade is not likely to have a significant impact on any powerful owls.</p> <p>iii. Importance of habitat to be impacted</p> <p>Approximately 6.59 ha of potential foraging habitat would be removed but this does not contain any likely breeding or roosting habitat (this would be confirmed during detailed threatened bird surveys in spring/summer)</p>

Ninox strenua

Assessment of Significance criterion (Seven Part Test)

	<p>2014). The habitat to be removed occurs on the ridge, so may be less important than gully habitat for foraging. However, because powerful owls have large territories that they defend against rivals (Higgins 1999), only one or two pairs are likely to use habitat that would be lost. These individuals would be expected to continue utilising suitable habitat within nearby protected areas. Therefore, the majority of the local population would not be affected. Taken together, it is not considered important habitat for the local population's survival.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>The overall objective of the NSW Large Forest Owl Recovery Plan (DECC 2006) is to ensure that viable populations of the three species (including the powerful owl) continue in the wild in NSW in each region where they presently occur. Whilst the proposed road upgrade may impact on one or more pairs of owls in the survey area, it is unlikely to lead to a significant impact on or loss of the local population in the study area or wider region.</p> <p>There are 8 specific objectives in the recovery plan (DECC 2006), of which two are relevant to the proposed road upgrade:</p> <ul style="list-style-type: none"> · Objective 4: Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes. <p>The current assessment is consistent with Objective 4.</p> <ul style="list-style-type: none"> · Objective 5: Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites). <p>The proposed road upgrade will need to keep the loss and fragmentation of habitat to the minimum, but will be on a small scale. There would be no loss or fragmentation of breeding habitat.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>Of the 37 key threatening processes listed in NSW, three are relevant to the proposed road upgrade and powerful owl:</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Loss of hollow-bearing trees · Removal of dead wood and dead trees. <p>The proposed road upgrade involves the clearing of approximately 6.59 ha of woodland and heath. This will likely involve some large hollow-bearing trees and dead trees. However, since these would not be in favoured breeding habitats it would not impact directly on the powerful owl. However, as noted above, it would potentially reduce habitat for favoured prey species in the survey area.</p>

36.2 Conclusion

The proposed road upgrade would lead to the loss of approximately 6.59 hectares of potential foraging or roosting habitat for the powerful owl, but no loss of breeding habitat. One or two pairs might be impacted by the loss of foraging habitat, however it is a relatively small impact compared with retained habitat within the study area. Increased fragmentation would likely not affect this mobile species. Two key threatening processes would be exacerbated by the proposed road upgrade, but would not have a serious impact on the species. It is unlikely that the proposed road upgrade would have a significant impact on the species such that the local population would decline. A Species Impact Statement is not recommended for this species.

37 Eastern pygmy possum (*Cercartetus nanus*)

37.1 Background

The eastern pygmy possum (*Cercartetus nanus*) occurs along the east coast, from South Australia to south-east Queensland and in Tasmania. In New South Wales the species occurs as far west as Pilliga, Dubbo, Parkes and Wagga Wagga (OEH 2013), although its distribution is concentrated on the eastern side of the Great Dividing Range.

This species is found in a variety of habitats including rainforest, sclerophyll forest and woodlands, as well as heath. It requires tree hollows, rotten stumps, holes in the ground, and abandoned bird nests or common ringtail possum (*Pseudocheirus peregrinus*) dreys for sheltering. Tree hollows are preferred for nest building by females (OEH 2013).

Eastern pygmy possum is considered to be mostly solitary, with each individual using several nests over a home range. Young are born at any time of year but most are born in late spring through to early autumn. Females usually give birth to four young at a time and have up to three litters in a year. Young leave the pouch at 30 days and then are left in the nest until 65 days old when they are weaned. Sexual maturity is attained at 4.5 to five months of age (Van Dyck and Strahan 2008).

The species consumes mostly nectar and pollen from banksias, eucalypts and bottlebrushes. A large component of its diet is also insects and fruit (OEH 2013). Home ranges varies greatly in woodland and heath habitats (0.04 - 19.5 hectares), with males having significantly larger home ranges than females (Law et al. 2013).

One eastern pygmy possum was detected within the survey area in December 2013 during preliminary surveys and two more were detected in November 2014. Seventeen individuals were recorded during trapping and nest box surveys for this species approximately three kilometres to the west of the proposed construction footprint. Nest box survey and assessment has detected this species on 23 occasions in four locations within the study area as part of nest box surveys carried out by Pittwater Council (Law 2013).

This species is a habitat generalist and could be expected to utilise woodland and sandstone heath habitats. A total of 6.59 hectares of suitable habitat will be removed or modified during the proposed road upgrade. Approximately 12,678 hectares of this type of habitat occurs within the study area.

Cercartetus nanus

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population Until recently there were few records of this species within the study area and it was considered rare. Recent survey for this species using nest boxes has located substantial populations in Oxford Falls and Ingleside (Law 2013), 500 - 3,000 m from the survey area. Surveys of suitable habitat at a number of sites to the north of the study area have not been able to locate this species, suggesting that the Ingleside and Oxford Falls populations may be important to the persistence of the regional population, There were 27 records within 5 km of the centre of the concept design since 1980, and 159 within the study area (10 km from the centre of direct impact area) (OEH 2014a). Preliminary nocturnal surveys detected this species within the survey area in December 2013 and detailed surveys in November 2014 recorded this species twice, one was captured in a harp trap and the other record was from spotlighting. In summary, recent records suggest that an important viable population occurs within the study area and animals are utilising the survey area. This population apparently favours heathland and heathy woodland on the Ingleside Escarpment (Law 2013; 2014).</p> <p>Life cycle factors This species inhabits heath and woodlands where there are flowering trees, especially banksia. This habitat is abundant in the survey area. Eastern pygmy possum requires hollow bearing trees, rotten stumps, holes in the ground, abandoned bird nests or common ringtail possum dreys for sheltering. Females favour hollows for nesting.</p> <p>Assessment This species appears to be relatively common within the study area and occurs within the survey area (main report and Law 2013). The extent of impact depends on the proportion of the local viable population utilising the habitat to be removed and the extent to which an increase in the width of the road and volume of traffic will have on the population. This requires investigation of the population size and habitat use before a full assessment can be made.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the</p>	<p>n/a</p>

Cercartetus nanus

Assessment of Significance criterion (Seven Part Test)

<p>composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat</p> <p>Approximately 6.59 ha of potential foraging and sheltering habitat would be removed to facilitate the proposed road upgrade.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between individuals on the southern and northern sides of the existing road. This could potentially have two impacts:</p> <p>1. Increased vehicle strikes</p> <p>Eastern pygmy possums are known to travel on the ground and have been killed by cars previously in the survey area. Widening of the road to four lanes will increase the risk of mortality from vehicle strike. However, Roads and Maritime will be installing strategically placed fencing along the road to limit animals from crossing the road and being struck by vehicles. With this mitigation measure, it is unlikely that vehicle strikes will impact the population to the point where it could face local extinction.</p> <p>2. Population isolation</p> <p>The existing road may be a barrier to movement for the current population, although unfenced connectivity exists at Narrabeen Creek through an underpass. The current underpass at Narrabeen Creek will be replaced and include strategic fencing to increase fauna connectivity between Katandra Bushland Sanctuary) and Ingleside Chase Reserve (both known locations for this species). A rope bridge is also proposed at the same location, primarily for small birds, however eastern pygmy possums may also use this.</p> <p>The underpass will be carefully designed to maximise the use of the underpass by pygmy possums, which have been recorded using underpasses in NSW (QDMR 2000). This is the main potential impact of the proposed road upgrade and it is unknown at this stage if the ability to safely cross the road is important to this species. Even if populations on either side of the road are usually separate, fire and other rare stochastic events may make it necessary for animals to move through the landscape. Strategic planting of vegetation to provide cover and funnel animals to the underpass at Narrabeen Creek will be used as well as appropriate predator control to reduce risks associated with crossing by these animals. Monitoring of the underpass at Narrabeen Creek before and after construction is recommended</p> <p>iii. Importance of habitat to be impacted</p> <p>The woodland and heath habitats where this species has been found will be impacted, with 6.59 ha removed as a result of the proposed road upgrade. This habitat is still common throughout the study area and it is unlikely</p>

Cercartetus nanus

Assessment of Significance criterion (Seven Part Test)

	that this amount of removal will significantly impact on the population.
e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat has been declared for this species.
f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan	<p>There is no recovery plan for this species, however it has been designated as a landscape managed species under the <i>Saving our Species</i> program (OEH 2014b). The management actions identified for this species are:</p> <ol style="list-style-type: none"> 1) Conduct field surveys using "Elliot" traps in trees and on the ground and pitfall traps to further delineate distribution and key populations. Avoid periods of cold weather. Areas identified for development should receive high priority 2) Control and monitor abundance of feral predators, especially cats, where there are known populations of eastern pygmy possum in areas of high quality habitat and encourage night-time curfews for cats on urban fringes adjacent to these habitats 3) Provide map of known occurrences to Rural Fire Service and seek fire frequency of >10 years on Bush Fire Risk Management Plan(s), risk register and/or operation map(s) 4) Reserve fire management strategies to include operational guidelines to protect this species from fire, with fire frequency of >10 years 5) Encourage research on appropriate fire and land management regimes for retention and recruitment of eastern pygmy possum habitat 6) Encourage research on the ecology, movements, habitat use and genetics of populations 7) Encourage and support land managers to undertake management actions that benefit the species. <p>As a result of the proposed road upgrade, nest boxes for survey were installed in November 2014 and monitoring is scheduled for early 2015. The results of the first monitoring event (January 2015) included finding one individual (main report). However, the proposed road upgrade will clear a small area of eastern pygmy possum habitat, which is not consistent with the overall aim of the management of this species.</p>

Cercartetus nanus

Assessment of Significance criterion (Seven Part Test)

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| g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP | The proposed road upgrade may exacerbate the following key threatening processes. <ol style="list-style-type: none">1) Clearing of native vegetation2) Climate change (human-caused)3) Predation by dogs4) Predation by European red fox5) Loss of hollow bearing trees. |
|---|--|

37.2 Conclusion

Eastern pygmy possum has been regularly recorded within both the study and survey area, during current surveys and in previous studies (eg Law 2013). The proposed road upgrade will result in the removal of 6.59 hectares of known foraging and breeding habitat for the eastern pygmy possum. The impact of the removal of this amount of habitat for this species is likely to be relatively small compared with other proposed infrastructure in the area.

The key potential impact for this section of the road will be in the potential for increased isolation caused by the widening of the road. A dedicated fauna underpass will allow safe crossing of the road, and a rope bridge may also be used by this species. Use of fauna crossings by eastern pygmy possums could be increased by strategic vegetation planting surrounding each side of the underpass, leading on to areas with installed nest boxes and trees with hollows. Predator monitoring, particularly in and around the underpass, will also be undertaken although there is little evidence that predators change their behaviour as a result of the installation of underpasses (eg Ford and Clevenger 2010) and therefore the primary aim is to facilitate use by the eastern pygmy possum. An SIS is not recommended at this stage.

38 Spotted-tailed quoll (*Dasyurus maculatus*)

38.1 Background

Spotted-tailed quolls (*Dasyurus maculatus*) (listed as endangered under the EPBC Act and vulnerable under the TSC Act) are distributed along the east coast of Australia from Tasmania in the south to Bundaberg in central Queensland. A small sub-population occurs in north Queensland, while in New South Wales (NSW) the species is confined to within 200 kilometres of the coast (OEH 2013).

This species is known to use a variety of habitats, including rainforest, open forest, woodland, coastal heath, inland riparian forest, coast lines and sub-alpine zones. Preferred habitat comprises areas of wet mature forest that contain an abundance of prey (mostly small mammals and birds), and which are free from logging and other anthropogenic disturbances. For denning, the species requires hollow bearing trees, fallen logs, small caves, rock outcrops and rocky cliffs (DoE 2013).

Spotted-tailed quolls are carnivorous marsupials that predominately prey on small to medium sized mammals. Specifically, species most often predated on include the common ringtail possum, common brushtail possum, greater glider, and rabbit. In addition, a range of insects, lizards, poultry, birds, frogs, fish, and other smaller mammals will also form part of their diet.

The breeding season of the spotted-tailed quoll occurs between April to July (Van Dyck and Strahan 2008). Gestation is 21 days, with the female giving birth to four to six young in late July to mid-August. Young are attached to the teat for the first eight weeks but then left in the den until they reach 19 to 21 weeks old (DoE 2013) when they become independent. Both sexes become sexually mature at around one year of age.

There are six previous records of this species within 5 kilometres of the centre of the direct impact area and 20 within the study area (OEH 2014a). One individual was recorded dead (road kill) within the survey area in 1998. Camera traps and active searches were used in an attempt to identify this species in the survey area, but no spotted-tailed quolls or signs of this species were recorded.

Dasyurus maculatus

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population No quolls were recorded during preliminary or detailed surveys. One individual was recorded dead in 1998 within the survey area. Another three records occur south of the survey area in Narrabeen. A more recent record from 2004 occurs in Ku-ring-gai National Park off McCarrs Creek Road, approximately 4.8 km north of the survey site. No signs of this species were recorded during field surveys. This species is rarely seen, even in areas where it is relatively common, so it is possible that a viable population occurs in the study area.</p> <p>Life cycle factors Spotted-tailed quolls inhabit woodlands and open forests (as well as other habitats), and typically occupy large home ranges to satisfy foraging, denning and breeding needs. This species requires trees with large hollows, rocky outcrops or hollow logs for denning, all of which occur within the survey area.</p> <p>Assessment The proposed road upgrade contains potential foraging and denning habitat for spotted-tailed quolls. Approximately 9.87 ha of potential foraging and denning habitat will be removed by the proposed road upgrade which will reduce the availability of these resources in the local area. However, 14,392 ha of similar habitat is still available within the study area. Owing to the species' large home range, any individual would be utilising this habitat infrequently. Given the past and current disturbance and historical loss of connectivity in the study area, it is unlikely that a viable population of spotted-tailed quolls occur within the proposed footprint. As a result, it is unlikely that the proposed road upgrade will significantly impact a viable population of this species to the point where it would go extinct.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Dasyurus maculatus

Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 9.87 ha of potential foraging and denning habitat would be removed under the proposed road upgrade.</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Katandra bushland and the Warriewood escarpment. This is could potentially have two impacts:</p> <p><i>1. Increased vehicle strikes</i> Vehicle strike mortality is a common threat to spotted-tailed quolls. Individuals often feed on road kill beside the road exposing them to an increased likelihood of vehicle strike. Further, the home ranges of the spotted-tailed quoll means that males will travel large distances looking for mates, exposing them to higher risk of vehicle strikes. It is likely that the proposed road upgrade will increase the likelihood of a vehicle strike for individuals that may exist in the study area. However, it is understood that fences and underpasses will be installed along the alignment to stop animals from crossing the road and being struck by vehicles. With this mitigation measure, it is unlikely that vehicle strikes will impact the population to the point where it could face local extinction.</p> <p><i>2. Population isolation</i> Without mitigation, the wider road is likely to deter animals from crossing, which will result in less movement of individuals between Katandra bushland and the Warriewood escarpment. This could isolate individuals and increase inbreeding and the risk of local extinction from stochastic events. There is currently a single fauna underpass. As part of the proposed road upgrade, it is understood that this will be upgraded. This should improve movement between Katandra bushland and the Warriewood escarpment. Therefore it is unlikely that the proposed road upgrade will significantly increase population isolation above that which already exists, and it may in fact be decreased.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the small amount of habitat to be removed is of critical importance to the survival of the species. Habitat currently present is highly disturbed through weed incursion, traffic noise, frequented walking trails and management activities (slashing of grass, track maintenance). Road edges typically allow greater access to introduced species (eg dogs, cats, foxes), that will either predate on, or compete with the spotted-tailed quoll. Low quality disturbed habitat, and the potential high abundance of competitors/predators mean that habitat in the survey area is unlikely to be critical to the survival of the species.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

Dasyurus maculatus

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<ol style="list-style-type: none"> 1) There is no final recovery plan for this species, however it has been designated as a landscape managed species under the Saving our Species program (OEH 2014b). The management objectives for this species under this program are to secure the species in the wild in NSW and that its NSW geographic range is extended or maintained. The objectives for this species are: 2) Establish and maintain regional working groups in south-east and north-east NSW to coordinate research and management. 3) Review survey methods and assess effectiveness of different techniques to identify an optimal survey protocol. Undertake research into new methods, if necessary. 4) Conduct field and community surveys for the Spotted-tailed Quoll in areas where its distribution is poorly known. Areas identified for large-scale urban development (eg Far north coast, Hunter) and coastal reserves should be the highest priority. 5) Map Spotted-tailed Quoll distribution and update as additional data becomes available. 6) Identify study sites across the NSW range and within different habitat types at which long-term population monitoring can be undertaken. 7) Conduct systematic monitoring at key sites. Monitoring sites will be distributed across the NSW range of the Spotted-tailed Quoll and within different habitat types such as Kosciusko NP, Limeburner's Creek NR, northern tablelands and the Blue Mountains. 8) Develop a database and update it regularly to track population trends at monitoring sites, particularly with respect to density and survival of breeding females. 9) Develop standard data collection protocol to maximise information obtained from field surveys. Include procedure for monitoring disease status of wild animals and collecting and storing genetic samples. 10) Collect genetic samples from all Spotted-tailed Quoll populations during field surveys and regular monitoring activities. 11) Continue to undertake research on genetic diversity of populations to guide identification of appropriate genetic management units throughout range. 12) Conduct and publish ecological research on relationship between prey density, den availability and density of females in different habitat types to determine measures of habitat quality. 13) Liaise with key aboriginal groups and document understanding of Spotted-tailed Quoll's local distribution, abundance, ecology and threats. 14) Develop a licence agreement with managers of captive spotted-tailed quoll populations to enable recruitment to captive populations from wild populations. 15) Develop agreement with captive management institutions to facilitate use of captive animals for research when required. 16) Develop a communication strategy to raise public awareness of the Spotted-tailed Quoll, compile education resources and distribute to identify target audience. Support community participation in survey and
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Dasyurus maculatus

Assessment of Significance criterion (Seven Part Test)

- monitoring programs.
- 17) Consult with Aboriginal land managers regarding intended conservation management efforts for Spotted-tailed Quolls on lands of interest to them.
 - 18) Erect signs in areas where road kills are common to alert drivers to the presence of Spotted-tailed Quolls.
 - 19) Identify sections of roads where Spotted-tailed Quolls are frequently killed on roads. Conduct a media campaign to ask for public records of road kills and use data held by the relevant government agencies.
 - 20) At sections of roads where Spotted-tailed Quolls are frequently killed, incorporate methods to reduce the numbers of animals killed. Assess the effectiveness of different mitigation methods.
 - 21) Prepare brochure detailing designs of 'quoll-proof' poultry runs and aviaries and distribute within relevant locations.
 - 22) Seek funding or sponsorship to subsidise landholder costs of modifying poultry runs and aviaries.
 - 23) Habitat requirements of Spotted-tailed Quolls to be adequately conserved within environmental planning instruments and through other legislative protection mechanisms, including property vegetation plans.
 - 24) Develop environmental impact assessment guidelines for the Spotted-tailed Quoll, which includes information on adequate survey methods, survey effort, inappropriate development proposals, and impact mitigation measures.
 - 25) Reserve Fire management Strategy(s) include operational guidelines that protect rocky outcrops and riparian zones within areas of known habitat.
 - 26) Research and publish findings to determine impact of wildfires and prescription burns on populations, with emphasis on prey resources, refugia, impacts of foxes, cats and wild dogs/dingoes.
 - 27) Research disturbance thresholds and adequacy of existing prescriptions for retention of habitat of breeding females in timber production forests.
 - 28) Renegotiate habitat retention prescriptions in IFOAs if they are found to be inadequate following research into disturbance thresholds and habitat requirements of breeding females.
 - 29) Research to investigate interactions between native and exotic predators and their prey to better understand the consequences of 1080 baiting at an ecosystem level.
 - 30) Based on research, develop and implement a protocol for use of poison baits that further reduces impacts on individual Spotted-tailed Quolls.
 - 31) Investigate the demographics of Spotted-tailed Quoll populations and use results to develop viability models for quoll populations.
 - 32) Investigate the impact of fox and wild dog baiting on Spotted-tailed Quoll populations.
 - 33) Assess potential risk Cane Toads pose to populations of quolls.
 - 34) Monitor survival of Spotted-tailed Quoll populations in habitat newly colonised by cane toads.
 - 35) The threat of cane toads to be assessed as part of the DEC Cane Toad Action Plan.

Dasyurus maculatus

Assessment of Significance criterion (Seven Part Test)

	<p>36) Seminar on quoll biology and conservation. The proposed road upgrade will increase habitat loss and fragmentation which will impact objective 22 of the recovery actions.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes.</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Climate change (anthropogenic) · Predation by dogs · Predation by European red fox · Loss of hollow bearing trees.

38.2 Conclusion

Spotted-tailed quolls have been recorded in the study area previously, although most of the records are more than 10 years old (OEH 2014a). One of the records is within the proposed road footprint while others are 2.5 kilometres south. The proposed road upgrade will result in the removal of approximately 9.87 hectares of foraging and denning habitat for the spotted-tail quoll. Current habitat in the survey area is considered poor quality, and is highly disturbed due to its close proximity to an existing busy road and the associated anthropogenic impacts. The removal of a small amount of potential spotted-tailed quoll habitat for this proposed road upgrade is unlikely to increase the likelihood of local extinction of this species, or have an adverse effect on the life cycle of this species.

The increased carriageway width and traffic volume will contribute to a movement barrier for individuals that may persist in the study area. This could further isolate individuals from mating and foraging opportunities as well as increase the risk of vehicle strike mortality. However, the installation of fauna fencing along the road and enhancement of the fauna underpass will reduce this impact to the point where it is unlikely to have a significant impact on the viability of the local population. It is therefore considered unlikely that the proposed road upgrade and associated loss of habitat will significantly impact this species so a Species Impact Statement is not required.

39 Southern brown bandicoot (*Isoodon obesulus*)

39.1 Background

The southern brown bandicoot (*Isoodon obesulus*) is found in New South Wales (NSW), Victoria and South Australia. The species is listed as endangered under the EPBC Act. The subspecies *Isoodon obesulus obesulus* is also listed as endangered in NSW under the TSC Act. The primary reason for the species conservation listing is a severe contraction in its geographic distribution, and subsequently a severe reduction in numbers (TSSC 2001).

The southern brown bandicoot is a medium-sized, ground terrestrial marsupial that inhabits a variety of forest, woodland, and shrub and heath communities (Paull 2008; TSSC 2014). In NSW, the subspecies is predominately found in two areas, including Ku-ring-gai Chase and Garigal National Parks (outside of the study area), and on a variety of land types in the far south (eg national parks, state forests, nature reserves and private land) (DEC 2006). This species can be active diurnally or nocturnally and typically occupies a home-range size of between 0.5 and five hectares (Paull 2008). Preferred food sources include invertebrates, although fungal material can form a supplementary food source (Paull 2008).

The southern brown bandicoot typically nests in a shallow depression in the ground covered by leaf litter, grass or other plant material, which forms a hollow chamber with no distinct entrance or exit (Gordon 1974; DEC 2006; Paull 2008). Females have the ability to reproduce multiple times annually; however the breeding season has been strongly linked to environmental factors such as food availability or photoperiod (Stoddart and Braithwaite 1979). Litter size can range between one and six (Braithwaite 1983; Paull 2008), although juvenile mortality is considered high (Copley et al. 1990; Paull 2008). The gestation period is short, and lasts for an estimated 15 days before neonates enter the pouch for a further two months (Stoddart and Braithwaite 1979; Lobert and Lee 1990). Juvenile bandicoots are independent immediately after leaving the pouch (Stoddart and Braithwaite 1979) and weigh approximately 105-140 grams (Lobert and Lee 1990).

Southern brown bandicoots face multiple threats to their survival. These can include: predation by introduced carnivores (eg foxes, dogs, cats) (Claridge et al. 1991; Paull 1999; Ecotone 2003), habitat loss and modification (Seebeck 1977; Moloney 1982; Aitken 1983; Menkhorst and Seebeck 1990), inappropriate fire regimes (Kemper 1990; DEC 2006), vehicle strikes (DEC 2006), and low genetic diversity and small population sizes (Johnston et al. 2002 *in* DEC 2006).

Isoodon obesulus

Assessment of Significance criterion (Seven Part Test)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viabale local population

There are 29 previous records from OEH (2014a) within 5 km from the centre of the footprint and 300 within the study area (although none since 2010). The last record within the study area was in 2010 (road kill to west of the survey area) (OEH 2014a). Preliminary habitat searches and nocturnal spotlight surveys found no direct or indirect evidence of the southern brown bandicoot. Intensive trapping to the south in Garigal National Park has not located the southern brown bandicoot since 2000, and while it has been trapped in Ku-ring-gai Chase National Park, this has been predominately near Bobbin Head (discussed in Ecosure 2014b). The relatively small home-range size of southern brown bandicoots suggests that individuals found outside of the study area are unlikely to disperse near the survey area. These results indicate that although the southern brown bandicoot may be occasionally encountered, the survey area is unlikely to be an important component of the home range of any members of a viable local population.

Life cycle factors

Potential southern brown bandicoot habitat was located in parts of the survey area. However, the absence of any direct or in-direct evidence to indicate the presence of southern brown bandicoot suggests that the study area does not support a resident population, and as such does not provide an important breeding place.

Assessment

The proposed road upgrade will result in the removal of 6.59 ha of potential southern brown bandicoot habitat. Despite this, the limited records from recent surveys and past intensive trapping in the study area indicates that the road upgrade is unlikely to significantly impact on a viable population to the point where it will be at risk of extinction. Further to this, while records are present for areas outside of the study area, the relatively small home-range size of southern brown bandicoots suggests that individuals in these areas are unlikely to disperse into the survey area and therefore a viable local population will not be put at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

n/a

Isoodon obesulus

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat</p> <p>The proposed road upgrade will result in the removal of approximately 6.59 ha of potential southern brown bandicoot habitat. The extent of this removal is considered small compared to the availability of this habitat type in the study area (12,678 ha).</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal National Park and Ku-ring-gai National Park. While a number of fauna connectivity measures are proposed, it is not clear if these will be beneficial to this species. Southern brown bandicoots are negatively impacted by vehicle strikes. While southern brown bandicoots are considered unlikely to be present in the survey area, proposed fauna connectivity structures and exclusion fencing will reduce the likelihood of road mortality for individuals that may use the survey area in the future.</p> <p>iii. Importance of habitat to be impacted</p> <p>The absence of any direct or in-direct evidence of southern brown bandicoots in the survey area or recent records nearby indicates that the potential habitat being removed is unlikely to be important for the long-term survival of the species in the study area. This is also supported by the greater frequency of records in areas outside of the study area (eg Bobbin Head in Kuringai National Park). Also, given the relatively small home-range size of southern brown bandicoots they are unlikely to disperse long distances to enter the survey area. It is therefore considered that the habitat to be removed is not significant for any local viable population.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

Isoodon obesulus

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.</p>	<p>There is a recovery plan for the southern brown bandicoot under the TSC Act (DEC 2006):</p> <ul style="list-style-type: none"> · Objective 1: To continue state-wide recovery team and establish regional groups to enable efficient Implementation of recovery program · Objective 2: To identify and implement land management practices that assist in the recovery of the species · Objective 3: Clarify the status of the species by better defining its distribution and relative abundance · Objective 4: Undertake research to broaden the knowledge base on the species, gathering critical information to assist in its recovery · Objective 5: Improve community awareness of conservation significance of the southern brown bandicoot. <p>The lack of records from both recent surveys and past intensive trapping in the study area indicates that the proposed road upgrade will not interfere with these objectives or their actions, since it is highly unlikely that this species occurs.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change.

39.2 Conclusion

There are limited historical records of the southern brown bandicoot within the study area; however close to the study area (eg Bobbin Head in Ku-ring-gai Chase) are identified key locations for southern brown bandicoots in NSW. While the southern brown bandicoot has been the subject of intensive trapping to the south in Garigal National Park, it is naturally rare and has not been located there since 2000 (B. Hope pers. comm. 2013 *in* Ecosure 2014b). It has been trapped in Ku-ring-gai Chase National Park, particularly near Bobbin Head; however, the relatively small home-range size of southern brown bandicoots suggests that individuals in these areas are unlikely to disperse into the survey area. As a result, the study area is unlikely to support a viable southern brown bandicoot population, although they may be occasionally encountered (B. Hope pers. comm. 2013). This is further supported by recent preliminary habitat searches and nocturnal spotlight surveys of the survey area that found no direct or indirect evidence of the southern brown bandicoot in the survey area.

The proposed road upgrade will increase the width of the existing road, decrease potential connectivity and subsequently increase the risk of vehicle strike. Southern brown bandicoots are negatively impacted by vehicle strikes; however this species is considered unlikely to regularly utilise habitat within the survey area and if they do, proposed fauna connectivity structures and exclusion fencing will reduce the risk of road kill to the population. In summary, a Species Impact Statement is not recommended for this species.

40 Koala (*Phascolarctos cinereus*)

40.1 Background

The koala (*Phascolarctos cinereus*) is an iconic Australian marsupial and as such has been the focus of nationwide survey effort (Phillips 1990), including state-wide surveys in New South Wales and Queensland (Kikkawa and Walter 1968; Gall 1978; Patterson 1996; Lunney et al. 2009). Analyses of historical koala records are increasingly being used to inform planning outcomes at the local government area level (Lunney et al. 1998; Biolink 2007; Phillips and Hopkins 2009; Ecosure 2013). In Queensland, NSW and the Australian Capital Territory, the koala is listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The koala is also listed as vulnerable in NSW under the *Threatened Species Conservation Act 1995* (TSC Act) and as an endangered population in the Pittwater Local Government Area (LGA).

The koala is a folivorous arboreal marsupial restricted to forests which contain their preferred food tree species (Lee and Martin 1988). Koalas exhibit strong preferences between individual trees species, with species of the genus *Eucalyptus* consumed as a primary source of food, while other genera such as *Corymbia*, *Lophostemon* and *Melaleuca* may also be incorporated into the diet as supplementary browse and/or utilised for other purposes (Lee and Martin 1988; Hindell and Lee 1990; Phillips 1990; Phillips, Callaghan and Thompson 2000; Phillips and Callaghan 2000). Specifically, swamp mahogany (*E. robusta*) and grey gum (*E. propinqua*) are recognised as the most preferred koala food trees, which are found throughout the study area. Due to their highly specialised diet, food availability is thought to be a key determinant of high quality koala habitat (Moore and Foley 2000). High nutrient soils affecting palatability of the leaves (Reed et al. 1988), forest area and landscape configuration are also considered to be involved in the overall desirability of koala habitat (McAlpine et al. 2006).

Koalas are solitary animals with a highly defined social structure at the local aggregation level. Juveniles disperse at around 18 to 36 months to sustain healthy social and mating systems and food availability (Dique et al. 2003). Home range reflects the resource ability for required food, shelter and space for successful reproduction. Therefore an abundance of healthy large food and shelter trees would allow koalas to have smaller home ranges than would an area with fewer resources (Callaghan et al. 2011). Generally, the breeding and primary dispersal seasons for koalas are in spring and summer (Martin and Handasyde 1999).

Key threats to koalas throughout its range are well documented and include road mortality, habitat loss, dog attack and disease. Roads pose a significant threat to koala populations due to habitat loss and fragmentation, as well the high vulnerability of koalas to vehicle collisions (Canfield 1987; Backhouse and Crouch 1990; Kraschnefski, 1999; Dique et al. 2003; DECC 2008; Preece 2009). Koalas are also considered susceptible to low genetic diversity which may be exacerbated by road barriers (DECC 2008; AMBS 2012). In a recent study in south-east Queensland, roads were found to be a key barrier to genetic flow in the

koala population (Dudaniec et al. 2013). The impacts of roads may be reduced by implementing appropriate mitigation measures, which include connectivity structures and exclusion fencing. Historically, there are few records of the koala within the Pittwater and Warringah local government areas; however there are no previous records (OEH 2014a) within the five kilometre of the centre of the direct impact area.

Phascolarctos cinereus

Assessment of significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>There are no previous records within 5 km from the centre of the footprint, although 352 records occur within the study area, with the most recent at West Head in 2013(OEH 2014a). Preliminary targeted searches of preferred koala food trees using the Spot Assessment Technique (SAT), found no direct (observation) or indirect (faecal pellets) evidence of koalas in the survey area.</p> <p>No evidence of koala activity was found during detailed SAT surveys as part of the adjacent upgrade to Mona Vale Road (west), nor was there any evidence recorded during targeted searches of preferred food trees in Ku-ring-gai Chase National Park and West Head. These results indicate that the survey area and nearby connected habitat are unlikely to support a viable local population.</p> <p>Life cycle factors</p> <p>Preferred koala food trees were located in parts of the survey area. However, the absence of any direct or indirect evidence of koalas indicates that the survey area does not support a resident population, and as such does not provide an important breeding place for koalas.</p> <p>Assessment</p> <p>The proposed road upgrade will result in the removal of 5.95 ha of potential koala habitat (this excludes disturbed and heath only vegetation types). Although further detailed surveys have been recommended, preliminary assessments indicate that koalas are unlikely to persist in the survey area. Combined with the absence of koala records from the study area, or from nearby surveys (Mona Vale Road Upgrade West and Ku-ring-gai Chase National Park (Ecosure 2014b), this indicates that the road upgrade is unlikely to impact significantly on a viable population to the point where it will be at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>The above assessment is relevant for the endangered population of koalas within Pittwater LGA.</p>

Phascolarctos cinereus

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat</p> <p>The proposed road upgrade will result in the removal or modification of 5.95 ha of potential koala habitat and preferred koala food trees. The extent of habitat removal is considered small compared to the availability in the region. For example, ridge top woodland constitutes 40% of the vegetation of Warringah local government area, while there is 350 ha of Hornsby Sandstone Exposed Bloodwood Woodland within Pittwater local government area, the primary community that is to be removed as part of the proposed road upgrade.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Garigal and Ku-ring-gai National Parks. Koalas are negatively impacted by increased traffic volumes and subsequent increases to vehicle strike mortalities. While koalas are considered unlikely to be present in the survey area, the implementation of mitigation measures (including fauna connectivity structures and exclusion fencing) would assist in delivering safe passage for koalas (if present) traversing the survey area in the future.</p> <p>iii. Importance of habitat to be impacted</p> <p>The absence of direct or indirect evidence of koala in the study area, or in nearby contiguous habitat (Ku-ring-gai Chase National Park), indicates that the potential koala habitat being removed is unlikely to be important for the long-term survival of the species in the study area. This is also supported by the lack of previous records.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat within the study area has been declared for this species.</p>

Phascolarctos cinereus

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is a recovery plan for the koala under the TSC Act (DECC 2008). This recovery plan uses seven specific objectives that align with those outlined in the National Koala Conservation Strategy (ANZECC 1998):</p> <ul style="list-style-type: none"> · Objective 1: To conserve koalas in their existing habitat · Objective 2: To rehabilitate and restore koala habitat and populations · Objective 3: To develop a better understanding of the conservation biology of koalas · Objective 4: To ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local scale · Objective 5: To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care · Objective 6: To manage over-browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat · Objective 7: To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW. <p>The absence of any previous records within 5 km of the study area, coupled with no direct or indirect evidence of koala during recent preliminary surveys, indicates that the proposed road upgrade will not interfere with these objectives or their actions.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening process that is relevant to this species.</p> <p>1) Clearing of native vegetation</p> <p>Despite this, the unlikely presence of koala individuals or populations in the survey area means that the potential impact of this key threatening process on the koala is unlikely to be increased by the proposed road upgrade.</p>

40.2 Conclusion

The proposed road upgrade will result in the removal of a small amount of potential koala habitat and preferred koala food trees, as well as an increase in the width of the existing road and a decrease in potential connectivity. Koalas are negatively impacted by increased traffic volumes through consequent increases in vehicle strike mortality. Although historically there are a few records of the koala within the Pittwater and Warringah local government areas, there are no previous records within 5 kilometres from the centre of the footprint, although 552 records occur within the study area (OEH 2014a). In addition, preliminary targeted searches of preferred koala food trees found no direct (observation) or indirect (faecal pellets) evidence of koalas in the survey area. Additional detailed surveys as part of the adjacent upgrade to Mona Vale Road (west) found no evidence of koala activity, nor were there any evidence recorded during targeted searches of preferred food trees in Kuring-gai Chase National Park and West Head. These results indicate that the survey area and nearby connected habitat are unlikely to support a viable local population.

Koalas are considered unlikely to be present in the survey area in sufficient numbers for a viable local population (there may be the occasional transient individual). As such, any impacts relating to the proposed road upgrade are unlikely to have an adverse effect on any local koala population. Nonetheless, mitigation measures implemented into road design, such as fauna connectivity structures and exclusion fencing, will contribute to connectivity if individuals traverse the survey area in the future. Owing to the lack of evidence for koalas in the survey area, and assuming the aforementioned mitigation measures are implemented, there is unlikely to be a significant impact on this species, and it is recommended that a Species Impact Statement is not required.

41 Eastern freetail-bat (*Mormopterus norfolkensis*)

41.1 Background

The eastern freetail-bat (*Mormopterus norfolkensis*) is listed as vulnerable under the TSC Act, but not listed under the EPBC Act. They are found along the east coast of New South Wales, from near Brisbane to the south of Sydney (Churchill 2008). Preferred habitat is typically dry eucalypt forest and woodland on the coastal side of the Great Dividing Range where they favour open spaces (Churchill 2008). They are occasionally found in wet sclerophyll forest, swamp forest and mangroves (OEH 2013).

This species is known to roost in the following:

- Tree hollows, particularly hollow spouts of large mature trees
- Roofs of buildings
- Under exfoliating bark on trees
- Man-made objects (roost boxes, under caps on telephone poles etc.).

Birth of young occurs in late November to early December. Females lactate until January, and juveniles leave the maternity roost in January. The eastern freetail-bat forages in openings and gaps in the forest; however their diet is unknown (Churchill 2008). Maternity roosts seem to be relatively small and may not require large congregations of bats, unlike other similar species (McConville 2013).

This species was not recorded during the field surveys and records in the study area are scarce (four since 1980), one previous record occurs within five kilometres of the centre of the study area (OEH 2014a). The survey area contains both potential foraging and roosting habitat for this species.

Mormopterus norfolkensis
Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>Four records occur for this species within the study area since 1980, suggesting that this species is rarely recorded. These data indicate that although recorded numbers are low and the absence of this species in echolocation call and harp trap data suggests that if it does occur in the survey area, it is a rare visitor. As such it is unlikely that a viable local population occurs.</p> <p>Life cycle factors</p> <p>Little is known about the life history of this species. They are known to roost in hollow limbs of trees. Young are born in late November to early December (Churchill 2008). This species is thought to be primarily solitary although it has been recorded communally.</p> <p>Assessment</p> <p>The direct impact area contains approximately 6.59 ha of potential foraging and roosting habitat for eastern freetail-bats. This will marginally reduce roosting and foraging habitat within the study area. However, the number of hollow trees to be removed is relatively small, and large hollow bearing trees will remain outside of the survey area, particularly around Narrabeen Creek. This species is highly mobile so the removal of some roosting locations and foraging habitat is unlikely to significantly impact the local population to the point that it is at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Mormopterus norfolkensis

Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat</p> <p>Approximately 6.59 ha of potential foraging habitat would be removed by the proposed road upgrade. A portion of this habitat contains tree hollows and trees with exfoliating bark which could also be used for roosting. However, the density of tree-hollows is relatively low across the survey area, and the area removed is small compared with available habitat in the around (12,678 ha within the study area).</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Katandra bushland and the Warriewood escarpment. Bonsen (2012) found that eastern freetail-bats generally only occur in low development areas and generally avoid urbanisation. However, recent (2009 and 2010) records in urban areas (near St Ives) suggest that this species at least occasionally travels through urban areas and across roads (Atlas of Living Australia 2013). Traffic on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026) following the road upgrade, although the majority of this increase will occur during the day, when bats are not active. The increased traffic may result in higher mortality rates through vehicle strikes but this increase is unlikely to significantly impact the long term survival of the species. Further, eastern freetail-bats are highly mobile and are unlikely to be significantly impacted by the relatively small decrease in connectivity caused by the road widening.</p> <p>iii. Importance of habitat to be impacted</p> <p>It is unlikely that the small amount of habitat to be removed is of critical importance to the survival of a viable local population. The habitat available for foraging in the footprint is currently disturbed by traffic noise and lights which would reduce its suitability for foraging. It is unlikely that the habitat to be impacted is important for the long-term survival of the species in the area.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species.</p>

Mormopterus norfolkensis

Assessment of Significance criterion (Seven Part Test)

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	The proposed road upgrade will exacerbate the following key threatening processes. <ul style="list-style-type: none">· Clearing of native vegetation· Climate change (human-caused)· Loss of hollow-bearing trees. These threatening processes could impact this species.
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41.2 Conclusion

This species has been recorded only once in the study area in 2004 (2.5 kilometres north-east of the survey area) (OEH 2014a), but has been recorded several times within the Pittwater local government area. The proposed road upgrade will result in the removal of 6.59 hectares of foraging and roosting habitat for the eastern freetail-bat. This habitat is considered to be of poor quality for foraging and roosting as it is along an existing busy road and is disturbed by traffic and artificial light sources. The removal of the small amount of disturbed habitat is unlikely to significantly increase the likelihood of local extinction of this species, or have an adverse effect on the life cycle of the species. Vehicle strikes may have a greater impact due to traffic associated with the increased road capacity although this is unlikely to significantly affect the long-term survival of the species. It is therefore unlikely that the action will cause a significant impact on the species, and a Species Impact Statement is not recommended.

42 Little bentwing-bat (*Miniopterus australis*)

42.1 Background

Little bentwing-bats are listed as vulnerable under the TSC Act and are not listed under the EPBC Act. They are found along the coast of eastern Australia from Cape York to Sydney (Churchill 2008). They are found in a range of habitats including rainforest, vine thicket, wet and dry eucalypt forest, *Melaleuca* swamps and coastal forests (Churchill 2008).

This species forms large maternity colonies in caves during the summer months. Only five maternity colonies are known to occur in Australia. In New South Wales the largest maternity colony is found with a maternity colony of eastern bentwing-bats (*Miniopterus orianae oceansis*) at Willi Willi bat cave, near Kempsey. In winter the bats disperse and are known to roost in caves, abandoned mines and tunnels, stormwater drains, buildings and tree hollows.

Mating is thought to occur in July and August. Maternity colonies are established in November and young are born in December (B. Law, pers. comm August 2014). Little bentwing-bats are known to consume mostly beetles, moths, flies and spiders (Churchill 2008). They forage rapidly between shrubs and canopy layers (OEH 2014d).

A possible call from this species was detected during this survey, at Narrabeen Creek. This species has been regularly detected in the Warringah LGA (Bonsen 2012; B. Law, pers. comm August 2014) The closest previously recorded location to the survey area is approximately 700 metres away, in Katandra Bushland Sanctuary.

Miniopterus australis

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population Since 1980, there has been nine records of this species within 5 km from the centre of the footprint. The study area has had 26 records in the same time period. In 2005 this species was recorded 700 m north of the existing road in Katandra Bushland Sanctuary, approximately 1 km to the north of the survey area. This species occurs in communal maternity roosts and there are no known maternity roosts within the study area, the closest being at Willi Willi, more than 400 km to the north. The species echolocation call was possibly recorded at a rock shelf on Narrabeen Creek. The species is known to roost outside the breeding season in culverts, caves and rarely in hollow rainforest trees. Small caves, rock crevices and culverts do occur in the study area although surveys have confirmed that the majority of these are not likely to be suitable for roosting. Little bentwing bat forages in woodland which occurs within the survey area.</p> <p>Life cycle factors The survey area contains foraging habitat and potential marginal roosting habitat in the form of rock crevices underneath an overhang at Narrabeen Creek. If used for roosting by this species, then it would be transitory only as it is not considered optimal habitat for them (refer to main report for detailed discussion) There are no known maternity roosts within the study area, with the closest at Avalon (approximately 14 km away), which they share with Eastern bentwing-bats.</p> <p>Assessment The proposed impact area contains potential foraging and roosting habitat for little bentwing-bat. Approximately 6.59 ha of potential foraging habitat will be removed. Narrabeen Creek contains some marginal roosting habitat, however this area will be protected, with the road design going to the north in this area. No maternity roosts will be impacted by the proposed road upgrade. This species is highly mobile so the removal of some roosting locations and foraging habitat is unlikely to significantly impact the local population to the point that they are at risk of extinction. The proposed road upgrade will increase the number of cars travelling through the area and increase noise and light pollution which could impact this species. However, this road is already very busy, with traffic noise and lights present all night. This impact is likely to be increased but not to the extent that the species is placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>

Miniopterus australis

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 6.59 ha of potential foraging habitat would be removed under the proposed road upgrade. Traffic, traffic noise and artificial lighting will all increase under the proposed road upgrade and this could impact bats directly through increased vehicle strikes or through a decrease in habitat quality. Traffic during peak periods on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026). This is an increase of approximately 30 % during peak periods. This increase could increase the number of bats killed through road kill although it is difficult to know what the impact on the population of any increased road kill without long term monitoring and microbats road kill rates are difficult to estimate as recorded bat casualties are frequently underestimated (Lesinski et al, 2011).</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and has the potential decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood escarpment, if no revegetation of that corridor through Narrabeen Creek so that connectivity will be maintained or improved. Little bentwing-bats are also highly mobile and are likely to be able to cross the road, meaning that the habitat fragmentation that may occur as a result of the proposed road upgrade will not be significant for this species. There is a small risk of increased vehicle strikes which are likely to increase with the proposed road upgrade.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the small amount of habitat to be removed is of critical importance to the survival of the species. The foraging habitat to be removed is currently disturbed by traffic noise and lights so it is unlikely to be preferred foraging habitat, since little bentwing-bats seems to avoid urban areas (Blackthorn 2013).</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>

Miniopterus australis

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, however it has been designated as a site managed species under the <i>Saving our Species</i> program (OEH 2014b). The management objectives for this species under this program are to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act. Conservation actions are proposed for a site at Willi Willi, north west of Kempsey which is more than 400 km from the study area. The proposed road upgrade will not interfere with these management objectives.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ol style="list-style-type: none"> 1) Clearing of native vegetation 2) Anthropogenic climate change.

42.2 Conclusion

The proposed road upgrade will result in the removal 6.59 hectares of potential foraging and roosting habitat for little bentwing-bat. This habitat is generally of poor to moderate quality as it is along an existing busy road and is disturbed by traffic and artificial light sources. The proposed road upgrade will further decrease habitat quality by increasing traffic noise and artificial lighting. There is also a small potential risk of increased mortality of bats through vehicle strikes as the number of vehicles travelling on the road is likely to increase. Given the high mobility of this species, the removal of the small amount of disturbed habitat and an increase in the number of vehicles using the road is unlikely to significantly increase the likelihood of local extinction of this species or have an adverse effect on the life cycle of the species. Therefore a Species Impact Statement is not recommended.

43 Eastern bentwing-bat (*Miniopterus orianae oceanensis*)

43.1 Background

The eastern bentwing-bat (*Miniopterus orianae oceanensis*) is listed as vulnerable under the TSC Act, and is found along the coast of eastern Australia from Cape York to Castlemaine (Churchill 2008). This species is not listed under the EPBC Act. Preferred habitat types typically include rainforest, wet and dry eucalypt forest, monsoon forest, open woodland, *Melaleuca* swamps and open grasslands (Churchill 2008).

Eastern bentwing-bats are primarily cave dwellers, but also use abandoned mines and road culverts. This species forms communal maternity roosts in caves that are used annually. Populations of this species are usually centred on this maternity cave; however individuals will disperse to other caves outside the breeding season. There are only four known maternity caves in New South Wales (NSW), with the closest known site 200 kilometres south-west of Mona Vale in Bungonia (Churchill 2008). In southern Australia, eastern bentwing-bats are known to hibernate during the winter (Churchill 2008).

Mating takes place in May and June but implantation is delayed until August. Maternal colonies are formed in October, and young are born from December to mid-January (Churchill 2008). Females leave the maternity roost in March while juveniles leave a few weeks later by April.

Eastern bent-wing bats are known to consume mostly moths, but they also feed on flies, cockroaches and beetles (Churchill 2008). Foraging usually takes place above the canopy; however individuals will also forage close to the ground in open areas.

Harp trapping and echolocation call detection surveys were undertaken by Ecosure in December 2013, May 2014 and November 2014. Additional echolocation call detection surveys were also undertaken in May 2014 for this species within the survey area. Calls were recorded within the survey area near the end of Ingleside Road and adjacent to Narrabeen Creek. There are 241 records for this species in the study area since 1994 with at least 20 within five kilometres of the centre of the direct impact area.

Miniopterus orianae oceanensis

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population This species has been regularly recorded within the study area since 1994 (OEH 2014a) and was recorded just outside of the survey area. The species was recorded in 2014 during field surveys within the survey area, (near the end of Ingleside Road and at Narrabeen Creek). This species is a communal maternity rooster and there are no known maternity roosts within the study area, with the closest at Avalon which it shares with the little bentwing-bat. The species is known to roost outside the breeding season in caves, road culverts and abandoned mines, which do occur in the survey area, but no optimal habitat is present. The overhang at Narrabeen Creek may be used during transit, but this will not be impacted by the proposed road upgrade with the alignment going to the north in this area. The species forages in woodland that is abundant in the area, and the study area is likely to support a local population.</p> <p>Life cycle factors Approximately 6.59 ha of foraging habitat will be removed as a result of the proposed road upgrade. There are no known maternity roosts within the study area.</p> <p>Assessment The proposed impact area contains potential foraging and roosting habitat for eastern bentwing-bat. Approximately 6.59 ha of potential foraging habitat will be removed or modified. No maternity roosts will be impacted by the proposed road upgrade. This species is highly mobile so the removal of some roosting locations and foraging habitat is unlikely to significantly impact any local population to the point that they become at risk of extinction. The proposed road upgrade will increase the number of vehicles travelling through the area, and will increase noise and light pollution that could impact this species. While these impacts are likely to be increased, it is considered unlikely to be to the extent that a viable local population is placed at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Miniopterus orianae oceanensis

Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 6.59 ha of potential foraging habitat would be removed or modified under the proposed road upgrade. Traffic, traffic noise and artificial lighting will all increase under the proposed road upgrade and this could impact bats directly through increased vehicle strikes or indirectly through a decrease in habitat quality. Traffic during peak periods on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026). This is an increase of approximately 30% during peak periods, and some increase in off peak times. An increased number of cars during off peak periods (particularly at night) could present a greater risk as the cars will likely be travelling at a faster speed than during peak times. This increase could lead to more bats killed through vehicle strike, although it is difficult to estimate the level of impact on the population of any increased road kill without long term monitoring.</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood escarpment. Eastern bentwing-bats are highly mobile and are unlikely to be significantly impacted by an increase in size of the existing road. It is however possible that some individuals will be killed through vehicle strikes which are likely to increase with the proposed road upgrade.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the small amount of habitat to be removed is of critical importance to the survival of the species. The foraging habitat available in the survey area is currently disturbed by noise and lights associated with road use and design, and as a result it is unlikely to be preferred foraging habitat. It is therefore considered unlikely that the habitat to be impacted is important for the long-term survival of the species in the study area.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, however it has been designated as a site managed species under the <i>Saving our Species</i> program (OEH 2013). The management objectives for this species under this program are to secure the species in the wild for 100 years and maintain its conservation status under the TSC Act. Conservation actions are proposed for four sites in NSW, all more than 100 km from the study area. The proposed road upgrade will not interfere with these management objectives.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ul style="list-style-type: none"> · Clearing of native vegetation · Anthropogenic climate change.

43.2 Conclusion

The proposed road upgrade will result in the removal of 6.59 hectares of foraging habitat for eastern bentwing-bat. The most likely area for roosting, at Narrabeen Creek will be avoided as part of the road design and measures will be taken to avoid any impact to this area. The foraging habitat which will be removed is generally of poor to moderate quality as it is along an existing busy road and is disturbed by traffic and artificial light sources. The proposed road upgrade will further decrease habitat quality by increasing traffic noise and artificial lighting. There is also the potential for increased mortality of bats through vehicle strikes as the number of vehicles travelling on the road is likely to increase. Given the high mobility of this species, increased fragmentation is unlikely to impact on connectivity of this species. In addition, the removal of the small amount of disturbed habitat and an increase in the number of vehicles using the road is unlikely to increase the likelihood of local extinction of this species, or have an adverse effect on the life cycle of the species. Therefore, no significant impacts from the proposed action are expected and a Species Impact Statement is not required for this species.

44 Grey-headed flying-fox (*Pteropus poliocephalus*)

44.1 Background

The grey-headed flying fox (*Pteropus poliocephalus*) is listed as vulnerable under the *TSC Act* and *EPBC Act*. It primarily occurs in the coastal belt from central Queensland to Victoria, however, it occasionally ranges into South Australia and is frequently observed west of the Great Dividing Range (Tidemann 1998). The relative abundance of this species varies widely within its distribution between seasons and from year to year (Eby and Lunney 2002).

The grey-headed flying-fox typically roosts near water on exposed branches, and can form aggregations (camps) ranging from a few individuals to over 70,000. The species utilises a range of vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. It is often found in highly modified vegetation in urban and suburban areas (van der Ree 2006).

Mating occurs in early autumn and females give birth to a single young each year in September/October after a six month gestation (Van Dyck and Strahan 2008). Initially the young are carried around by the mother, but after several weeks they are left in the camp while the mother forages. The young remain in the camp until January/February when they leave to forage for themselves (Churchill 2008). The grey-headed flying-fox has a diverse diet of nectar, pollen and fruit which is derived from native and introduced plants. The species usually forages within 15 kilometres of roost sites but will migrate over greater distances in response to the availability of food resources (Eby and Lunney 2002). Sedentary individuals form the core population of continuously occupied camps. However, the majority are highly nomadic and move several hundred kilometres each year in largely unpredictable patterns (DoE 2013). The key threats to this species include (DoE 2013):

- Habitat loss and fragmentation
- Culling for orchard protection
- Competition and hybridisation
- Pollutants, electrocution and pathogens.

There are 28 records of grey-headed flying-fox within five kilometres of the centre of the direct impact area, and 494 within the study area. More than 300 of grey-headed flying-fox were counted flying west over the proposed footprint at dusk during the field surveys conducted by Ecosure in May 2014. Many individuals were also observed foraging in the trees along the roadside. No camps were recorded within the road corridor but two known camps occur in the study area. A camp containing this species occurs less than two kilometres from the proposed impact area in Warriewood and a smaller camp at Avalon. At a count in May 2014 the camp contained between 5,000 and 10,000 grey-headed flying-fox (DoE 2014).

Pteropus poliocephalus

Assessment of Significance criterion (Seven Part Test)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

The grey-headed flying-fox has been recorded foraging within the survey area. A camp for this species occurs less than 2 km (in Warriewood) (this is a camp is currently not nationally important) (DoE 2014) from the survey area but no camps were recorded within the survey area or immediate surrounds. This species has a viable local population, which is likely to forage in the study area.

Life cycle factors

This species communally roosts. It is likely that the roost at Warriewood is also used as a natal site. This species is highly nomadic and travels large distances in response to flowering eucalypts and fruiting trees. Juveniles are born in September/October and are carried with the females for several weeks and then left in the maternity camp.

Assessment

The direct impact area will require the removal or modification of 6.59 ha of potential foraging habitat for the grey-headed flying-fox. Flowering eucalypts and fruiting trees within the study area will provide a seasonal food resource for the population. Some potential foraging trees will be directly removed by the proposed road upgrade, which will reduce the number of trees available for food in the local area. However, the number of trees to be removed will be small compared to the large area of suitable foraging habitat which will remain within the study area. This species is highly mobile and can travel large distances for food resources. The removal of some food trees is unlikely to significantly impact the local population to the point that they are risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

n/a

Pteropus poliocephalus

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 6.59 ha of potential foraging habitat would be removed under the proposed road upgrade. This foraging habitat includes eucalypts and other flowering and fruiting trees.</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Katandra bushland and the Warriewood escarpment. However, the widening of the road is unlikely to significantly increase the barrier effect for the species given that it is highly mobile.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the small amount of habitat to be removed is important to the survival of the species, since 12,678 ha of similar habitat will be retained and no camps will be impacted. The foraging habitat available in the footprint is currently disturbed by edge effects from the road (eg traffic noise and lights) so it is unlikely to be preferred foraging habitat. No camps were recorded within the proposed road upgrade and no suitable roosting locations (along creeks, mangroves etc) were observed. Therefore it is unlikely that the habitat to be impacted is important habitat for the long-term survival of a viable local population.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>Critical habitat for the grey-headed flying-fox is defined when the roost meets particular criteria. No roosts occur within the design footprint so it is unlikely that the proposed road upgrade will directly or indirectly impact critical habitat.</p>

Pteropus poliocephalus

Assessment of Significance criterion (Seven Part Test)

<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>The draft national recovery plan for the grey-headed flying-fox (DECCW 2009) lists the following objectives:</p> <ul style="list-style-type: none"> · To reduce the impact of threatening processes on grey-headed flying-foxes and arrest decline throughout the species' range · To conserve the functional roles of grey-headed flying-foxes in seed dispersal and pollination · To improve the standard of information available to guide recovery of the grey-headed flying-fox, in order to increase community knowledge of the species and reduce the impact of negative public attitudes on the species. <p>The proposed road upgrade is inconsistent with the objectives of the recovery plan, as it does not contribute to conservation of this species.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species</p> <ol style="list-style-type: none"> 1. Clearing of native vegetation 2. Climate change (human-caused).

44.2 Conclusion

The proposed road upgrade will result in the removal of approximately 6.59 hectares of foraging habitat for grey-headed flying-fox; however, no roosting habitat will be impacted by the proposed road upgrade. The removal of this small amount of disturbed habitat for this species is unlikely to increase the likelihood of local extinction, or have an adverse effect on the life cycle of the species. It is therefore unlikely that the action will cause a significant impact, and a Species Impact Statement is not recommended.

45 Greater broad-nosed bat (*Scoteanax rueppellii*)

45.1 Background

The greater broad-nosed bat (*Scoteanax rueppellii*) is listed as vulnerable under the TSC Act. It is not listed under the EPBC Act.

This species is found along the coast of eastern Australia from Atherton in Queensland to north eastern Victoria (Churchill 2008). Preferred habitat varies and can include woodland, wet and dry eucalypt forest and rainforest; however they are most commonly recorded in tall wet forest (Churchill 2008).

This species usually roosts in tree hollows but is occasionally found roosting in buildings (OEH 2013). Females congregate in maternity sites within suitable tree hollows. Young are generally born in January (Churchill 2008).

Greater broad-nosed bats are known to consume beetles and possibly other insects, and have been recorded preying on other bat species. This species generally forages just after sunset along river and creek corridors (Churchill 2008).

There are three previous records of this species within the study area, but none were detected within the survey area or nearby Mona Vale Road West area during preliminary or detailed surveys.

Scoteanax rueppellii
Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population Harp trapping and echolocation call detection surveys in December 2013, May and November 2014 did not detect this species. There are three previous records within the study area, one of which, recorded in 2008 lies 2 km north of the survey area and another, from 1996 lies 3.7 km south off Wakehurst Parkway, in Oxford Falls.</p> <p>Life cycle factors The species roosts almost exclusively in tree hollows. Maternity colonies are also formed inside tree hollows.</p> <p>Assessment The proposed road upgrade requires the removal of 5.95 ha of potential foraging and roosting habitat (woodland) for the greater broad-nosed bat. This species is highly mobile so the removal of some roosting locations and foraging habitat is unlikely to impact the local population to the point that they are at risk of extinction.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Scoteanax rueppellii
Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat Approximately 5.95 ha of potential foraging and roosting habitat would be removed or modified as part of the proposed road upgrade. Some of this habitat contains tree hollows that could also be used for roosting.</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood escarpment. Greater broad-nosed bats are however highly mobile and are likely to be able to cross the road. Traffic, noise and artificial lighting will all increase under the proposed road upgrade and this could impact bats directly through increased vehicle strikes or through a decrease in habitat quality. Traffic during peak periods on the road is predicted to increase by approximately 30%: from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026). Mortality from vehicle strike is likely to increase with the proposed road upgrade given the projected additional traffic, however this is considered to be a minimal increased risk.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the small amount of habitat to be removed is of importance to the survival of a viable local population, given that 12,678 ha of similar habitat is still available within the study area, much of which is within national parks and council reserves within the study area. The habitat available in the footprint for foraging is currently disturbed by traffic noise and lights which would make it less desirable for foraging. Hollow-bearing trees are at a low density (estimated at three per/ha). Therefore, it is unlikely that the habitat to be impacted is important for the long-term survival of a local viable population.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, however it has been designated as a site managed species under the Saving our Species program (OEH 2014b). The management objectives for this species under this program are to secure the species in the wild in NSW and that its NSW geographic range is extended or maintained. Relevant management actions include:</p> <ul style="list-style-type: none"> · Prepare Environmental Impact Assessment guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, and structural diversity. Give priority to largest hollow bearing trees · Identify the effects of fragmentation on the species in a range of fragmented landscapes, such as cleared coastal river valleys. For example movement and persistence across a range of fragment sizes · Research the degree of long-term fidelity to roost trees and roosting areas in order to assess their importance and the effects of their removal · Identify important foraging range and key habitat components for this species. <p>The proposed road upgrade will not interfere with the implementation of these management actions.</p>

Scoteanax rueppellii**Assessment of Significance criterion (Seven Part Test)**

g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP	The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species. 1) Clearing of native vegetation 2) Anthropogenic climate change 3) Loss of hollow bearing trees.
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45.2 Conclusion

The proposed road upgrade will result in the removal of 5.95 hectares of foraging and roosting habitat for the greater broad-nosed bat. This habitat is generally of poor to moderate quality as it is along an existing busy road and is currently disturbed by traffic and artificial light sources. These disturbance sources will be exacerbated by the proposed road upgrade. Despite this, the high mobility of this species means that the removal of the small amount of habitat and an increase in vehicle usage is unlikely to significantly increase the possibility of local extinction of this species, or have an adverse effect on the life cycle of the species. Therefore, no significant impacts from the proposed road upgrade are expected and a Species Impact Statement is not required for this species.

46 Southern myotis (*Myotis macropus*)

46.1 Background

Southern myotis (*Myotis macropus*) is listed as vulnerable under the TSC Act however it is not listed under the EPBC Act. Its distribution extends along the coast from Kimberley in Western Australia, east along the coast through the Northern Territory, Queensland, New South Wales (NSW), Victoria to South Australia. This species is found along streams and permanent waterways in a variety of habitats including woodlands, rainforests and wet sclerophyll forests. Roosting occurs near water in caves, tree hollows, amongst vegetation, under bridges and in mines, tunnels, culverts and stormwater drains (OEH 2013). They are also known to roost in disused fairy martin (*Petrochelidon ariel*) nests. Individuals roost alone, in pairs or in small groups (Churchill 2008).

In NSW, southern myotis usually have two litters of a single young per year in October and January. Gestation is 12 weeks, with the female pregnant with the second young while lactating for the first. The young are weaned after eight weeks and then the mother and young forage together for a further three to four weeks (Churchill 2008).

This species consumes insects, small fish and prawns, which they capture by dragging their feet over the water surface (OEH 2013). They prefer to forage over still water rather than flowing streams. Insects including termites, flies, ants, moths, beetles and cockroaches are also caught during flight (Churchill 2008).

Harp trapping and echolocation call detection surveys were conducted in December 2013, May 2014 and November 2014 across the survey area. One southern myotis was captured in the survey area on Narrabeen Creek under a large rock shelf. This species echolocation call was also possibly detected at Narrabeen Creek, but it is almost impossible to distinguish its call from long-eared bats (*Nyctophilus* sp). There are 30 previous records within the study area since 2007.

Myotis macropus

Assessment of Significance criterion (Seven Part Test)

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>Viable local population</p> <p>This species was captured in the survey area during 2014 field surveys under a rock shelf on Narrabeen Creek, is has also been possibly detected by bat detector. Thirty records occur within the study area, all since 2007. It is likely that a viable local population occurs within the study area and occasionally utilises the survey area.</p> <p>Life cycle factors</p> <p>The survey area contains no permanent foraging habitat for this species. This species generally roosts near water but there is no permanent water in the survey area so it is unlikely that this species is roosting permanently, it may be utilising Narrabeen Creek for occasional foraging or roosting. It is likely that the species infrequently forages in or travels through the survey area.</p> <p>Assessment</p> <p>This species requires water, preferably still pools, to forage for insects and small fish. No large permanent creeks or pools occur within the survey area. No permanent foraging habitat occurs within the survey area and it is unlikely that this species is roosting in the survey area due to a lack of waterbodies. The proposed road upgrade is unlikely to significantly impact the life cycle of a viable population of this species.</p>
<p>b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction</p>	<p>n/a</p>
<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <p>i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>	<p>n/a</p>

Myotis macropus

Assessment of Significance criterion (Seven Part Test)

<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <p>i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and</p> <p>ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</p> <p>iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.</p>	<p>i. Extent of impact on habitat No significant foraging or roosting habitat for southern myotis will be impacted in the survey area by the proposed road upgrade. It is possible that some individuals may occasionally roost in the overhangs, hollow trees and rock crevices within the survey area, but this is unlikely to be for long periods or be significant habitat for this species due to the lack of permanent water.</p> <p>ii. Habitat fragmentation The proposed road upgrade will increase the width of the existing road and has the potential to decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood escarpment. However, it is unlikely that this species is using the survey area for any significant periods of time and as this species is highly mobile, it is unlikely to be significantly impacted by any increased fragmentation caused by widening the road.</p> <p>iii. Importance of habitat to be impacted It is unlikely that the habitat in the survey area is important for this species. There are no permanent waterbodies within the survey area which could be used for foraging. It is unlikely that any significant numbers of southern myotis are using the area for roosting. Therefore, it is unlikely that the habitat to be impacted is important for the long-term survival of the species in the area.</p>
<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan for this species, however it has been designated as a site managed species under the Saving our Species program (OEH 2014b). The management objectives for this species under this program are to secure the species in the wild and that its NSW geographic range is extended or maintained. The objectives for this species are:</p> <ul style="list-style-type: none"> · Ensure the largest hollow bearing trees in riparian zones are given highest priority for retention in PVP assessments or other land clearing assessment tools · Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity, structural diversity. Give priority to largest hollow bearing trees · Investigate the effectiveness of logging prescriptions · Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes · Identify, protect and enhance roost habitat beneath artificial structures (eg bridges), especially when due for replacement, and assess effectiveness of the actions · Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species · Promote roosting habitat in new artificial structures within the species range · Better regulate pollution of waterways eg sewage and fertilizer run-off (eutrophication) and

Myotis macropus

Assessment of Significance criterion (Seven Part Test)

	<p>pesticide/herbicide leakage (chemical pollution) and thermal pollution</p> <ul style="list-style-type: none"> · Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation · Research to identify important foraging range and key habitat components for this species. Identify the importance of riparian vegetation to the species · Determine susceptibility to logging · Identify the spatial population structure, including genetic isolation, movement and persistence across the species range. · Survey large inland waterways for this species to determine distribution in Murray Darling Basin · Resolve species taxonomy by morphology/genetics and reassess conservation status · Assess the importance by survey of estuaries and other tidal waterways for the species across its range. <p>The most relevant objectives for the proposed road upgrade include retention of hollow-bearing trees, and promotion of artificial roosting habitat. The proposed road upgrade will not interfere with these objectives. These objectives will be considered when developing mitigation measures for any environmental management plans.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ol style="list-style-type: none"> 1) Clearing of native vegetation 2) Anthropogenic climate change 3) Loss of hollow bearing trees.

46.2 Conclusion

The proposed road upgrade is unlikely to remove any important habitat for southern myotis, since the overhang and ephemeral pool at the bottom of the waterfall at Narrabeen Creek will not be impacted. It is possible that the species occasionally roosts in caves and hollow trees in the survey area; however, given its preference for habitat near waterbodies the survey area is unlikely to be important habitat for the species. No significant impacts from the proposed road upgrade are expected and a Species Impact Statement is not recommended for this species.

47 Large-eared pied bat (*Chalinolobus dwyeri*)

47.1 Background

The large-eared pied bat (*Chalinolobus dwyeri*) is a medium-sized insectivorous bat with shiny black fur, large ears and a white stripe on their vent (OEH 2014d). They are listed as vulnerable under both the New South Wales TSC Act and the EPBC Act.

The distribution of the large-eared pied bat is not well known, but appears to be patchy and naturally rare. In NSW the largest concentrations are known from the Sydney Basin and north-west slopes. Only four maternity roosts have been confirmed, with two of these no longer being used. A potential maternity cave is being investigated at Michael's Cave in Avalon (B. Law pers. comm.). One maternity roost is located in a disused mine in Barraba (250 kilometres from study area), the other is in a sandstone cave in Coonabarabran, about 400 kilometres north west of the study area (DoE 2013).

Large-eared pied bats have been recorded from a diverse range of vegetation types including (Churchill 2008):

- Dry and wet sclerophyll forest
- Cyprus pine (*Callitris glauca*) dominated forest
- Tall open eucalypt forest with a rainforest sub-canopy
- Sub-alpine woodland
- Sandstone outcrop country.

This species is known to roost in:

- Sandstone cliffs, especially in the vicinity of fertile woodland valleys, such as box gum woodlands or river/rainforest corridors which are used for foraging
- Disused mine shafts
- Caves
- Overhangs
- Disused fairy martin (*Petrochelidon ariel*) nests (OEH 2014d)
- Road culverts.

Mating is assumed to occur in early winter with females giving birth by early December. Females usually give birth to two young that leave the maternity roost by March. The required structure of the maternity roost site is very specific, comprising caves with arched roofs with indentations, and which are also deep enough to allow juvenile bats to learn to fly. Maternity roosts are thought to be occupied between September and April.

Found in well-timbered areas containing gullies, the diet of the large-eared pied bat is assumed to consist entirely of insects (Churchill 2008).

The large-eared pied bat has been recorded within the study area in Oxford Falls, at three locations quite close to Wakehurst Parkway, a busy road similar to Mona Vale Road (Bonsen 2012). Surveys for both this project and Mona Vale Road West have recorded a number of calls that could possibly belong to this species, but it was not possible to obtain a long enough sequence of good quality calls to definitively identify this species.

Chalinolobus dwyeri

Assessment of Significance criterion (Seven Part Test)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Viable local population

This species has been recorded at Oxford Falls, approximately 5 km from the survey area. Calls tentatively attributed to this species were recorded at Narrabeen Creek within the survey area during preliminary biodiversity surveys (see main report). Searches of the rock shelf found that there were few roosting locations for this species, with most of the shelf being too low or exposed to allow safe roosting for bats. The shelf had small sections of honeycombing in the roof that may be used occasionally by small numbers of bats. Another three calls from this species were possibly recorded within the road corridor 3 km west near Tumburra Street during the current field surveys. These calls could not be positively identified due to a short, fragmented duration. The species was also recorded recently within 1 km of the survey area (Bonsen 2012) at Ingleside. No known maternity roosts occur within the local area and no caves or mine shafts suitable for maternity roosts were identified during the surveys. The rock shelf on Narrabeen Creek provides limited and marginal roosting habitat and is unlikely to be a significant roost site for this species. It is possible that a population of large-eared pied bats occur near or within the vicinity of the proposed road upgrade, but we have not been able to confirm this. Taking a precautionary approach, we assume that there is a viable local population.

Life cycle factors

Two confirmed maternity roosts are known to be used in NSW. A third maternity cave is being investigated at Michaels Cave in Avalon (approximately 14 km north-east of the study area). No confirmed maternity caves have been recorded near the footprint. The species requires large domed caves (or mine shafts) with indentations for breeding. They are sensitive to disturbances during breeding and roosts have been abandoned due to disturbance from people and animals.

Assessment

The proposed road upgrade may result in the removal of some potential roosting and foraging habitat. The action will remove approximately 6.59 ha of foraging habitat (primarily woodland), which is unlikely to significantly impact on a viable population, to the point where there is a risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

n/a

Chalinolobus dwyeri

Assessment of Significance criterion (Seven Part Test)

<p>c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	<p>n/a</p>
<p>d) In relation to the habitat of a threatened species, population or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	<p>i. Extent of impact on habitat</p> <p>Approximately 6.59 ha of potential foraging habitat would be removed under the proposed road upgrade. The best roosting habitat is the overhang at Narrabeen Creek which will not be impacted, the road design goes to the north in this section.</p> <p>Traffic, traffic noise and artificial lighting will all increase under the proposed road upgrade and this could impact bats directly through increased vehicle strikes or through a decrease in habitat quality. Traffic on the road is predicted to increase from 10,482 cars per day (both east and west bound in 2011) to 13,423 cars per day (both east and west bound in 2026) following the road upgrade, although the majority of this increase will occur during the day when bats are not typically mobile. This may increase the risk of road kill to this species, but likely not to be significant.</p> <p>ii. Habitat fragmentation</p> <p>The proposed road upgrade will increase the width of the existing road and decrease the connectivity between Katandra Bushland Sanctuary and the Warriewood escarpment. Large-eared pied bats are a highly mobile species but may still be negatively impacted by increased traffic and vehicle strikes. Further investigation is required to determine the extent and distribution of this species within the road corridor.</p> <p>iii. Importance of habitat to be impacted</p> <p>This species has been recorded in low numbers nearby in Ingleside (B.Law pers comm. 2014) so if this species exists within the study area, it may be an important regional population and therefore the foraging and roosting habitat to be removed may be important. There are no known maternity roosts within the footprint and surveys within the road footprint did not locate any caves that may be suitable in the future. The foraging habitat available in the footprint may not be of high quality due to traffic noise and lights, but given that we cannot yet confirm the occurrence or distribution of the population within the study area, we have assumed it is foraging habitat. However it is considered to be marginal and there is 12,678 ha of similar habitat remaining within the study area.</p>

Chalinolobus dwyeri

Assessment of Significance criterion (Seven Part Test)

<p>e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</p>	<p>No critical habitat has been declared for this species.</p>
<p>f) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan</p>	<p>There is no recovery plan under the TSC Act, However, the National Recovery Plan for the large-eared pied bat lists five specific objectives (DERM 2011):</p> <ul style="list-style-type: none"> · Identify priority roost site and maternity sites for protection · Implement conservation and management strategies for priority sites · Educate the community and industry to understand and participate in the conservation of the large-eared pied bat · Research the large-eared pied bat to augment biological and ecological data to enable conservation management · Determine the meta-population dynamics throughout the distribution of the large-eared pied bat. <p>The proposed road upgrade will not interfere with these objectives, and further investigation may contribute to understanding the distribution and requirements of this species.</p>
<p>g) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP</p>	<p>The proposed road upgrade will exacerbate the following key threatening processes that are relevant to this species.</p> <ol style="list-style-type: none"> 1) Clearing of native vegetation 2) Anthropogenic climate change 3) Loss of hollow-bearing trees.

47.2 Conclusion

Until recently, large-eared pied bat had not been recorded within the Pittwater or Warringah Local Government Areas. Recent confirmed sightings of this species have demonstrated its occurrence within the study area (Bonsen 2012), and possible calls from this species were recorded on Narrabeen Creek at a rock shelf on the southern side of Mona Vale Road within the survey area. Further investigations of the rock shelf found that the shelf is unlikely to be a significant roosting location due to vulnerability to predators and lack of microhabitat locations for roosting. However, potential foraging habitat occurs within the study area. No maternal roosting habitat has been identified within the study area. The proposed road upgrade will result in the removal of 6.59 hectares of marginal foraging habitat for and will not impact on roosting habitat. The disturbed nature of the habitat surrounding the road, and impacts from traffic and artificial light sources mean it is not likely to be important to this species. The occurrence and distribution of this species within the local and regional areas is not well understood, however it is considered that this small amount of clearing is unlikely to be important, particularly as potential roosting habitat at Narrabeen Creek will not be impacted. Therefore, it is not recommended that a species impact statement is prepared for this species.

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Revision History

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00	11/12/2014	Mona Vale East Detailed Biodiversity Investigation Report: Volume 2 Assessments of Significance	Dr Elvira Lanham, Senior Ecologist; Nathan Smith, Senior Botanist; Nicola Head, Ecologist	Nathan Smith, Senior Botanist, David James, Principal Ecologist and Dr Frank Lemckert, Principal Ecologist	Dr Alan House, Principal Ecologist
01	02/03/2015	Mona Vale East Detailed Biodiversity Investigation Report: Volume 2 Assessments of Significance. DR2	Dr Elvira Lanham, Senior Ecologist; Nicola Head, Ecologist	Beth Kramer, Senior Environmental Scientist/Gold Coast Manager	Beth Kramer, Senior Environmental Scientist/Gold Coast Manager
02	01/05/2015	Mona Vale East Detailed Biodiversity Investigation Report: Volume 2 Assessments of Significance. Final	Dr Elvira Lanham, Senior Ecologist; Nicola Head, Ecologist	Beth Kramer, Senior Environmental Scientist/Gold Coast Manager	Beth Kramer, Senior Environmental Scientist/Gold Coast Manager

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