Chapter 5

Assessment of Likely Impacts on Threatened Species and Populations

This chapter covers the following Director General's Requirements:

DGR 5. ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS

5.1 Assessment of Likely Impacts

5.1.1 Direct Impacts of Development

The primary and direct impact resulting from the proposed development is the loss of vegetation and associated habitat within the Subject Site. **Figure 4.2** shows the distribution of the vegetation communities mapped within the Subject Site. The areas of vegetation retained and removed as a result of the proposed works, including APZ establishment, are shown on **Figure 5.1**.

Coordinate System: MGA Zone 56 (GDA 94)

Figure 5.1. Vegetation removed and retained on the Subject Land

i. Vegetation communities

The Subject Site is approximately 1.06 ha in size, 0.85 ha of which consists of the native vegetation community Littoral Rainforest, in various condition classes, which is listed as an EEC under the TSC Act and a CEEC under the EPBC Act (in parts). The proposed development will result in the complete removal of a total of 0.05 ha (6%) of all Littoral Rainforest, which is made up of 0.04 ha of good quality, and 0.01 ha of poor quality Littoral Rainforest. Additionally, a further 0.15 ha (17%) of the total area of Littoral Rainforest will be modified as part of an APZ and other purposes, which is made up of 0.10 ha of good quality vegetation and 0.04 ha of poor quality examples of this community (**Figure 4.2**). The remaining areas of the Subject Site are comprised of urban native/exotic vegetation and existing buildings and an unsealed driveway.

Portions of all condition classes of Littoral Rainforest will be removed as a result of the proposal. A more detailed discussion of impacts to the EEC and CEEC recorded within the Subject Site and Study Area is provided in **Chapter 6**. An area of the urban exotic/native vegetation will also be removed and some will form part of landscaping within the APZ, which will include a simplified form of Littoral Rainforest.

ii. Loss of specific habitat features

The following key threatening processes are applicable to the habitat to be removed from the Subject Site:

- Clearing of native vegetation;
- Bushrock removal; and
- Removal of dead wood and dead trees.

The key threatening processes listed above, as occurring as a result of the proposal, will remove suitable features for a range of native fauna species including threatened species. The habitat most likely utilised by threatened species is within areas of Littoral Rainforest. These areas provide suitable foraging habitat for threatened bat and bird species known to occur in the locality. Additional habitat likely to be utilised by threatened species is the small caves that exist at the base of bushrock. These caves may provide suitable roosting habitat for threatened bat species known to occur within the locality.

However, the proposed development has considered of retention of bushrock, and to the greatest extent possible, including within the modified driveway alignment and building envelope placement. All large rock outcrops will be retained, and any small areas of bushrock required to be removed as part of the proposed works, will be retained elsewhere on the Subject Site.

Although suitable habitat features for threatened species will be removed and modified, these impacts are considered to have only minor impacts on the threatened species likely to utilise them. The habitat to be removed is relatively small and suitable habitat will be retained

within the Subject Site and locality, including the adjoining Attunga Reserve. Additionally, connectivity to suitable habitat within reserves will also be retained.

iii. Threatened species

The clearing of habitat within the Subject Site will directly remove potential habitat for highly mobile threatened fauna species such as the Superb Fruit-Dove, Barking Owl, Powerful Owl, several microchiropteran bats and Grey-headed Flying-fox. Additionally, some threatened species such as Squirrel Glider may use the Subject Site as part of a local corridor, but would not utilise the habitats present on the Subject Site to a large extent, due to a very low density of forage species present and a lack of denning habitat. Local population of this species are therefore considered to be impacted by the proposal to a very minor extent. The threatened population of koalas in Pittwater have no foraging habitat on the Subject Site, and would be unlikely to utilise the habitats present, except as part of a movement corridor for occasional individuals in the area. For these reasons, the Pittwater threatened population of Koala is not considered as an 'affected species', as discussed in **Section 5.2**.

With the exception of some of the microchiropteran bats, the majority of these threatened species are likely to only utilise the habitat within the Subject Site as part of a much broader foraging range. The suitable roosting habitat for microchiropteran bats is likely utilised for breeding or nursing and is unlikely to be important to the long-term survival of a local population.

Although suitable habitat for threatened species will be impacted as a result of the proposal, the impacts are not seen to significantly impact any of these species such that a local population would be placed at risk of extinction in the short or long-term. Suitable habitat for all affected species will be retained within the Subject Site and locality, and connectivity to offsite reserves containing suitable habitat will also be retained.

5.1.2 Indirect Impacts of Development

i. Habitat fragmentation

The clearing of vegetation as a result of the proposal will result in habitat fragmentation. Habitat fragmentation is the process whereby habitat loss results in the division of large, continuous habitats into small, isolated habitat fragments (Ewers and Didham, 2006). The area between fragments is typically man-made and largely inhabited by the species that previously existed in the area. The ecological impacts of habitat fragmentation include (Andrews, 1990):

- Changes in the number of species in fragments;
- Changes to the composition of faunal assemblages; and
- Changes to ecological processes in fragments such as food chains, predator-prey interactions, plant-animal pollination and dispersal associations.

The proposal will remove approximately 0.05 ha of native vegetation habitat within the Subject Site and modify a further 0.15 ha. The vegetation and associated habitats in the Study Area and locality are affected by fragmentation due to urban development. The proposed removal of this small area of vegetation and habitat would add further to the existing levels of fragmentation and reduce faunal corridors over current conditions. However, the proposal will not completely isolate the habitat present as connectivity will remain to offsite habitat.

ii. Edge effects

"Edge effects" are impacts occurring at an interface between natural environments and disturbed or developed land. The following are types of edge effects can occur (Murcia, 1995):

- Abiotic effects, involving changes in the environmental conditions that result from proximity to a structurally dissimilar matrix;
- Direct biological effects, which involve changes in the abundance and distribution of species caused directly by the physical conditions near the edge; and
- Indirect biological effects which involve changes in species interactions, such as predation, competition, herbivory and biotic pollination and seed dispersal.

Given that the Subject Site has previously been developed and disturbed areas already exist, the vegetation within the Subject Site currently experiences the negative impacts of edge effects. The proposal will further increase the edge effects on the vegetation and habitat within the Subject Site as additional structures will be constructed and approximately 0.05 ha of vegetation will be removed and 0.15 ha of vegetation modified. Although the proposal will increase the edge effects on vegetation and habitat within the Subject Site, these effects are likely to have only minor impacts on the flora and fauna present as they currently utilise habitat experiencing these effects.

iii. Increased light penetration to rainforest

At the margins of the clearing area, there will be an increase in the light penetration of the rainforest vegetation. This has the potential to alter the structure of the community and may favour the growth of exotic species at the rainforest edges. This may reduce the habitat suitability for some fauna species, including birds such as the Superb Fruit-dove. However, for the majority of threatened fauna with potential to occur, slightly increased light penetration at the margins of the rainforest vegetation is unlikely to result in the habitat being unsuitable for foraging.

Potential roosting habitat for the Powerful Owl may be reduced due to increased light penetration, although structured and intact rainforest habitat will remain un-affected in the upslope portions of the Subject Site, and within the adjoining Attunga Reserve.

iv. Alteration to hydrological regimes

Changes to drainage can affect the integrity, structure and composition of habitat and thus, have secondary impacts on the species that rely on them. As detailed in S4.1 - Water Management within the SEE, there is little surface run-off on the Subject Site, as the substrate is highly permeable, and the site is predominantly vegetated. A minor drainage depression runs from a discharge point from the adjoining lot to the northwest, and runs through the centre of the Subject Site. This drainage line is not defined as a watercourse for the purposes of the *Water Management Act 2000*.

The proposal will slightly modify the hydrological regimes of the Subject Site due to the increased run-off from the future dwellings, and installation of minor drainage structures including outlet pipes and a rocky 'rip-rap' channel beneath the driveway. However, generally, the existing drainage depression and its course will be maintained, while the additional run-off from the proposed future dwellings will be diverted to onsite detention basins, as detailed in the Stormwater Management Plan (Martens & Associates, 2015).

Sediment and erosion controls will also be implemented to further reduce any potential impacts on waterways during the construction phase of the project.

v. Increased sedimentation and erosion

Increased sediment and eroded material can smother retained vegetation, cause dieback of herbs and shrubs and reduce regeneration of groundcover species. Sediment and eroded material can also contain weed matter and nutrients. Sediment and erosion controls will be implemented to reduce any potential impacts on waterways during the construction phase of the project. The design also includes the installation of stormwater drains to ensure that stormwater will be channelled to an appropriate location and ensures sedimentation and erosion do not occur downslope more than at present.

5.2 Assessment of Species Likely to be Affected

DGR 5.1 Assessment of species likely to be affected

> *An assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action (Section 110(2)(b)).*

Affected species are defined within the SIS as subject species and populations likely to be affected by the proposal. The impacts include the direct impact of loss of habitat through clearing and/or indirect impacts. The species and populations and communities selected as "affected" include threatened fauna species that are known to occur in the locality and are known to utilise Littoral Rainforest for foraging and/or roosting.

The following threatened species and populations include those that are considered most likely be affected by the proposal and are therefore assessed in subsequent sections of this chapter:

- Superb Fruit-Dove;

- Powerful Owl;
- Barking Owl;
- Eastern Bentwing-bat;
- Large-eared Pied Bat;
- Little Bentwing-bat;
- Greater Broadnosed Bat;
- Grey-headed Flying-fox; and
- Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill

5.3 Analysis of Affected Species

The following DGRs have been addressed for each affected species and populations.

DGR 5.2 *Discussion of local and regional abundance and distribution*

An estimate for the local and regional abundance of those species or populations (Section 110(2)(d))

DGR 5.2.1 *Discussion of other known local populations*

DGR 5.3 *Assessment of habitat*

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f)).

DGR 5.3.1 *Description of habitat values*

DGR 5.3.2 *Discussion of habitat utilisation*

DGR 5.4 *Discussion of conservation status*

For each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it (Section 110(2)(c)).

An assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region (Section 110(2)(e)).

An assessment of whether any of those species or populations is at the limit of its known distribution (Section 110(2)(e1)).

DGR 5.5 *Discussion of the likely effect of the proposal at local and regional scales*

A full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region

DGR 5.5.1 *Significance within a local context*

DGR 5.5.2 *Discussion of connectivity*

DGR 5.5.3 *Consideration of threatening processes*

5.3.1 Superb Fruit-Dove (Ptilinopus superbus)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are no known records of the Superb Fruit-Dove in the Pittwater LGA and only one individual has been recorded in the locality dating back to 1992 (see **Figure 3.2**) (OEH, 2015b; Pittwater Council, 2015). The only record of the species from the locality is from Avalon beach to the north. The date and low number of records for this species indicates that there is not a local population present within the Study Area. Furthermore, the Study Area is relatively small and no individuals have been recorded within it. Therefore, any individuals utilising the Study Area would form a component of the broader population ranging outside of the locality.

b. Discussion of other known regional populations

The Superb Fruit-Dove is found mainly from north-eastern Queensland to north-eastern NSW, becoming less common further south where it is typically confined to patches of closed forests. Species records do exist as far south as Victoria and Tasmania, but these are believed to be vagrant records (OEH, 2012b).

Within the greater Sydney metropolitan area, the species has previously been recorded in Sydney Harbour National Park, Brisbane Water National Park and Berowra Valley Regional Park (OEH, 2012b).

ii. Assessment of habitat

a. Description of habitat values

The Superb Fruit-Dove occurs primarily in rainforest habitats and similar closed forests and less often in eucalypt or acacia woodland. The species feeds on fruit high in the canopy and builds a nest within trees and shrubs. Breeding habitat for the species consists of rainforest

vegetation where nests are made between 5-30 m off the ground in shrubs and trees (OEH, 2012b).

The Subject Site provides limited foraging habitat in the form of rainforest canopy and shrub species. The most suitable foraging habitat for the Superb Fruit-Dove within the Subject Site is present in areas of Littoral Rainforest with a closed native canopy and native dominated understorey. Additional foraging habitat located within the Subject Site and Study Area includes known feed trees such as Camphor Laurel and fig trees.

No breeding habitat is present as the Superb Fruit-Dove is not known to breed in the Pittwater CMA sub-region (OEH, 2012b).

b. Discussion of habitat utilisation

The Subject Site offers limited sub-optimal foraging habitat for the Superb Fruit-Dove which is a highly mobile species that accesses resources from across a wide area. Within the Pittwater CMA sub-region, the species is only known as a rare winter visitor. With consideration of the above, the species would likely only utilise the site during winter as part of a much broader foraging range and it would not depend upon resources contained on the Subject Site for its survival.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Superb Fruit-Dove is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2012b).

b. Threatening processes

The following key threatening processes are known to affect the Superb Fruit Dove:

- Clearing and degradation of rainforest remnants (OEH, 2012b).

c. Habitat requirements

The Superb Fruit-Dove requires rainforest and similar closed forests with high canopy trees. The species forages amongst figs, palms, and other fruit-bearing trees within rainforest, closed forest vegetation and occasionally in eucalypt or acacia woodland. Roosting also takes place in rainforest vegetation where nests are made between 5-30 m off the ground in shrubs and trees; however the species is not known to breed in the Pittwater CMA sub-region (OEH, 2012b).

d. Other documentation

The Superb Fruit-Dove has a targeted management strategy developed under the Saving Our Species Program. The major objective of the program is to secure critical populations of the species in NSW in the long-term. No threat abatement plan is relevant to the species and

no critical habitat has been identified by the Director General of the OEH for the species (OEH, 2012b).

e. Assessment of adequacy of reservation

Less than 10% of the species' total population occurs within NSW; however there are known occurrences of the species in both urban areas and conservation reserves throughout the greater Sydney region. Conservation areas where the species is known to occur include Sydney Harbour National Park, Brisbane Water National Park and Berowra Valley Regional Park. These reserves may provide adequate foraging habitat for the species during its winter visits; however none of the reserves have been identified as key management sites for the species (OEH, 2012b).

f. Limit of known distribution

Less than 10% of the species' total population occurs within NSW. Within NSW, the Superb Fruit-Dove's known distribution occurs from Victoria to Queensland primarily along the coasts and as far inland as Muswellbrook (OEH, 2012b). The study area falls within the known distribution of this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a very small area of potential, albeit sub-optimal, foraging habitat for the species in relation to the habitat within the locality. The clearance of this small area of potential foraging habitat is not considered significant within the local context as larger areas of higher quality habitat remain within the locality and wider region. These areas of higher quality habitat are more likely to provide foraging habitat for this species.

b. Discussion of connectivity

Suitable habitat for the Superb Fruit-Dove within the Study Area and Subject Site has connectivity to the Attunga Reserve (7.95ha) located directly east of the Subject Site, the Angophora Reserve (18.5 ha) to the north and the Crown of Newport Reserve (4.12 ha) to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides, the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment available habitat for this species within the Subject Site to some extent; however suitable habitat for the species will be retained on-site and connectivity will remain to off-site reserves. Additionally, the species is highly mobile and able to migrate to areas of suitable habitat that are not connected. Due to this, the proposed development will not likely affect habitat connectivity for the Superb Fruit-Dove within the Subject Site or the locality.

c. Consideration of threatening processes

The Superb Fruit-Dove may be generally threatened by the following processes:

- Clearing and degradation of rainforest remnants

The rainforest remnants to be removed as a result of the proposal are not considered to form significant habitat for this species as it does not breed in the locality and vegetation available would be utilised solely for foraging. Furthermore, suitable foraging habitat for the species will remain on-site and in the locality within Attunga Reserve.

5.3.2 Barking Owl (Ninox connivens)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are four known records of the Barking Owl in the Pittwater LGA and 17 records within the locality, with records as recent as 2014 (see **Figure 3.2**) (OEH, 2014a; OEH, 2015b). Occurrences within the Pittwater LGA and the locality are from Scotland Island, Church Point, the Bilgola Plateau and Warriewood.

The Study Area is relatively small and no individuals have been detected within it. This species has a large foraging range of up to 6000 ha, with 2000 ha being more common within NSW habitats. Therefore, any individuals utilising the Study Area would likely form a component of the broader population ranging outside of the locality.

b. Discussion of other known regional populations

The Barking Owl occurs throughout the mainland of Australia except for the central and arid regions. Within the greater Sydney metropolitan area, the Barking Owl has been recorded within both urban areas and areas of intact bushland. Urban records from the region range from Penrith to the west, Cowan to the north, Watsons Bay to the east and south. The species has also been recorded in the nearby Garigal and Ku-ring-gai Chase National Parks, along with four occurrences just south of Narrabeen Lagoon (OEH, 2014a).

ii. Assessment of habitat

a. Description of habitat values

The Barking Owl occurs in a variety of habitats such as woodland, open forest, fragmented remnants and partly cleared farmland. The species utilises trees with hollows and dense foliage for roosting and forages in a variety of habitats, but prefers areas containing tree hollows suitable for arboreal mammals (OEH, 2014a).

The Subject Site provides little to no suitable roosting habitat for the Barking Owl as the vegetation of the site lacks suitable hollows. Some potential foraging habitat is present; however it is not preferred foraging habitat as the site lacks hollows suitable for arboreal mammals, the primary prey of this species.

b. Discussion of habitat utilisation

The Subject Site offers sub-optimal foraging habitat for the barking owl and no suitable roosting habitat. As the species has a large territory and is highly mobile, the Subject Site may be utilised as part of a much larger foraging range, but this species would not be dependent on the site for survival.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Barking Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2014a).

b. Threatening processes

The following key threatening processes are known to affect the Barking Owl:

- Clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures;
- Inappropriate forest harvesting practices that remove old, hollow-bearing trees and change open forest structure to dense regrowth;
- Firewood harvesting resulting in the removal of fallen logs and felling of large dead trees;
- Too-frequent fire leading to degradation of understorey vegetation which provides shelter and foraging substrates for prey species; and
- Disturbance of nesting and excessive disturbance of foraging by inappropriate use of call-playback surveys (OEH, 2014a).

c. Habitat requirements

The Barking Owl occurs throughout mainland Australia except for the central and arid regions. It is known to utilise a variety of habitats but has shown preferences to woodland, open forest remnants and partly cleared farmland. Trees with dense foliage and adequately sized hollows are required for roosting. Required foraging habitat for the species varies as it has shown to adapt to its changing surroundings. Its preferred prey are arboreal mammal species which primarily occur in areas with hollows suitable for such species. In areas lacking hollows, the Barking Owl will forage for birds, bats, rodents and invertebrates (OEH, 2014a).

d. Other documentation

The Barking Owl has been assigned to the “Landscape species” management stream under the "Saving Our Species" program. The major objective of the program is to ensure that the species is secure in the wild in NSW and that it’s NSW geographic range is extended or

maintained. No threat abatement plan is relevant to this species and no critical habitat has been identified by the Director General of the OEH for this species (OEH, 2014a).

e. Assessment of adequacy of reservation

The Barking Owl has been recorded in several conservation reserves, primarily within the northern extent of the greater Sydney metropolitan area including: Berowra Valley Regional Park, Lane Cove National Park, Muogamarra National Reserve, Ku-ring-gai Chase National Park and Garigal National Park. The individuals occurring in these conservation areas are more secure than individuals occurring on private property closer to developed areas.

f. Limit of known distribution

In NSW, the Barking Owl is known to occur throughout the state except for in the more arid central regions (OEH, 2014a). The Study Area falls within the known distribution for this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a very small area of potential, albeit sub-optimal, foraging habitat for the species in relation to the habitat within the locality. The clearance of this small area of potential foraging habitat is not considered significant within the local context as larger areas of higher quality habitat containing hollows suitable for preferred prey (i.e. arboreal mammals) remain within the locality and wider region. These areas are more likely to be utilised by the species for foraging and the Study Area is likely only utilised as part of a much broader foraging range.

b. Discussion of connectivity

Suitable habitat for the Barking Owl within the Study Area and Subject Site has connectivity to the Attunga Reserve (7.95ha) located directly east of the Subject Site, the Angophora Reserve (18.5 ha) to the north and the Crown of Newport Reserve (4.12 ha) to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides, the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment available habitat for this species within the Subject Site to some extent; however suitable habitat for the species will be retained on-site and connectivity will remain to off-site reserves. Additionally, the species has a large home range, is highly mobile, and is capable to moving to areas of suitable habitat that are not connected. Due to this, the proposed development will not likely affect habitat connectivity for the Barking Owl within the Study Area or the locality.

c. Consideration of threatening processes

The Barking Owl may be generally threatened by the following processes:

- *Clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures;*

  The vegetation to be cleared for the proposal is not considered to form significant habitat for this species. Larger areas of bushland exist within the locality and these areas are considered to be more likely to constitute habitat for this species. Inappropriate forest harvesting practices that remove old, hollow-bearing trees and change open forest structure to dense regrowth;

- *Firewood harvesting resulting in the removal of fallen logs and felling of large dead trees;*

  No firewood harvesting will occur as a result of the proposal.

- *Too-frequent fire leading to degradation of understorey vegetation which provides shelter and foraging substrates for prey species; and*

  The proposal will not require burning.

- *Disturbance of nesting and excessive disturbance of foraging by inappropriate use of call-playback surveys.*

  Call-playback was required as part of a single survey as part of the impact assessment of this project, however, this is not considered an ongoing impact.

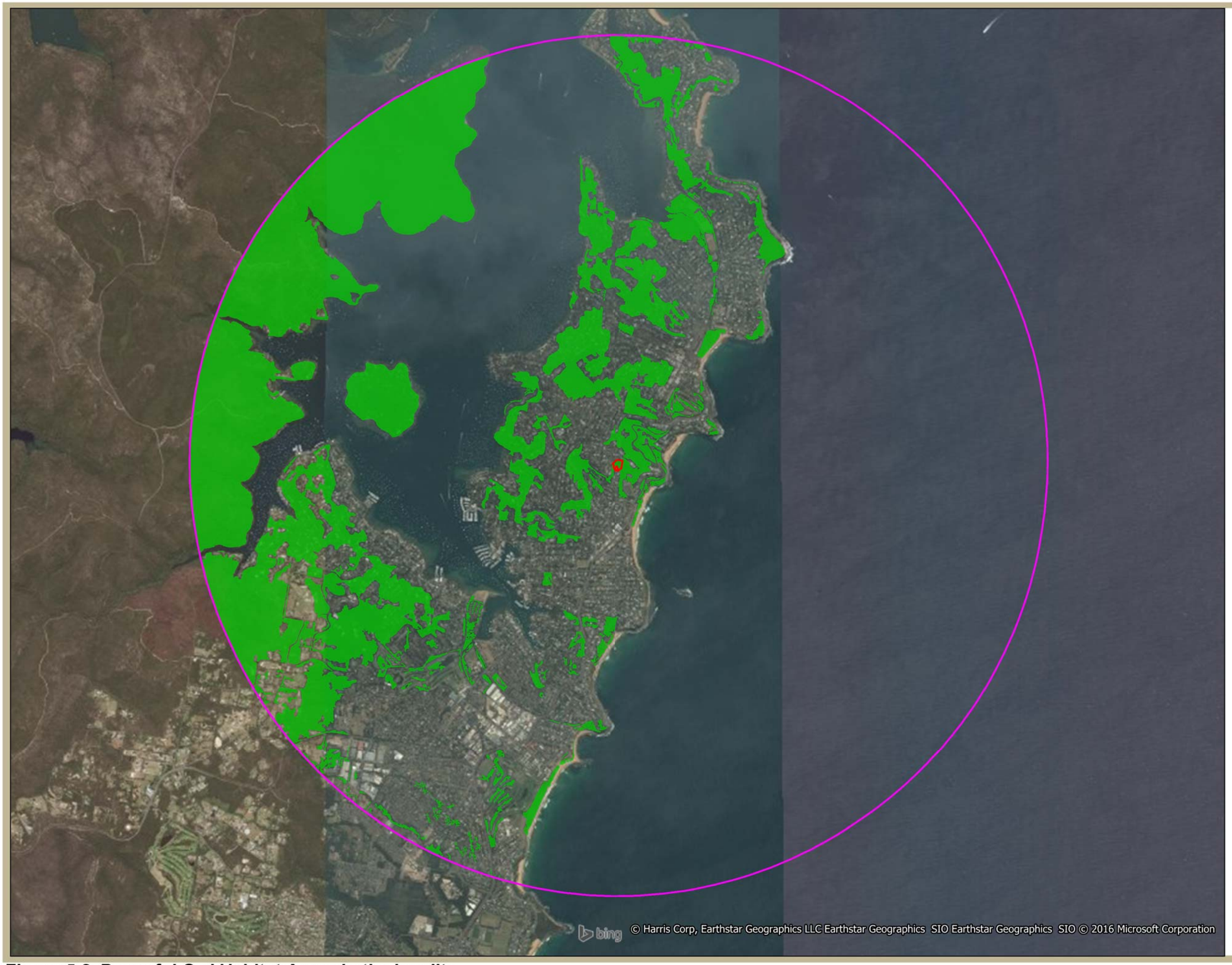
5.3.3 Powerful Owl (Ninox strenua)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are 30 records of the Powerful Owl within the Pittwater LGA, 166 records from the locality (see **Figure 3.2**), and the species has been recorded on the Subject Site on three occasions (twice by Ms M. Dalby-Ball in late 2006 and once in response to call playback for the previous SIS in early February 2007) (F Dominic Fanning, 2007; OEH, 2015b; Pittwater Council, 2015). The local population was also targeted in a study undertaken by BirdLife Australia (2014) where it was determined that the Powerful Owl both nests and forages within the locality of the Subject Site. The majority of the Pittwater LGA records occurred around the suburbs of Ingleside, Warriewood, Church Point and Bayview (Pittwater Council, 2015); however the species has been recorded throughout areas of suitable habitat within the Barrenjoey Peninsula (see **Figure 5.1**). Within the locality, records for the species range from Ku-ring-gai Chase National Park to the east, Whale Beach to the north, and Narrabeen Lagoon to the south (OEH, 2014d).

Coordinate System: MGA Zone 56 (GDA 94)



Legend

- Subject Site
- Locality (5km)
- Powerful Owl Habitat

Grid North

Data Source:
OEH (2013). The Native Vegetation of the Sydney Metropolitan Area. Office of Environment and Heritage NSW.

cumberland ecology

I:\...\15023\FiguresIRP1_SIS\20160511\Figure 5.2. Powerful Owl Habitat Areas

Figure 5.2. Powerful Owl Habitat Areas in the locality

0.5 0 0.5 1 1.5 2 km

b. Discussion of other known regional populations

The Powerful Owl occurs primarily on the eastern side of the Great Dividing Range near coastal regions from south-west Victoria to McKay. This species is known to occur throughout the greater Sydney metropolitan area from the Blue Mountains to the west, the Hawkesbury River to the north, along the entire east coast, to Royal National Park to the south (OEH, 2014d).

ii. Assessment of habitat

a. Description of habitat values

The Powerful Owl is known to utilise a variety of vegetation types including woodland, open sclerophyll forest, tall open wet forest and rainforest. Typically the Powerful Owl utilises large areas of connected woodland or forest habitat, but it also occurs in fragmented habitats as well. Large eucalypt trees containing large hollows within dense vegetation are required for roosting, with preferred roosting sites being located in riparian areas high in catchment areas (Bain *et al.*, 2014). Required foraging habitat for the species consists of vegetation containing suitable hollows for prey such as the Greater Glider, Common Ringtail Possum and Sugar Glider (OEH, 2014d). Suitable foraging habitat for the species includes all patches of suitable habitat greater than 1ha (Bain *et al.*, 2014)

No nesting sites have been recorded within the Subject Site, likely due to an absence of large hollows required by the species. The site does contain suitable foraging habitat for the species; however this habitat is not ideal as it lacks hollows suitable for its preferred prey.

b. Discussion of habitat utilisation

The Subject Site is unlikely to offer suitable nesting habitat for the species as adequate hollows are not present. Suitable foraging habitat is present in the form of rainforest vegetation with a patch size greater than 1 ha. However, the locality and Subject Site are situated amongst highly developed areas contributing to limited hollows suitable for preferred prey. Nevertheless, the species is likely to utilise the site for foraging purposes as it has previously been recorded on site and is known to occur within the LGA. The species is known to have a home range ranging from 300 – 4774 ha (Bain *et al.*, 2014), depending on the habitat present. Powerful Owls in areas containing few hollows require larger home ranges than owls located in areas of abundant hollows due to a lack of prey (OEH, 2014d). For this reason, the habitat present within the Subject Site is likely utilised as part of a much larger foraging range for this species due to a lack of available prey.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Powerful Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2014d).

b. Threatening processes

The following key threatening processes are known to affect the Powerful Owl:

- Historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl;
- Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat;
- Can be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success;
- High frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability;
- Road kills;
- Secondary poisoning; and
- Predation of fledglings by foxes, dogs and cats (OEH, 2014d).

The removal of vegetation on the Subject Site is not considered likely to represent optimal habitat for the prey species of the Powerful Owl, due to a general lack of blossom producing eucalypts. Furthermore, the most intact native vegetation will be retained on the Subject Site, and there it is not likely that a significant reduction in prey species available for the Powerful Owl.

No hollow-bearing trees will be removed and no nest sites are known from the Subject Site (Bain et al, 2014).

High frequency fire is unlikely to result from the proposed development on the Subject Site.

There is some potential for an increase in road kills, secondary poisoning and predation of fledglings from foxes and domestic dogs and cats, through the increased urban areas. However, the residential development is small scale, and will not significantly exacerbate the effects of these existing processes beyond current threat levels for the species.

c. Habitat requirements

The Powerful Owl occurs in a variety of habitats including woodland, open sclerophyll forest, tall open wet forest and rainforest. Typically it requires large tracts of native vegetation; however it also occurs in fragmented areas. It will utilise a variety of tree species for roosting as long as it is densely vegetated and provides adequate cover during the day. Large eucalypt trees with dense vegetation that contain large hollows are required for breeding.

Foraging habitat exists in areas that have numerous hollows suitable to provide adequate densities of arboreal mammals and other preferred prey (OEH, 2014d).

d. Other documentation

The Powerful Owl has been assigned to the "Landscape species" management stream under the Saving our Species program. The major objective of the program is to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2014d). The Powerful Owl is also included in the Recovery Plan for the Large Forest Owls. The relevant objectives of the Recovery Plan are:

- Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes; and
- Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites) (DEC (NSW), 2006).

A three year study of the Powerful Owl within Sydney was produced by Birdlife Australia (2014) which has identified foraging and nesting habitats of the species within Sydney's urban landscape. The results of this study indicate that both suitable nesting and foraging habitat are present within the locality.

No threat abatement plan is relevant to this species and no critical habitat has been identified by the Director General of the OEH for this species.

e. Assessment of adequacy of reservation

It is estimated that 10,000 Powerful Owl individuals are present in NSW alone and the majority of these individuals are present in forests of the coast, escarpment and tablelands of eastern New South Wales, and is "widespread throughout these environments" (DEC (NSW), 2006).

The Powerful Owl has been recorded in many national parks and state forests throughout its range, including the greater Sydney metropolitan area and is likely present in all reserves that contain suitable habitat for the species. Furthermore, within the Sydney basin, Powerful Owl records have increased in the past decade (Pittwater Council, 2015).Nevertheless, the species is not considered adequately represented in reserves as it still listed as Vulnerable under the TSC Act.

f. Limit of known distribution

The Powerful Owl's known distribution ranges from the eastern side of the Great Dividing Range, extending from south-west Victoria to Mackay (OEH, 2014d). The Study Area falls within the known distribution of this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a very small area of potential, albeit sub-optimal, foraging habitat for the species in relation to the habitat within the locality. The clearance of this small area of potential foraging habitat is not considered significant within the local context as larger areas of higher quality habitat containing higher abundances of hollows suitable for preferred prey (i.e. arboreal mammals) remain within the locality and wider region. These areas are more likely to be utilised by the species for foraging and the Subject Site is likely only utilised as part of a much larger foraging range.

b. Discussion of connectivity

Suitable foraging habitat for the Powerful Owl within the Study Area and Subject Site has connectivity to the Attunga Reserve (7.95ha) located directly east of the Subject Site, the Angophora Reserve (18.5 ha) to the north and the Crown of Newport Reserve (4.12 ha) to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides, the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment available habitat for this species within the Subject Site to some extent; however suitable habitat for the species will be retained on-site and connectivity will remain to off-site reserves. Additionally, the species has a large home range, is highly mobile, and is capable of moving to areas of suitable habitat that are not connected. Due to this, the proposed development will not likely affect habitat connectivity for the Powerful Owl within the Study Area or the locality.

c. Consideration of threatening processes

The Powerful Owl may be generally threatened by the following processes:

- *Historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl.*

  The proposal will further fragment suitable foraging habitat for the species; however the vegetation to be removed does not provide suitable hollows to support a high density of arboreal prey, including the Greater Glider.

- *Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat.*

  The vegetation cleared does not contain old growth hollow-bearing trees suitable for prey habitat.

- *Can be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success.*

No nest sites are present on the Subject Site as no suitable hollows are present.

- *High frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability.*

No hazard reduction burning will occur as a result of the proposal.

- *Road kills.*

Traffic will increase very slightly as a result of the proposed development, however the shared driveway in association with the development (Approved driveay) will be used privately and only utilised by residents, therefore is unlikely to contribute to road kills of the species.

- *Secondary poisoning.*

  No poisoning will occur as a result of the proposal.

- *Predation of fledglings by foxes, dogs and cats.*

The proposal may lead to a slight increase of dogs and cats on the Subject Site depending on future residents; however the Subject Site lacks suitable breeding habitat meaning fledglings are not likely to utilise the Subject Site.

5.3.4 Eastern Bentwing-bat (Miniopterus schreibersii oceanensis)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are 41 records of the Eastern Bentwing-bat in the locality (see **Figure 3.2**) and it is known to regularly occupy the St. Michaels Cave at Avalon with the Pittwater LGA. The species was also recorded on the Subject Site during surveys in 2015.

b. Discussion of other known regional populations

The Eastern Bentwing-bat occurs along the entire east coast of NSW and as far inland as Dubbo. This species is known to occur throughout the entire greater Sydney metropolitan area (OEH, 2014b). Within the Pittwater LGA, the Eastern Bentwing-bat is known to occur in the following suburbs: Ingleside, Angophora Reserve, Avalon, McKay Reserve, Elanora Heights, Bayview, Church Point, Bilgola Plateau, Deep Creek and Bayview Woods (Pittwater Council, 2015).

ii. Assessment of habitat

a. Description of habitat values

The Eastern Bentwing-bat occurs along the entire east coast of NSW where it primarily utilises caves for roosting. The species is also known to utilise derelict mines, stormwater tunnels, buildings and other manmade structures for roosting. Foraging primarily occurs in forested areas where it preys on flying insects above the canopy (OEH, 2014b).

The Subject Site provides both potential foraging and roosting habitat for the Eastern Bentwing-bat. Foraging habitat is present above the forested areas of the site while roosting habitat is primarily present in the form of small caves under boulders and openings within existing housing structures.

b. Discussion of habitat utilisation

This species has been recorded in the Study Area during surveys and is known to occur within the nearby Angophora Reserve. As the Subject Site provides both potential foraging and roosting habitat, this species likely utilises the Subject Site for both purposes. The Eastern Bentwing-bat likely forages in the forested areas of the site and roosts within the small caves under boulders and/or in the openings of existing housing structures.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Eastern Bentwing-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2014b).

b. Threatening processes

The following key threatening processes are known to affect the Eastern Bentwing-bat:

- Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding;
- Loss of high productivity foraging habitat;
- Introduction of exotic pathogens, particularly white-nose fungus;
- Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances; and
- Hazard reduction and wildfire fires during the breeding season (OEH, 2014b).

c. Habitat requirements

The Eastern Bentwing-bat occurs along the entire east coast of NSW in a variety of habitats, but prefers well-timbered valleys. Other suitable vegetation types include wet and dry

sclerophyll forest, open woodland, paperbark forest, rainforests and grasslands. It primarily utilises caves for roosting, but is known to utilise culverts, derelict mines and other manmade structures. Foraging requirements for the species include forested areas that contain flying insects (Pittwater Council, 2015).

d. Other documentation

The Eastern Bentwing-bat has been assigned to the "Landscape species" management stream under the 'Saving our Species' program. The major objective of the program is to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2014b). No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Director General of the OEH for this species.

e. Assessment of adequacy of reservation

The Eastern Bentwing-bat is known to occur within several reserves in the greater Sydney metropolitan area. This includes Ku-ring-gai Chase National Park, Berowra Valley Regional Park, and Brisbane Water National Park to the north. Although these reserves provide habitat for the species, the majority of this species' records are outside of reservations and are susceptible to further losses of habitat due to development. With this in mind, this species is not considered adequately represented in reserves, and as it still listed as Vulnerable under the TSC Act

f. Limit of known distribution

The known distribution of the species spans the entire east coast of NSW and as far inland as Wagga Wagga. The Study Area falls within the known distribution of this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The Eastern Bentwing-bat has been recorded on the Subject Site and likely utilises the habitat present for both foraging and roosting. The proposal will remove a small area of both potential foraging and roosting habitat for this species; however this removal of potential habitat is considered unlikely to be significant to the long-term survival of the Eastern Bentwing-bat in the local context as extensive areas of suitable habitat occur in nearby reserves, including Attunga Reserve (7.95ha) adjoining the Subject Site, and Angophora Reserve (18.5 ha) to the north. Furthermore, suitable roosting and foraging habitat will also be retained on the Subject Site.

b. Discussion of connectivity

Suitable habitat for the Eastern Bentwing-bat within the Study Area and Subject Site has connectivity to the Attunga Reserve located directly east of the Subject Site, the Angophora Reserve to the north and the Crown of Newport Reserve to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides,

the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment available habitat for this species within the Subject Site to some extent; however suitable habitat for the species will likely be retained on-site and connectivity will remain to off-site reserves. Additionally, the species is highly mobile, and is capable of moving to areas of suitable habitat that are not connected. Due to this, the proposed development is not considered likely to affect habitat connectivity for the Eastern Bentwing-bat within the Study Area or the locality.

c. Consideration of threatening processes

The Eastern Bentwing-bat may be generally threatened by the following processes:

- *Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding.*

  No suitable caves on-site for cavers or general public to access as only small opening suitable for the species are present.

- *Loss of high productivity foraging habitat.*

  The proposal will result in the loss of some foraging habitat; however suitable foraging habitat will be retained on-site and occurs in adjacent reserves.

- *Introduction of exotic pathogens, particularly white-nose fungus.*

  The proposal is unlikely to introduce exotic pathogens, especially white-nose fungus.

- *Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances.*

  The proposal is unlikely to block cave entrances as no health and safety reasons have been cited on-site.

- *Hazard reduction and wildfire fires during the breeding season.*

  The proposal is not likely to contribute to wildfire fires due to the low combustion potential of the vegetation, and management of APZ's on the Subject Site.

5.3.5 Large-eared Pied Bat (Chalinolobus dwyeri)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There is one known record of the Large-eared Pied Bat from the locality (see **Figure 3.2**) and the species has been recorded in the Pittwater LGA as recent as 2005 (OEH, 2015b;

Pittwater Council, 2015). This species was observed utilising the nearby St. Michaels Cave from 1998 to 2005, and calls for the species were recorded in Angophora Reserve in 2005 (Pittwater Council, 2015). The species was not recorded within the Subject Site or Study Area, and although there are no records of the species in the LGA since 2005, it still may be present in the locality.

b. Discussion of other known regional populations

The Large-eared Pied Bat's distribution is patchy in NSW and extends from the Queensland border to Bungonia, and from the coast to as far inland as Goobang National Park. Within the greater Sydney metropolitan area, records are patchy and extend from the coast to the Blue Mountains, and from Scheyville National Park to just south of Georges River National Park (OEH, 2016b).

ii. Assessment of habitat

a. Description of habitat values

The Large-eared Pied Bat occurs in well-timbered areas containing gullies with caves and crevices. Its primary roosting habitat is caves, and crevices in cliffs, but it will also roost in old mines and Fairy Martin nests. Additionally, maternity roosts have been identified in sandstone caves and overhangs. They are thought to forage below the forest canopy in dry open forest and woodland close to their roosting sites (OEH, 2016b).

The Subject Site provides potential roosting habitat in areas with sandstone boulders along the existing drainage line. The vegetation of the Subject Site however, does not provide preferred foraging habitat for the species as dry open forest and woodland are not present.

b. Discussion of habitat utilisation

The Subject Site offers some suitable roosting habitat but lacks suitable foraging habitat as dry open forest and woodland are not present. Although the species has been recorded within the nearby Angophora Reserve and St. Michaels Cave (Pittwater Council, 2015), it was not recorded on site during previous surveys. With consideration of the habitat present, it is unlikely that this species would roost on site due to the lack of records from the Study Area and there being no suitable foraging habitat present.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Large-eared Pied Bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is also listed as Vulnerable under the EPBC Act (OEH, 2016b).

b. Threatening processes

The following key threatening processes are known to affect Large-eared Pied Bat:

- Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development;
- Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing;
- Damage to roosting and maternity sites from mining operations, and recreational caving activities;
- Use of pesticides; and
- Disturbance to roosting areas by goats (OEH, 2016b).

c. Habitat requirements

The Large-eared Pied Bat has a patchy distribution in NSW and occurs in well-timbered areas containing gullies, extensive cliffs and/or caves. This species requires caves, crevices in cliffs, old mines or disused Fairy Martin nests. Required foraging habitat for the species is not known, but it is thought to forage in dry open forest and woodland close to its roost for flying insects below the canopy (OEH, 2016b).

d. Other documentation

OEH has identified 17 priority actions to recover the Large-eared Pied Bat; however none of these priority actions are relevant to this proposal. No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Director General of the OEH for this species.

e. Assessment of adequacy of reservation

The majority of occurrences for this species within the greater Sydney metropolitan area occur outside of reserves within urban areas. One record exists within Georges River National Park and two records are within Scheyville National Park. Presently there is inadequate reservation of this species in the region as most individuals are located in urban areas and susceptible to further habitat removal.

f. Limit of known distribution

The Large-eared Pied Bat's distribution extends from Rockhampton, Queensland to Bungonia, NSW in well-timbered areas with gullies (OEH, 2016b). The Study Area is within this species known distribution.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The Large-eared Pied Bat has not been recorded on the Subject Site, but has been recorded in the LGA and locality. The Subject Site offers potential roosting habitat for this species; however as no foraging habitat is present on site, the potential roosting habitat is sub-

optimal as this species prefers to roost near foraging habitat (Threatened Species Scientific Committee, 2012). The proposal will remove a small area of this sub-optimal roosting habitat for this species; however this removal is unlikely to significantly impact on the long-term survival of this species in the local context as it is unlikely dependent on the Subject Site for survival.

b. Discussion of connectivity

Suitable habitat for the Large-eared Pied Bat within the Study Area and Subject Site has connectivity to the Attunga Reserve (7.95ha) located directly east of the Subject Site, the Angophora Reserve (18.5 ha) to the north and the Crown of Newport Reserve (4.12 ha) to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides, the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment available habitat for this species within the Subject Site to some extent; however suitable habitat for the species will likely be retained on-site and connectivity will remain to off-site reserves. Additionally, the majority of records in the locality occur outside of existing reserves and are instead amongst developed areas. Furthermore, the species is highly mobile, and is capable of moving to areas of suitable habitat that are not connected. Due to this, the proposed development will not likely affect habitat connectivity for the Large-eared Pied Bat within the Subject Site or the locality.

c. Consideration of threatening processes

Large-eared Pied Bat may be generally threatened by the following processes:

- *Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development.*

  The proposal may involve the clearing and isolation of forest near cliffs and caves; however the cliffs and caves impacted are sub-optimal habitat for the species and likely not utilised.

- *Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing.*

  The Subject Site lacks preferred foraging habitat for the species.

- *Damage to roosting and maternity sites from mining operations, and recreational caving activities.*

  No mining operations or recreational caving activities will occur on the Subject Site as a result of the proposal.

- *Use of pesticides.*

  No pesticides will be used as a result of the proposal.

- *Disturbance to roosting areas by goats.*

  No goats will be present on-site as a result of the proposal.

5.3.6 Little Bentwing-bat (Miniopterus australis)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are seven known records of the Little Bentwing-bat in the Pittwater LGA and 18 records from the locality (see **Figure 3.2**) (OEH, 2015b; Pittwater Council, 2015). Within the Pittwater LGA, occurrences for this species have been recorded: within the nearby Angophora Reserve; in Avalon to the north; within Ku-ring-gai Chase National Park to the west; and to the south of the Study Area within Warriewood and near Narrabeen Lagoon. The Little Bentwing-bat was also recorded on-site on two different nights. Therefore, a local population is present in the locality and this population may utilise the Subject Site for roosting and/or foraging purposes.

b. Discussion of other known regional populations

The Little Bentwing-bat mainly occurs in moist areas including rainforest, melaleuca swamps, coastal forests and moist eucalypt forest. Its primary distribution is in coastal areas along most of the east coast of NSW. Within the greater Sydney metro region, a number of populations exist with recorded occurrences of the species as far: north as Brisbane Water National Park; west to Ropes Crossing, south as far as Heathcote National Park; and east to Avalon (OEH, 2015c).

ii. Assessment of habitat

a. Description of habitat values

The Little Bentwing-bat primarily occurs in moist areas with dense vegetation which is utilises for foraging. Known roosting habitat includes mine shafts, caves, tunnels, tree hollows, storm water channels, buildings, under bridges and in dense foliage (OEH, 2014c).

The Subject Site contains areas of dense rainforest vegetation which could provide suitable foraging habitat for the species. Suitable roosting habitat is also available in the form of buildings and small rock caves.

b. Discussion of habitat utilisation

Within the locality and greater Sydney metropolitan area, the Little Bentwing-bat has primarily been recorded in either densely vegetated areas near or along waterways (OEH, 2015c). The Subject Site and Study Area contain densely vegetated areas near an ephemeral drainage depression. As the habitat present on-site corresponds with the Little Bentwing-bat's preferred foraging habitat and the species has been recorded on-site, it is

likely that the Study Area and Subject Site are utilised for foraging by this species. Furthermore, as the Subject Site contains suitable roosting habitat for the species, there is potential for the Little Bentwing-bat to roost within the Subject Site too.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Little Bentwing-bat is listed as Vulnerable under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2014c).

b. Threatening processes

The following threatening processes are known to affect the Little Bentwing-bat:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic;
- Destruction of caves that provide seasonal or potential roosting sites;
- Changes to habitat, especially surrounding maternity /nursery caves and winter roosts;
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals;
- Predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges;
- Introduction of exotic pathogens such as the White-nosed fungus;
- Hazard reduction and wildfire fires during the breeding season;
- Large scale wildfire or hazard reduction can impact on foraging resources; and
- Poor knowledge of reproductive success and population dynamics.

c. Habitat requirements

The Little Bentwing-bat requires areas with dense vegetation, often near water, where it forages for insects beneath the canopy. Roosting habitat occurs in caves, tunnels, tree hollows, mines, stormwater drains, culverts, bridges and buildings. The species has also been frequently recorded roosting with the Common Bentwing-bat (OEH, 2014c).

d. Other documentation

No threat abatement plan is relevant to this species, no recovery plan exists, and no critical habitat has been identified by the Director General of the OEH for this species. A 'Saving Our Species' conservation project is currently being developed for this species (OEH, 2014c).

e. Assessment of adequacy of reservation

Within the greater Sydney Metropolitan area, the species is known to occur primarily in areas with dense vegetation, often near waterways within and outside of existing reserves, with the majority of records occurring outside. Reserves where the species has been recorded include Heathcote National Park, Ku-ring-gai Chase National Park and Berowra Valley National Park. Presently there is inadequate reservation of this species in the region as most individuals have been recorded outside of reserves and the species is considered susceptible to further habitat removal.

f. Limit of known distribution

The Little Bentwing-bat occurs along most of the east coast of NSW, extending from the Queensland border to as far south and inland as Goulburn (OEH, 2014c). The Study Area is within the known distribution for this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove only a very small area of suitable foraging habitat and potential roosting habitat, albeit the roosting habitat is sub-optimal, for the species in relation to the habitat within the locality. The clearance of this small area of foraging and potential roosting habitat is not considered significant within the local context as larger areas of similar or higher quality habitat within the locality and wider region, including Attunga Reserve (7.95ha) adjoining the Subject Site, and Angophora Reserve (18.5 ha) to the north. This includes nearby reserves that will ensure the long-term conservation of suitable habitat within the locality for this species.

b. Discussion of connectivity

Suitable habitat for the Little Bentwing-bat within the Study Area and Subject Site has connectivity to the Attunga Reserve located directly east of the Subject Site, the Angophora Reserve to the north and the Crown of Newport Reserve to the west. As these reserves are situated on the Barrenjoey Peninsula and bounded by residential development on all sides, the existing vegetation corridors to these reserves is the limit of the Subject Sites connectivity to offsite vegetation.

The habitat to be removed as part of the proposal will fragment some suitable habitat for this species within the Subject Site to some extent; however suitable habitat for this species will likely be retained on-site and connectivity will remain to off-site reserves. Additionally, the

majority of records in the locality occur outside of existing reserves and are instead amongst developed areas. Furthermore, the species is highly mobile, and is capable of moving to areas of suitable habitat that are not connected. Due to this, the proposed development is not considered likely to affect habitat connectivity for the Little Bentwing-bat within the Study Area or the locality.

c. Consideration of threatening processes

The Little Bentwing-bat may be generally threatened by the following processes:

- *Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic.*

  The proposal is unlikely to disturb a nursery or hibernation caves as none are known to occur within the Study Area.

- *Destruction of caves that provide seasonal or potential roosting sites.*

  The proposal has the potential to remove potential roosting sites for the species as buildings and small caves will be removed.

- *Changes to habitat, especially surrounding maternity/nursery caves and winter roosts.*

  The proposal will change some habitat for the species as some foraging habitat and potential roosting habitat will be removed; however this habitat is not near any known maternity/nursery caves.

- *Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals.*

  The proposal will not use pesticides resulting in individuals being poisoned.

- *Predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges.*

  The proposal is unlikely to increase the predation from foxes on the species.

- Predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges.

  The proposal is unlikely to increase the predation from feral cats on the species.

- Introduction of exotic pathogens such as the White-nosed fungus.

  The proposal is unlikely to introduce any exotic pathogens.

- Hazard reduction and wildfire fires during the breeding season.

The proposal is unlikely to lead to hazard reduction and/or wildfires during the breeding season.

- Large scale wildfire or hazard reduction can impact on foraging resources.

  The proposal is unlikely to lead to hazard reduction and/or wildfires impacting on foraging resources.

- Poor knowledge of reproductive success and population dynamics.

  The proposal has provided data regarding population dynamics as the species was recorded on-site.

5.3.7 Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill (Petaurus norfolcensis)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are two records of the Squirrel Glider from the locality and this species is known to occur within the Pittwater LGA (see **Figure 3.2**) (OEH, 2015b; Pittwater Council, 2015). Occurrences of this population have declined in recent years, but the following reserves within the Pittwater LGA have been identified as being important habitat for the local population: Stapleton Park, Angophora Reserve, Attunga Reserve, Palmgrove Reserve and Toongari Reserve (Pittwater Council, 2015).

b. Discussion of other known regional populations

The Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill is the only known regional population for this endangered population (Pittwater Council, 2015).

ii. Assessment of habitat

a. Description of habitat values

The Squirrel Glider on Barrenjoey Peninsula population occurs in coastal habitats comprised of low scrubby eucalypt woodlands and banksia thickets, and tall wet eucalypt forests bordering on rainforest vegetation. This species utilises tree hollows for dens preferring *Eucalyptus, Corymbia* and *Angophora* trees. Suitable foraging habitat includes areas with flowering vegetation year round (OEH, 2012a).

The Subject Site provides some suitable foraging habitat for this species in the form of flowering vegetation but lacks adequate hollows to support a local population. Preferred foraging species on-site includes the presence of *Eucalyptus botryoides* and *Banksia integrifolia*, although these trees are sparsely distributed, with the majority of vegetation being rainforest species. Far more extensive foraging habitat occurs in Attunga Reserve, to

the east of the Subject Site, where dense heath vegetation occurs, and also where wet eucalypt dominated forest types occur.

b. Discussion of habitat utilisation

The Subject Site offers some suitable foraging habitat for this species in the form of flowering vegetation known to be preferred by the Squirrel Glider. Although the Subject Site lacks hollows suitable for denning habitat, this species is known to travel up to 1 km from denning sites to access foraging habitat (Goldingay *et al.*, 2010). As this species is believed to occur within the adjacent Attunga and nearby Angophora Reserves, there is potential that the Squirrel Glider may utilise the Subject Site for foraging purposes as part of a broad home range. However, food resources are limited to scattered Banksia and Eucalypts on the Subject Site. As there is suitable foraging habitat connected to the Subject Site, it is unlikely that a local population would be solely dependent on the Subject Site for its long-term survival.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill is listed as an Endangered Population under Schedule 2 of the TSC Act. It is not listed under the EPBC Act (OEH, 2012a).

b. Threatening processes

The following key threatening processes are known to affect the Squirrel Glider on Barrenjoey Peninsula population:

- Habitat loss, modification and fragmentation due to urban development;
- Predation by cats, dogs, and foxes; and
- Death or injury by fire and motor vehicles (OEH, 2012a).

c. Habitat requirements

The Squirrel Glider on Barrenjoey Peninsula occur in coastal habitats comprised of low scrubby eucalypt woodlands and banksia thickets, and tall wet eucalypt forests bordering on rainforest vegetation. This species utilises tree hollows for dens preferring *Eucalyptus, Corymbia* and *Angophora* trees. Suitable foraging habitat is areas with flowering vegetation year round, preferring the following species: Coast Banksia (*Banksia integrifolia*), Spotted Gum (*Corymbia maculata*), Old Man Banksia (*B. serrata*), Grey Ironbark (*Eucalyptus paniculata*), *Angophora costata, Banksia spinulosa, Corymbia gummifera, Eucalyptus botryoides, E. punctata, E. robusta, Melaleuca quinquenervia*, mistletoes and *Xanthorrhoea* species (OEH, 2012a).

d. Other documentation

The Squirrel Glider on Barrenjoey Peninsula has been included in the Saving our Species program which aims to secure this endangered population in the long-term (OEH, 2012a). No threat abatement plan is relevant to this population, no recovery plan exists, and no critical habitat has been identified by the Director General of the OEH for this population.

e. Assessment of adequacy of reservation

The Squirrel Glider on Barrenjoey Peninsula population is located in an area with a high level of residential development. A result of this development has seen suitable habitat for the population decline from 705 hectares in 1946 to 125 hectares in 1989 within the Pittwater LGA. Stapleton Park, Angophora Reserve, Attunga Reserve, Palmgrove Reserve and Toongari Reserve and their respective connectivity to one another have been identified as key factors for the long-term survival of this population (OEH, 2011). As the population has been identified as being in immediate danger of extinction, there is not an adequate level of reservation for this species.

f. Limit of known distribution

The distribution of the Squirrel Glider on Barrenjoey Peninsula population extends from the tip of the Barrenjoey Peninsula to Bushrangers Hill (OEH, 2012a). The Study Area is within this population's known distribution.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove a small area of potential foraging habitat for this species in relation to the habitat within the locality. The habitat to be removed is not likely to be utilised for denning and is likely only utilised for foraging as part of a much larger range. Additionally, more suitable foraging and denning habitat will be maintained in the adjacent Attunga Reserve which has been identified as important habitat for the population by Pittwater Council (2015). With consideration of the above, the habitat removed on site as a result of the proposal is unlikely to be significant to the survival of the population in the long-term.

b. Discussion of connectivity

Suitable habitat for the Squirrel Glider on Barrenjoey Peninsula population within the Study Area and Subject Site has connectivity to the Attunga Reserve located directly east of the Subject Site, the Angophora Reserve to the north and the Crown of Newport Reserve to the west. Both the Attunga and Angophora Reserves and their connectivity to one another have been identified as important to the long-term survival of the population.

The habitat to be removed as part of the proposal will fragment some suitable foraging habitat for this species within the Subject Site; however suitable foraging habitat for this species will be retained on-site and connectivity will remain to off-site reserves. Due to this,

the proposed development not considered likely to affect habitat connectivity for the Squirrel Glider on Barrenjoey Peninsula population as connectivity to off-site reserves will remain.

c. Consideration of threatening processes

The Squirrel Glider on Barrenjoey Peninsula population may be generally threatened by the following processes:

- *Habitat loss, modification and fragmentation due to urban development.*

  The proposal will result in some loss, modification and fragmentation of suitable foraging habitat for this population. Suitable habitat for this population will be retained within the Subject Site and the locality. The modifications and fragmentation of the suitable habitat present will still allow for off-site connectivity to suitable habitat within nearby reserves.

- *Predation by cats, dogs, and foxes.*

  The proposal may result in predation by cats and dogs depending on the actions of future residents of the property.

- *Death or injury by fire and motor vehicles.*

  The proposal may lead to an increase in motor vehicles; however this increase is predicted to be minimal and is unlikely to result in death or injury as only three properties will be developed. The proposal will also not increase the likelihood of fires in the Study Area.

5.3.8 Grey-headed Flying-fox (Pteropus poliocephalus)

i. Discussion of local and regional abundance and distribution

a. Discussion of other known local populations

There are 32 records of the Grey-headed Flying-fox from the locality (see **Figure 3.2**) and two known camps are present within the Pittwater LGA (OEH, 2015b; Pittwater Council, 2015). The two camps are located within Cannes Reserve located just over 2 km to the north of the Study Area and the Warriewood Wetlands located approximately 5 km to the south.

b. Discussion of other known regional populations

There are approximately 18 Grey-headed Flying-fox camps in the greater Sydney metropolitan area (Ku-ring-gai Bat Conservation Society, 2011). These camps are located as far west as Penrith Lakes Regional Park, as far south as Camden, as far north as Richmond and several located near the east coast.

ii. Assessment of habitat

a. Description of habitat values

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, and in urban gardens and fruit crops. Roosting camps are typically located in vegetation with a dense canopy that is close to water and often in a gully. Camps are also usually located within 20 km of a regular food source preferring native *Eucalyptus, Melaleuca and Banksia* trees, but will also forage on rainforest trees, cultivated gardens and fruit crops (OEH, 2015d).

The Subject Site does not contain a roosting camp for this species but suitable foraging habitat is present. Suitable foraging habitat exists as native *Eucalyptus, Banksia* and rainforest trees are present

b. Discussion of habitat utilisation

The Subject Site is unlikely to be utilised for roosting purposes as no camp is present. The presence of two known roosting camps in the locality along with the presence of suitable/preferred foraging vegetation suggests that the Subject Site is likely utilised as foraging habitat by this species. As the species is known to travel up to 50 km from its roosting site to forage (OEH, 2016a), this species is unlikely to be entirely dependent on the Subject Site for foraging and it likely only forms a small portion of a much larger foraging range.

iii. Discussion of conservation status

a. Local, regional and state-wide status

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 2 of the TSC Act. It is also listed as Vulnerable under the EPBC Act (OEH, 2015d).

b. Threatening processes

The following key threatening processes are known to affect Grey-headed Flying-fox:

- Loss of roosting and foraging sites;
- Electrocution on powerlines, entanglement in netting and on barbed-wire;
- Heat stress; and
- Conflict with humans (OEH, 2015d).

c. Habitat requirements

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps, and in urban gardens and fruit crops. Roosting camps are typically located in vegetation with a dense canopy that is close to water and

often in a gully. Camps are also usually located within 20 km of a regular food source preferring native *Eucalyptus, Melaleuca and Banksia* trees, but will also forage on rainforest trees, cultivated gardens and fruit crops (OEH, 2015d).

d. Other documentation

The Grey-headed Flying-fox has been included as a Landscape species in the Saving our Species program. The management aim of the program is to ensure that this species is secure in the wild in NSW and that its NSW geographic range is extended or maintained (OEH, 2015d).

A Draft National Recovery Plan has also been developed for the Grey-headed Flying Fox. The relevant objectives of the plan are(DECCW, 2009):

- **Objective 1:** To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range.

  The Subject Site does not provide foraging habitat critical to the survival of Grey-headed Flying-foxes as identified in the Draft National Recovery Plan for this species. For habitat to be identified as critical to this species survival, one or more of the following criteria must be met:

  - productive during winter and spring, when food bottlenecks have been identified (ParryJones and Augee (1991), Eby et al. (1999);
  - known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult);
  - productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May);
  - productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions); and/or
  - known to support a continuously occupied camp.

- **Objective 2:** To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes.

  Key winter and spring foraging habitat for the Grey-headed Flying-fox includes the following species: *Eucalyptus tereticornis, E. albens, E. crebra, E. fibrosa, E. melliodora, E. paniculata, E. pilularis, E. robusta, E. siderophloia, Banksia integrifolia, Castanospermum australe, Corymbia citriodora citriodora, C. eximia, C. maculata (south from Nowra), Grevillea robusta* and *Melaleuca quinquenervia.*

  The Subject Site contains one of these species (*Banksia integrifolia*).

- **Objective 3:** To identify roosting habitat critical to the survival of Grey-headed Flying-foxes.

  According to the Draft National Recovery Plan for the Grey-headed Flying-fox, at least one of the following criteria must be met for roosting habitat to be considered as critical to the survival of the species must:

  - is used as a camp either continuously or seasonally in > 50% of years;
  - has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (i.e. in the order of days rather than weeks or months); and/or
  - has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May).

  The Subject Site does not contain critical roosting habitat as the habitat within the site does not meet one of the above criteria.

- **Objective 4:** To protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes.

  The Subject Site does not contain roosting habitat critical to the survival of Grey-headed Flying-foxes.

A management plan for the Cannes Reserve Flying-fox Camp (2015) has been developed in accordance with the OEH draft management plan; however all of its objectives only apply to the reserve itself and are not relevant to this proposal.

No threat abatement plan is relevant to this population and no critical habitat has been identified by the Director General of the OEH for this population.

e. Assessment of adequacy of reservation

Grey-headed Flying-fox camps in the greater Sydney metropolitan area exist both within and outside of reserves. Camps located within the current reserve system are more likely to provide roosting habitat in the long-term as they are less susceptible to future development. Although camps may be adequately protected under existing reserves, there has been a steady decline in population numbers in recent years. The cause of this decline has been attributed to several factors, one of which includes foraging habitat loss (Pittwater Council, 2015), meaning that camps may be adequately reserved, but foraging habitat is not.

f. Limit of known distribution

The distribution of the Grey-headed Flying-fox within NSW extends to anywhere within 200 km of the east coast (OEH, 2015d). The Subject Site is within the known distribution for this species.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

The proposal will remove no roosting habitat and only a small area of potential foraging habitat for this species in relation to the habitat within the locality. The habitat to be removed is not considered to be critical to the survival of the species as identified in the Draft National Recovery Plan (2009). Additionally, as this species has a large foraging range, it likely only utilises the Subject Site on occasion as part of a much larger foraging range. Furthermore, more suitable foraging and roosting habitat will be retained in the locality within nearby reserves. With consideration of the above, the habitat removed on site as a result of the proposal is unlikely to be significant to the survival of this species in the locality in the long-term.

b. Discussion of connectivity

Suitable habitat for the Grey-headed Flying-fox within the Study Area and Subject Site has connectivity to the Attunga Reserve located directly east of the Subject Site, the Angophora Reserve to the north and the Crown of Newport Reserve to the west. Under current conditions, there is no connectivity to off-site camps located within the Warriewood Wetlands to the south and the Cannes Reserve to the north.

The habitat to be removed as part of the proposal will fragment some suitable foraging habitat for this species within the Subject Site; however suitable foraging habitat for this species will be retained on-site and connectivity will remain to off-site reserves. The Grey-headed Flying-fox is also a very mobile species capable of foraging up to 50 km from its camp. Due to this, the proposed development will not likely affect habitat connectivity for the Grey-headed Flying-fox as existing connectivity to off-site reserves will remain intact.

c. Consideration of threatening processes

The Grey-headed Flying-fox may be generally threatened by the following processes:

- *Loss of roosting and foraging sites.*

  The proposal will result in the loss of some potential foraging habitat; however this foraging habitat is not critical to the survival of the species. Additionally, suitable foraging habitat will be retained on the Subject Site and occurs within the locality. The proposal will not result in the loss of roosting habitat as this species is not known to roost on the Subject Site.

- *Electrocution on powerlines, entanglement in netting and on barbed-wire.*

The proposal is unlikely to contribute to electrocution on powerlines, entanglement in netting or on barbed-wire.

- Heat stress.

  The proposal will not contribute to heat stress for the Grey-headed Flying-fox.

- Conflict with humans.

  The proposal will not result in a conflict with humans as a roosting camp is not present within the Study Area and only limited foraging habitat is present.

5.4 Feasible Alternatives

DGR 5.6 *Description of feasible alternatives*

The following are further requirements related to your obligation under Section 110(2)(h) to address the following:

> *a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.*

There are three broad alternatives to the proposal:

- Do nothing;
- Alternative development layout; and
- Reduced scale.

These are discussed below.

5.4.1 Do Nothing

If nothing is done and no development occurs, the remnant native vegetation within the Subject Site, Littoral Rainforest, is likely to survive in the long term *in situ*, although the condition is likely to continue to degrade. Further development of the locality is inevitable, as is an increased threat of weed invasion, and introduction of pest species. Weed invasion is a key threatening process for this community.

The Subject Site has been maintained as a residence and native garden by the current owner, and weed control measures have been implemented according to this use. If development does not occur on the Subject Site, funding associated with the proposed development, earmarked to fund the management of all retained native vegetation across the Subject Site under a VMP, will be lost. The spread of 'transformer weeds' listed as a key

threat to the long-term survival of Littoral Rainforest (Threatened Species Scientific Committee, 2008) is likely to continue throughout the Subject Site and adjoining lands if no development occurs.

5.4.2 Alternative Development Location, Layout and Scale

The Subject Site has a long history of development proposals, including for the previous subdivision proposal in 2009, which was part of a Land and Environment Court case. The current layout is a reduced scale development, with four residential lots proposed (in addition to the two approved), reduced from previously proposed eight lots, over the Subject Site.

A pre-DA meeting with Pittwater Council was also held onsite on the 2nd of June, 2015. At this meeting, a five lot subdivision proposal was tabled, although Council feedback indicated that this could not be adequately supported on the Subject Site, due to slope constraints, traffic / parking issues, and vegetation removal. The current proposed layout has been prepared in response to the pre-DA meeting, following discussions with Council, and through co-ordination of engineering design, and ecological assessment to address the identified constraints of the Subject Site.

The current proposal layout has been configured to respond to Council's concerns with regard to parking provisions, and also locating the indicative building pads as close to the shared driveway as possible, in order to minimise vegetation clearing. This has resulted in a reduced building setbacks from the driveway than the DCP requirements.

As part of the preparation of the current DA, there has been consultation with Rural Fire Service (RFS) to refine the road alignment, and the use of permeable road surfaces. This has included avoidance of significant rock outcrops and boulders and also mature trees, particularly Cabbage Tree Palms to the greatest extent possible.

A reduced scale development would make the proposed development financially unviable. A detailed cost analysis has been undertaken by the landowner, including consideration of the cost of the DA preparation, and four lots is the minimum required to make the development viable. This will also allow for the greatest contribution of funds to the conservation of retained areas of Littoral Rainforest onsite, and implementation of the VMP. The burden of the cost can be shared, and there is more chance of active participation from the future owners.

There is very limited scope for reconfiguring the layout of the proposed lots on the Subject Site, due to the positioning of the approved shared driveway. Furthermore, the indicative building footprints have been located in the area of greatest disturbance on the Subject Site, which reduces the associated ecological impacts.

i. Consideration of DCP 21

The proposed development has been prepared in regard to Council's Development Control Plan (DCP) P21 B4.15 Littoral Rainforest – Endangered Ecological Community in terms of avoiding impacts to threatened species, populations and ecological communities. B4.15 provides the following criteria:

- Development shall not remove or significantly impact on areas of littoral rainforest.
- Development shall restore and regenerate areas of littoral rainforest.
- Development shall not result in a significant loss of canopy cover or a net loss in native canopy trees.

In consideration of DCP21 (B4.15) the development has been significantly refined to avoid impacts to Littoral Rainforest through a number of measures. This includes the proposed creation of larger than allowable lot sizes, reducing the total number of lots and developed area across the Subject Site. Building footprints, ancillary works, and APZ's have been clustered and centred on the most disturbed portions of the Subject Site, to maximise the area of intact Littoral Rainforest that is retained. To the extent possible, the buildings and ancillary works have also been tightly clustered, to reduce impacts from clearing and edge effects.

The development proposal has focused on retention of the best quality Littoral Rainforest on the upslope parts of the Subject Site, and maintaining a wide corridor that links remnant vegetation east to west, and in to Attunga Reserve.

There is expected to be a minor net loss of canopy trees on the Subject Site, however the canopy loss will be offset by supplementary replanting of Littoral Rainforest tree species within the retained areas of Littoral Rainforest, APZs, and the drainage line, which contains a number of large exotic Coral Trees that will be removed (accounting for 6% of the total canopy cover on the Subject Site), as part of the proposal. The APZ for Lot 1c and Lot 1d has some available area for clustered planting of fire retardant Littoral Rainforest tree species including Lilly Pilly (*Acmena smithii*) and Cheese Tree (*Glochidion ferdinandi*). When considered in context of the Study Area, the loss of canopy cover is considered marginal.

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Chapter 6

Assessment of Likely Impacts on Endangered Ecological Communities

This chapter covers the following DGRs:

DGR 6. ASSESSMENT OF LIKELY IMPACTS ON ENDANGERED ECOLOGICAL COMMUNITIES

6.1 Determining Affected Endangered Ecological Communities

DGR 6.1 Assessment of endangered ecological communities likely to be affected

The following are further requirements related to your obligation under Section 110(3)(a) to address the following:

> *a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action.*

One EEC has been determined as occurring within the Study Area. A total of approximately 0.84 ha of Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions occurs throughout the Subject Site. This community is listed as an EEC under the TSC Act and a CEEC under the EPBC Act.

Littoral Rainforest occurs in various conditions throughout the Subject Site, with the most intact sections being located in the northern half and along the southern edge of the Subject Site (**Figure 4.2**). These areas have a closed native canopy with a native dominated understorey and conform to both the TSC Act and EPBC Act listings for the community. A total of 0.61 ha of good quality Littoral Rainforest is present on the Subject Site. Areas of lower condition Littoral Rainforest are located in the south central section of the site. Within this section of the Subject Site, the community exists in two conditions: a closed native canopy with an exotic dominated understorey; and as an open native canopy with an exotic dominated understorey. Both of these conditions conform to the TSC Act listing for the community due to their degraded understorey but not the high quality required for listing under the EPBC Act. A total of 0.23 ha of low quality Littoral Rainforest is present on the Subject Site.

More information regarding the floristics and structure of these conditions of the community within the Study Area and Subject Site can be found in **Chapter 4**.

Examination of the final determination for this community, the descriptions by Tozer *et al.* (2010) and mapping prepared by the SMCMA have been utilised as part of this assessment.

6.2 Assessment of Endangered Ecological Communities Likely to be Affected

The following DGRs have been addressed for the affected EEC:

DGR 6.2 *Description of habitat*

The following are further requirements related to your obligation under Section 110(3)(c) to address the following:

> *a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region.*

DGR 6.2.1 *Study area*

An assessment of habitat in the study area is required and must include:

- *a description of each (C)EEC, including:*
  - *a description of those areas where the community may only be represented by soil stored seed with no or few above ground components, and*
  - *description of disturbance history and recovery capacity. If the site shows signs of disturbance, details should be provided of the site's disturbance history. An assessment should be made of the ability of the (C)EECs to recover to a state representative of its pre-disturbance condition. This assessment will include consideration of the site's in-situ and migratory resilience and will be accompanied by a map of the recovery capacity of the ecological community across the site. Consideration should be given to the results (preliminary or otherwise) of restoration projects being undertaken at other sites that contain the (C)EECs when assessing its recovery capacity.*
- *comparison of the affected community with the(C)EECs as determined by the NSW Scientific Committee.*
- *reference to any relevant available recovery plans and draft recovery plans and vegetation assessment and mapping.*
- *maps, consistent with the descriptions provided, showing the extent and condition of the (C)EEC.*

DGR 6.2.2 *Locality*

A discussion of other occurrences of each (C)EECs populations in the locality must be provided. This must include:

- *a comparison of other known occurrences and their habitats with those of the study area in terms of remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances).*

- *The tenure and long-term security of other occurrences and their habitat.*

- *The relative significance of the Subject Site for each (C)EEC in the locality and region.*

DGR 6.3 *Discussion of conservation status*

The following are further requirements related to your obligation under Section 110(3)(b) to address the following:

> *for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally effecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it.*

The following are further requirements related to your obligation under Section 110(3)(b1) to address the following:

> *an assessment of whether those ecological communities are adequately represented in conservation reserves (or other similar protected areas) in the region.*

The following are further requirements related to your obligation under Section 110(3)(b2) to address the following:

> *an assessment of whether any of those ecological communities is at the limit of its known distribution.*

The relative significance of the Subject Site for each (C)EEC in the locality must be discussed. In particular, discussion of other known occurrences of each affected (C)EEC must be provided. Such an assessment must consider and compare the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.

Known occurrences in the locality and region of fragmentation, decrease in extent or degradation of each (C)EEC or its habitat should be documented.

DGR 6.4 *Discussion of the likely effect of the proposal at local and regional scales*

The following are further requirements related to your obligation under Section 110(3)(d) to address the following:

> *a full assessment of the likely effect of the action on the ecological community, including, if possible, the quantitative effect of local populations in the cumulative effect in the region.*

DGR 6.4.1 *Significance within a local context*

Provision of information to allow adequate determination of the significance of the effects of the proposal in accordance with Section 5A of the EP&A Act (see section 8 of these requirements below) is required. The significance of impacts in the study area for conservation of affected (C)EECs in the locality must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in remnant sizes, connectivity, species diversity and abundances, quality and condition (including levels of disturbances, weed diversity and abundances), tenure and long-term security of other known occurrences and habitats in the locality with those in the study area.

DGR 6.4.2 Extent of habitat removal or modification

The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the (C)EEC in the locality.

This must include an assessment of the proportion of the (C)EEC to be affected by the proposal, in relation to the total extent of the (C)EEC, and the impact of this on the viability of the (C)EEC at the local level.

DGR 6.4.3 Discussion of connectivity

The potential of the proposal to increase fragmentation of each (C)EEC, its relation to adjoining vegetation and to exacerbate edge effects or to decrease the ability for movement of individuals and/or gene flow between habitats must be discussed.

If connectivity between adjacent remnants of (C)EEC is likely to be affected, the impact of the proposal on connectivity must also be discussed.

DGR 6.4.4 Consideration of threatening processes

Assessment of effects must not be limited to threats that are recognised as key threatening processes, but must include threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include consideration of information in the Priorities Action Statement and any approved or draft recovery plans or threat abatement plans which may be relevant to the proposal.

6.2.1 Littoral Rainforest

Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions occurs in close proximity to the coast and is dominated by rainforest species along with scattered sclerophyll species including *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *E. tereticornis*. Littoral Rainforest occurs on soils derived from underlying rocks and on sand dunes (NSW Scientific Committee, 2004).

The geographic distribution of Littoral Rainforest is generally restricted to within 2 km of the coast or areas maintaining a maritime influence. As a whole, this community is relatively small and makes up only 1% of the area for all rainforests in NSW. The largest known stand of the community occurs within the Iluka Nature Reserve and is approximately 136 ha; however the community primarily occurs only as small stands due to fragmentation as a result of urban development. Furthermore, the majority of the stands remaining have low species richness, which declines even more the further south you go. The Littoral Rainforest within the Subject Site falls within the south-central extent of this community's distribution (NSW Scientific Committee, 2004).

i. Description of habitat within the study area

Within the Study Area this community occurs in three separate conditions covering a total area of approximately 2.1 ha. Approximately 0.84 ha of this community is within the Subject Site while the remaining areas exist primarily within the adjacent Attunga Reserve and the strip of vegetation to the west of the Subject Site.

Generally, the upslope portions of the Subject Site contain high quality Littoral Rainforest, with a closed canopy and intact understorey of rainforest species, including dense ferns, vines and messic shrubs, with some species more closely associated with wet sclerophyll forest present also. Large sandstone boulders are prominent on the Subject Site.

In the most disturbed parts of the site, the Littoral Rainforest is considered to be in low condition, and weed species present include 'transformer weeds' as per the EPBC Act listing advice. Transformer weeds include those species that are likely to degrade the condition of Littoral Rainforest to the extent that it may no longer remain in a viable condition. Some 'transformer weeds' present on the Subject Site include *Lantana camara* (Lantana), *Ehrharta erecta* (Panic Veldtgrass), *Asparagus aethiopicus* (Sprenger's Asparagus), and *Tradescantia fluminensis* (Fluminensis). Although densities of these 'transformer weeds' are currently varied across the Subject Site, and cover is low in the most intact portions to the north, it is possible that without active management, these species would spread in the future, and degrade the current condition of the patch overall.

a. Disturbance, Seed Bank and Recovery Potential

Disturbance on the Subject Site has included clearing, historical planting of exotic species for landscaping as part of the exiting dwelling, uncontrolled run-off from upslope properties, and general weed invasion across the Study Area. Upslope habitats are in far better condition than the downslope areas of Littoral Rainforest, which is likely due the aforementioned disturbance factors, which are compounded downslope. Nonetheless, the overall disturbance levels are not considered to be severe, such that the viability of the community is threatened in the short-term. In the long term, the disturbances may increase, and threaten the viability of the Littoral Rainforest present.

There is evidence of natural regeneration of native species in all stratum. This indicates that the soil-stored seed bank is intact, and the natural regeneration potential of this remnant is high. However, parts of the Subject Site show fairly high concentrations of exotic species, and many are recognised as 'transformer weeds', which indicates that the soil-stored seed-

bank would also contain these species. 'Transformer weeds' have the potential to degrade the remnant over-time.

Additional to the 'transformer weeds' present, there are a number of large trees of the exotic species; *Erythrina x sykesii* (Coral Tree) present on the Subject Site, which are acting to limit the growth of Littoral Rainforest species. It was generally observed that native species were completely absent beneath the canopy of these trees. The spread of these exotic Coral Trees is likely to further threaten the Littoral Rainforest community present on the Subject Site and in the Study Area.

Owing to changes to the natural vegetation and habitat over a prolonged period, it is concluded that the community function of this example of Littoral Rainforest has been reduced and modified, as indicated by the:

- Changes in community structure;
- Changes in species composition;
- Existing disruption of ecological processes (including modification of natural soil profiles and restriction of natural genetic exchange);
- Invasion and establishment of exotic species;
- Degradation of habitat, and
- Fragmentation and isolation of habitat.

Although this area has been reduced and modified, the remaining vegetation would likely regenerate to good condition Littoral Rainforest with following management actions:

- Weed management to eradicate problematic weeds present;
- Contain all existing planted gardens to eliminate garden escapees from encroaching; and
- Eliminate further land clearing.

The current extent of this community in the Study Area, with urban development on three sides, means that it faces significant edge-effects, and representation of its pre-disturbance condition is fairly unlikely, without active management. Any restoration efforts would rely on weed management, which could assist in the recovery of this community in the locality.

b. Comparison with the Final Determination

The final determination for Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions describes the community as one that typically occurs on areas with soils derived from underlying rocks or on sand dunes, in areas with a maritime influence, typically within 2 km of the coast (Paragraphs 1 and 2 of the Final Determination).

The structure of the community is described as being a closed forest dominated by rainforest species in all strata. Although rainforest species are dominate in this community, stands often contain scattered emergent sclerophyll individuals such as *Angophora costata, Banksia integrifolia, E. botryoides* and *E. tereticornis* (Paragraph 1). As the community primarily exists in small stands due to fragmentation, most areas of Littoral Rainforest have considerably less species richness then the list identified in the Final Determination. Furthermore, northern occurrences of the community have typically higher species richness than those in the south (Paragraph 3).

Characteristic species of Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions as listed in the Final Determination (Paragraph 3) include, but are not limited to the species identified in **Table 6.1.**

The Subject Site and Study Area are located within the Pittwater LGA. The soil landscape of the area is the Newport formation of the Narrabeen group of sandstones, some of which consist of quaternary deposits of alluvial materials, gravel, sand, silts and clay-derived particles. A total of 27 out of a possible 117 positive diagnostic Littoral Rainforest species were recorded on the Subject Site, and comprises a mix of planted and potential remnants and have been highlighted in the list of characteristic species from the Final Determination (NSW Scientific Committee, 2004), as shown in Table 6.1:

Table 6.1 Characteristic Littoral Rainforest species identified in Final Determination

Scientific Name			
Acacia binervata	*Cryptocarya glaucescens*	*Glycine clandestina*	*+Pisonia umbellifera*
Acmena hemilampra	*Cryptocarya microneura*	*+Gossia bidwillii*	*Pittosporum multiflorum*
Acmena smithii	*+Cryptocarya triplinervis*	*Guioa semiglauca*	*Pittosporum undulatum*
+Acronychia imperforata	*Cupaniopsis anacardioides*	*+Ixora beckleri*	*Platycerium bifurcatum*
Acronychia oblongifolia	*Cynanchum elegans*	*+Jagera pseudorhus*	*Podocarpus elatus*
Alectryon coriaceus	*Dendrocnide excelsa*	*+Lepidozamia peroffskyana*	*Pollia crispata*
+Alpinia caerulea	*+Dendrocnide photinophylla*	*Litsea reticulata*	*Polyscias elegans*
Alyxia ruscifolia	*Dioscorea transversa*	*Livistona australis*	*Pouteria australis*
+Aphananthe philippinensis	*Diospyros australis*	*Lomandra longifolia*	*Pouteria cotinifolia var. cotinifolia*
+Archontophoenix cunninghamiana	*Diospyros pentamera*	*+Lophostemon confertus*	*+Pouteria myrsinoides*
Arthropteris tenella	*Doodia aspera*	*Maclura cochinchinensis*	*Rapanea variabilis*
+Arytera divaricata	*Duboisia myoporoides*	*+Mallotus philippensis*	*Rhodamnia rubescens*
Asplenium australasicum	*+Dysoxylum fraserianum*	*Melaleuca quinquenervia*	*+Rhodomyrtus psidioides*
+Baloghia marmorata	*Ehretia acuminata*	*Melicope micrococca*	*Ripogonum album*
Banksia integrifolia subsp. integrifolia	*+Elaeocarpus0 obovatus*	*+Melicope vitiflora*	*Ripogonum discolor*
+Beilschmiedia obtusifolia	*+Elattostachys nervosa*	*Mischocarpus pyriformis1*	*Sarcomelicope simplicifolia*
Breynia oblongifolia	*Endiandra discolor*	*+Monococcus echinophorus*	*Scolopia braunii*

Table 6.1 Characteristic Littoral Rainforest species identified in Final Determination

Scientific Name			
+Bridelia exaltata	*Endiandra sieberi*	*+Morinda jasminoides*	*Smilax australis*
+Calamus muelleri	*Eucalyptus botryoides*	*+Mucuna gigantea*	*Smilax glyciphylla*
Canthium coprosmoides	*Eucalyptus tereticornis*	*Myoporum acuminatum*	*+Sophora tomentosa subsp. australis*
+Capparis arborea	*Eupomatia laurina*	*Notelaea longifolia*	*Stephania japonica var. discolor*
Cayratia clematidea	*Eustrephus latifolius*	*Olea paniculata1*	*Synoum glandulosum*
Celtis paniculata	*Ficus coronata*	*Oplismenus imbecillis*	*Syzygium australe*
Cissus antarctica	*Ficus obliqua*	*+Pandanus pedunculatus*	*+Syzygium luehmannii*
Cissus hypoglauca	*Ficus rubiginosa*	*Pandorea pandorana*	*Syzygium oleosum*
Cissus sterculiifolia	*+Ficus watkinsiana*	*Pararchidendron pruinosum var. pruinosum*	*Syzygium paniculatum*
Claoxylon australe	*Flagellaria indica*	*Parsonsia straminea*	*+Tetrastigma nitens*
+Cordyline congesta	*Geitonoplesium cymosum*	*+Pentaceras australis*	*Trophis scandens subsp. scandens*
+Cordyline stricta	*Glochidion ferdinandi*	*Piper novae-hollandiae*	*Viola banksii*
			Wilkiea huegeliana

**Note: + = species found north of Sydney*

c. Recovery Plan

There is no Recovery Plan relevant to this community.

d. Maps

Figure 4.2 shows the location of the area of Littoral Rainforest within the Study Area. Mapping of the community's occurrence within the locality is provided in **Figure 2.6**.

ii. Littoral Rainforest within the locality

Within the locality, small patches of Littoral Rainforest occur including the adjoining Attunga Reserve, Bilgola Bends Eric Green Reserve, Hamilton Reserve and Hewitt Park in Bilgola, and Ku-Ring-Gai Chase National Park (Threatened Species Scientific Committee, 2008).

iii. Discussion of conservation status

a. Conservation status

Littoral Rainforest is listed as an EEC under the TSC Act and a CEEC under the EPBC Act. All patches of Littoral Rainforest occurring within the Subject Site have been determined as corresponding to the TSC Act listing, while only two patches (see **Figure 4.2**) correspond to the EPBC Act listing too.

b. Key Threatening Processes

Littoral Rainforest is threatened by the following key threatening processes:

- Clearing of native vegetation;
- Invasion and establishment of exotic vines and scramblers as this may result in competition with native understorey and ground layer species;
- Invasion of native plant communities by exotic perennial grasses as this may result in competition with native understorey and ground layer species; and
- Invasion by a variety of weeds have been listed as key threatening processes (OEH, 2015e).

Other threatening processes that have relevance to the fauna associated with Littoral Rainforest include:

- Removal of dead wood and dead trees; and
- Loss of hollow-bearing trees.

Other threats to the community include

- Invasion of weeds threaten the integrity of particular stands;

- Clearing or damage to stand-margins resulting in salt and wind damage and loss of canopy integrity;
- Clearing and/or physical disturbance to the understorey and surround from action such as firewood collection, grazing, human visitation and rubbish dumping;
- Inappropriate collection of plant species;
- Fire, particularly along the boundary of the community;
- Introduction of pathogens;
- Loss of fauna due to predation from feral animals; and
- Clearing and fragmentation of stands not protect by State Environmental Planning Policy 26 (NSW Scientific Committee, 2004).

c. Habitat requirements

Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner bioregions mainly occurs on areas with soils derived from underlying rocks or on sand dunes, in areas with a maritime influence, typically within 2 km of the coast (NSW Scientific Committee, 2004).

d. Recovery or Threat Abatement Plan

There is no Recovery Plan applicable to this community. There are no specific Threat Abatement Plans relevant to this community.

e. Conservation reserves

Littoral Rainforest is not well represented in reserves within NSW, with the largest example occurring in Iluka Nature Reserve in the Northern Rivers CMA and in Murramarang National Park in the Southern Rivers CMA. Within the locality, small patches of Littoral Rainforest occur including the adjoining Attunga Reserve, Bilgola Bends Eric Green Reserve, Hamilton Reserve and Hewitt Park in Bilgola, and Ku-Ring-Gai Chase National Park (Threatened Species Scientific Committee, 2008).

f. Limit of distribution

Littoral Rainforest is known from the NSW coast, within 2 km from the ocean, in the Northern Rivers, Hunter-Central Rivers, Hawkesbury-Nepean, Sydney Metro and Southern Rivers CMAs. The study area is therefore within the limits of the distribution of this community.

iv. Discussion of the likely effect of the proposal at local and regional scales

a. Significance within a local context

Littoral Rainforest has a very restricted local distribution, and therefore the area of habitat on the Subject Site, totalling 0.84 ha contributes significantly to the local extent of this community. However, a total of 0.23 ha of the Littoral Rainforest present on the Subject Site occurs in very poor condition, and with exotic species dominating the understorey, and in many areas a complete lack of canopy cover. When considered in the context of the Study Area, being approximately 2.1 ha in total, the Subject Site represents a significant portion of the most intact areas of habitat (totalling 0.61 ha of good quality Littoral Rainforest), which are centred around Attunga Reserve immediately to the east. The most intact areas of Littoral Rainforest on the Subject Site, occurring in the northern half of the site, will be predominantly retained, with only 0.05 ha (6%) out of the 0.61 ha of good quality Littoral Rainforest present, being removed by the proposed development.

b. Extent of habitat removal or modification

The proposed development will result in the complete removal of a total of 0.05 ha (6%) of all Littoral Rainforest, which is made up of 0.04 ha of good quality, and 0.01 ha of poor quality Littoral Rainforest. Additionally, a further 0.15 ha (17%) of the total area of Littoral Rainforest will be modified as part of an APZ and other purposes, which is made up of 0.10 ha of good quality vegetation and 0.04 ha of poor quality examples of this community.

However, The Littoral Rainforest present on the Subject Site represents a portion of the total patch present in the Study Area, which includes the adjoining Attunga Reserve. The loss of Littoral Rainforest on the Subject Site represents approximately 3% of the total patch present in the Study Area, and the APZ / modified zones make up approximately 7% of the total patch present in the Study Area. The 0.65 ha of Littoral Rainforest retained on the Subject Site, including the northern corridor of vegetation, will retain connectivity to vegetation in the Study Area and broader locality post development.

Modification within APZs will be limited to reflect the low combustion potential and high ecological significance of the Littoral Rainforest present. A closed canopy will be maintained, and native understorey species will be retained or planted in clumps. The values of the Littoral Rainforest will be partly retained, with retention of a closed, and a fuel managed indigenous understorey. No hard landscaping will occur.

Littoral Rainforest retained on the Subject Site will be actively managed under a VMP to restore the degraded areas and maintain the integrity of the Littoral Rainforest patch present in the Study Area. This will include removal of large exotic trees; *Erythrina x sykesii* (Coral Tree), which constitute approximately 6% of all the canopy present on the Subject Site, and will allow for replacement planting with rainforest species in the APZ and drainage line.

c. Discussion of connectivity

The Subject Site falls within a local corridor of vegetation that extends to the south, east and north. The widest part of the local corridor is 350 m, located within Attunga Reserve, to the

east of the Subject Site, and the narrowest point is 26 m, occurring immediately to the south of the Subject Site, as shown in **Figure 4.5**. The proposed development of the Subject Site will not further reduce the width of the local corridor.

d. Consideration of threatening processes

The processes generally accepted as threatening Littoral Rainforest include:

- Invasion of weeds threaten the integrity of particular stands;
- Clearing or damage to stand-margins resulting in salt and wind damage and loss of canopy integrity;
- Clearing and/or physical disturbance to the understorey and surrounds from actions such as firewood collection, grazing, human visitation and rubbish dumping;
- Inappropriate collection of plant species (eg. epiphytes);
- Fire, particularly along the boundary of the community;
- Introduction of pathogens;
- Loss of fauna due to predation from feral animals; and
- Clearing and fragmentation of stands not protected by State Environmental Planning Policy 26

Of the aforementioned threats, the Littoral Rainforest present on the Subject Site is currently affected by weed invasion, clearing, the possible introduction of pathogens from clearing operations, and the potential loss of native fauna due to predation from feral species. The proposed development will slightly exacerbate these threats, as further clearing will occur for the construction of dwellings and infrastructure, and also the additional future dwellings and residents present. However, under the current proposal, the retained vegetation will be managed under a VMP, which will help to reduce the impacts of the threatening processes, and improve the condition of the Littoral Rainforest in the Study Area overall.

The stand of Littoral Rainforest present on the Subject Site is not protected by SEPP 26.

6.3 Description of Feasible Alternatives

DGR 6.5 *Description of feasible alternatives*

The following are further requirements related to you obligation under Section 110(3)(e) to address the following:

> *a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner*

proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development.

Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF.

The SIS must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

As discussed in **Section 5.4**, alternative development layouts and a reduced scale have all been considered and incorporated into the final proposed development layout. Building footprints have been concentrated around the areas of greatest existing disturbance, where possible with consideration of other constraints such as slope.

The only feasible alternative is to not proceed with the development of the Subject Site, although this will not allow for funds to be available for the long-term management of the Littoral Rainforest, as with the current proposal. A smaller scale development will not make the project financially viable, given that significant infrastructure must be installed, including the shared drivewayway, which will be offset by the sale of the proposed 4 lots.

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Chapter 7

Ameliorative Measures

This chapter covers the following DGRs:

DGR 7. AMELIORATIVE MEASURES

7.1 Description of Ameliorative Measures

DGR7.1 Description of ameliorative measures

The following are further requirements related to your obligation under Sections 110(2)(i) and 110(3)(f) to address the following:

> *a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations [s.110(2)(i)] [or] ecological community [s.110(3)(f)] including a compilation (in a single section of the statement) of those measures.*

Ameliorative measures as part of the proposal include during-construction measures and some long-term management strategies. Pre-construction measures such as pre-clearance fauna surveys to check for any nesting or roosting fauna and move them to adjacent habitat will be required due to the presence of habitat features suitable for native fauna within the Subject Site. Long-term management strategies are discussed in **Section 7.1.1**.

Potential impacts to flora and fauna occurring in the construction phase relating to the proposal and which can be managed include: runoff, sedimentation, erosion and pollution. Precautions need to be taken to minimise the drainage impacts downslope and at the storm water end point. Sediment control and reduction measures should be implemented to reduce sediment runoff into the waterways present to reduce impacts on-site and downslope. Stormwater, and Sediment and Erosion plans have been prepared by Martens and Associates (2016) which address the aforementioned potential impacts to flora and fauna.

During development, precautions should be taken to ensure that no pollution escapes the construction site. Pollution traps and regular removal of pollution to an off-site location would assist to minimise pollution impacts. A Waste Management Plan will be developed to mitigate waste and pollution entering the surrounding environment.

7.1.1 Long-term management strategies

DGR 7.1.1 Long term management strategies

A vegetation management plan (VMP) has been prepared for the retained Littoral Rainforest on the Subject Site. The implementation of the VMP is for three years, from the date of land subdivision. A conservation trust will be established, and a portion of the sale from each lot will contribute to the funds for implementation of the VMP, and some limited future maintenance works. The VMP has been prepared for all retained vegetation across all lots on the Subject Site, including those subject to the current subdivision, and also the balance of land from previously approved DA's. This is offered in order to maximise the value of the Littoral Rainforest retained on the Subject Site, and maintain a habitat corridor from east to west in perpetuity.

See the VMP for details of the long-term management strategies.

7.1.2 Compensatory strategies

DGR 7.1.2 Compensatory strategies

Compensation strategies include the implementation of a fully funded VMP for all areas of retained native vegetation on the Subject Site. This will maintain a continuous vegetated corridor or Littoral Rainforest in the northern part of the Subject Site, from east to west, as shown in **Figure 5.1**. Additional measures will include the installation of nest boxes, with a focus on threatened species such as Powerful Owl and hollow-dwelling microbats. The compensatory measures will improve the condition of Littoral Rainforest over the Subject Site and improve habitat for threatened fauna species, particularly the Powerful Owl.

7.1.3 Ongoing monitoring

DGR 7.1.3 Ongoing monitoring

The VMP includes a monitoring programme for the retained Littoral Rainforest on the Subject Site. This will enable the evaluation of the effectiveness of the restoration efforts, particularly the weed control measures and habitat enhancement measures.

7.1.4 Translocation

DGR 7.1.4 Translocation

There is no proposal for any translocation of flora or fauna from or within the Subject Site.

7.2 Impacts When Amelioration is Considered

Assessments of Significance (seven part tests) are threshold tests of significance that are prepared as a requirement of Section 5A of the EP&A Act for impacts arising from development applications. Assessments of significance determine whether there is likely to be a significant impact on any threatened flora and fauna in order to determine whether to proceed to prepare a SIS. Notwithstanding this, the seven part tests can be repeated within an SIS to consider whether a significant negative impact will occur once avoidance, mitigation and compensation measures are considered. This has been done within Chapter

8 for all threatened species and the EEC known or considered likely to occur on the Subject Site.

The seven part tests verify that although the EEC and several threatened species would be affected by future developments on the site, the amelioration measure proposed are likely to address such impacts such that the best quality example of Littoral Rainforest will be conserved on site, and actively managed under a fully funded VMP. The implementation of the VMP will reduce the existing impacts, such as weed invasion, which present a significant threat to the long-term survival of this community in the locality.

The retained vegetation is expected to provide opportunities for such fauna as birds and bats in the long term, and ensure that the habitat corridor that extends from east to west and into Attunga Reserve is maintained. Thus, when implemented, the suite of ameliorative measures are predicted to address the otherwise significant impacts of the development of the Newport Subject Site.

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Chapter 8

Assessments of Significance of Likely Effect of Proposed Action

This chapter covers the following Director General's Requirements:

DGR 8. ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

8.1 Endangered Ecological Communities

8.1.1 Littoral Rainforest

Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an endangered ecological community under the TSC Act and as a critically endangered ecological community under the EPBC Act. It is a closed forest community dominated by rainforest species but can also contain Eucalypt emergent and Banksias. Littoral Rainforest always has a maritime influence and is usually found within 2 km of the coast, is subject to wind-pruning and often occurs on sand dunes.

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,

Not applicable.

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,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(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.

The proposed development will remove patches of vegetation that are centred around the most disturbed central portions of the Subject Site, where an existing track occurs and a recently approved driveway. There is also likely to be indirect removal or modification of additional areas of this community through the establishment of Asset Protection Zones, and from site runoff. However, the majority of the intact Littoral Rainforest will be retained on the Subject Site, particularly upslope of the proposed development. This connects with vegetation in Attunga Reserve that conserves Littoral Rainforest in the locality.

For these reasons, although the proposed development will adversely affect the extent of this community and modify the composition of the ecological community to some extent, it is unlikely to place the local occurrence at risk of extinction.

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.

The proposed development will result in the complete removal of a total of 0.05 ha (6%) of all Littoral Rainforest, which is made up of 0.04 ha of good quality, and 0.01 ha of poor quality Littoral Rainforest. Additionally, a further 0.15 ha (17%) of the total area of Littoral Rainforest will be modified as part of an APZ and other purposes, which is made up of 0.10 ha of good quality vegetation and 0.04 ha of poor quality examples of this community.

There is also likely to be indirect removal or modification of additional areas of this community through the establishment of Asset Protection Zones, and from site runoff. However, a significant portion of this area is covered by a degraded form of Littoral Rainforest that retains a native canopy but has a predominantly exotic understorey.

The construction of the future dwellings and ancillary works will increase existing fragmentation the Littoral Rainforest patch present on the Subject Site and adjoining lands. However, the works are predominantly proposed in the most degraded portions of the Subject Site, and in association with existing clearings and a driveway, and therefore the Littoral Rainforest that will be retained both upslope and downslope of the proposed development will remain connected to the east via Attunga Reserve.

The area of Littoral Rainforest to be removed is not important for the long-term survival of the community. The proposed building footprints are such that it takes advantage of already disturbed areas and avoids tree clearance where possible. The areas partially fragmented will remain connected though Attunga Reserve.

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

No critical habitat for this endangered ecological community has currently been listed in the critical habitat registry by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

No recovery plan has been prepared for this community. The Bitou Bush Threat Abatement Plan is relevant to the community but is not relevant to the Subject Site as it is not a major weed threat in this instance.

The OEH has identified 12 priority actions to help recover this community including the following actions that are relevant to the proposed development:

- Enhance the capacity of persons involved in the assessment of impacts on this EEC to ensure the best informed decisions are made (Medium priority);
- Liaise with landholders and undertake and promote programs that ameliorate threats such as grazing and human disturbance (Low priority);
- Use mechanisms such as Voluntary Conservation Agreements to promote the protection of this EEC on private land (Medium priority); and
- Undertake bush regeneration to restore, expand and reconnect remnants where considered practical (Medium priority).

The proposal is not considered to be inconsistent with the objectives of the Priority Actions. A fully funded VMP will be implemented as part of the proposed development, and this will ensure that the retained Littoral Rainforest is actively managed using bush regeneration techniques.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Littoral Rainforest is generally threatened by (or the proposal could further impact the species through) the following processes:

- Clearing of native vegetation as this could destroy a small area of habitat;
- Invasion by weeds (Bitou Bush, Lantana, Exotic vines and scramblers) as this degrades the community;
- Infection by *Phytophthora cinnamomi* as this can lead to the death of individual plants; and

- High frequency fire as this can reduce the integrity of the canopy at the margins of the forest.

The proposal is considered to involve clearing of native vegetation, however, the best quality examples of this community will be retained and actively managed under a fully funded VMP, and therefore the overall condition and integrity of the broader patch will be improved over time. Weed invasion is already an active process on the Subject Site, and this will continue to impact the viability of the patch of Littoral Rainforest present in the Study Area if active management is not implemented. This this regard, the proposal is likely to reduce the impacts of these KTPs to a large extent.

High frequency fire is unlikely to be exacerbated by the proposed development.

Conclusion

The proposed development will result in the complete removal of a total of 0.05 ha (6%) of all Littoral Rainforest, which is made up of 0.04 ha of good quality, and 0.01 ha of poor quality Littoral Rainforest. Additionally, a further 0.15 ha (17%) of the total area of Littoral Rainforest will be modified as part of an APZ and other purposes, which is made up of 0.10 ha of good quality vegetation and 0.04 ha of poor quality examples of this community. In additional to direct impacts, there is the potential for indirect modification of a part of the local occurrence of this community, through the increase in edge-effects, light penetration and drying out of the retained vegetation.

However, the footprint locations have been located within the poorest condition portions of the patch of Littoral Rainforest on the Subject Site, and the retained areas of good quality vegetation will be actively managed through the implementation of a fully funded VMP. The community will be conserved in the wider locality including Attunga Reserve and Crown of Newport Reserve, and connectivity to these reserves through the northern part of the Subject Site will be retained. In this regard, when considered in context of the local occurrence of this community, and the potential improvements in quality through the implementation of a VMP, the overall impact on the community in the wider context is not considered to be significant.

8.2 Threatened Fauna

8.2.1 Superb Fruit-Dove (Ptilinopus superbus)

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,

The Superb Fruit-Dove (*Ptilinopus superbus*) is found mainly from north-eastern Queensland to north-eastern NSW, becoming less common further south. It occurs in rainforest habitats and similar closed forests and less often in eucalypt or acacia woodland. The species feeds on fruit high in the canopy and builds a nest within a tree or shrub. The Superb Fruit-Dove is listed as Vulnerable under the TSC Act.

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,*

The Superb Fruit-Dove generally requires rainforest trees and shrubs for foraging and nesting habitat. The Subject Site supports potential foraging and nesting habitat. The habitat to be removed as part of the proposal represents a very small portion of potential habitat available in the locality. More suitable habitat is present in the larger reserves.

The Superb Fruit-Dove is a highly mobile species that accesses resources from across a wide area and this species would not depend upon resources contained on the Subject Site for its survival. The proposal is not considered to affect the life cycle of this species such that a viable local population is placed 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,*

Not applicable.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(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.

Not applicable.

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.

The proposal will remove approximately 0.05 ha of native vegetation habitat within the Subject Site and modify a further 0.15 ha, which represents marginal potential foraging and

nesting habitat for this species. More optimal potential foraging and nesting habitat will remain to the east of the Subject Site and within other reserves in the locality.

As the habitat within the Subject Site is set within a residential area, it is not anticipated that further fragmentation or isolation will occur as a result of the proposal. Attunga Reserve is already surrounded by residential development, and the proposed action will remove a relatively small area, totalling 0.05 ha, and modify a further 0.15 ha, of sub-optimal habitat adjacent to the reserve.

Habitat on the Subject Site is not important for the Superb Fruit-Dove in the locality as it is a relatively small area of vegetation. Much larger areas of potential habitat occur throughout the wider locality in reserves such as the adjacent Attunga Reserve.

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

No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

No recovery plan or threat abatement plans have been prepared for this species.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal's actions would constitute the key threatening process of "Clearing of native vegetation". The vegetation to be removed on the Subject Site constitutes marginal habitat for the Superb Fruit-Dove. Therefore, the process of "Clearing of native vegetation" on the Subject Site is not likely to significantly affect this species.

Conclusion

The proposed development would result in the removal of a small area of native vegetation that potentially provides some foraging and nesting habitat for the Superb Fruit-Dove. Any local population of this species is unlikely to depend on the resources contained on the Subject Site for its survival and large areas of suitable habitat remain in the locality with much of that being in conservation reserves. Such reserves will remain in perpetuity and contain far higher habitat value than the marginal habitat proposed to be removed from the Subject Site. Therefore, the proposal is not considered to significantly impact the Superb Fruit-Dove.

8.2.2 Barking Owl (Ninox connivens)

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,

The Barking Owl (*Ninox connivens*) occurs throughout the mainland except for the central and arid regions. The species occurs in various habitats such as woodland, open forest, fragmented remnants and partly cleared farmland. It roosts in The Barking Owl is listed as Vulnerable under the TSC Act.

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,

The Barking Owl is a bird of prey which generally requires high density treed areas for foraging and roosting and large tree hollows for nesting. The Subject Site does not support nesting habitat however some occasional foraging habitat is present. The habitat to be removed as part of the proposal represents a very small portion of potential foraging habitat available in the locality.

The Barking Owl is a highly mobile species that accesses resources from across a wide area and this species would not depend upon resources contained on the Subject Site for its survival. The proposal is not considered to affect the life cycle of this species such that a viable local population is placed at risk of extinction.

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,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(iii) 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

(iv) 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.

Not applicable.

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

(iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(v) 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

(vi) 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.

The proposal will remove approximately 0.05 ha of native vegetation habitat within the Subject Site and modify a further 0.15 ha which represents marginal potential foraging habitat for this species. Optimum potential foraging and roosting habitat occurs to the east of the Subject Site within reserves in the locality such as Ku-ring-gai Chase National Park.

As the habitat within the Subject Site is set within a residential area, it is not anticipated that further fragmentation or isolation will occur as a result of the proposal. Attunga Reserve is surrounded by residential development, and the proposed action will remove a relatively small area of sub-optimal habitat adjacent to the reserve.

Habitat on the Subject Site is not important for the Barking Owl in the locality as it is a relatively small area of vegetation. Much larger areas of potential habitat occur throughout the wider locality in reserves such as the adjacent Attunga Reserve and Ku-ring-gai National Park further west of the Subject Site.

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

No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

A draft recovery plan has been prepared for the Barking Owl. The ultimate aim of the recovery plan is to recover the species to a position of viability in nature in NSW. The proposal is not considered to threaten the objectives of this plan. No Threat Abatement Plan exists for this species.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal's actions would constitute the key threatening process of "Clearing of native vegetation". The vegetation to be removed on the Subject Site constitutes marginal habitat for the Barking Owl. Therefore, the process of "Clearing of native vegetation" on the Subject Site is not likely to significantly affect this species.

Conclusion

The proposed development would result in the removal of a small area of native vegetation that potentially provides some foraging habitat for the Barking Owl. Any local population of this species is unlikely to depend on the resources contained on the Subject Site for its survival and large areas of suitable habitat remain in the locality with much of that being in conservation reserves. Such reserves contain higher habitat value than the marginal habitat

proposed to be removed from the Subject Site. Therefore, the proposal is not considered to significantly impact the Barking Owl.

8.2.3 Powerful Owl (Ninox strenua)

The Powerful Owl (*Ninox strenua*) is distributed from Mackay to south western Victoria, mainly on the coastal side of the Great Dividing Range. This species occurs in many vegetation types from woodland and open sclerophyll to tall open wet forest and rainforest. It requires large tracts of native vegetation but can survive in fragmented landscapes. It roosts in dense vegetation and nests in large tree hollows. The Powerful Owl is listed as Vulnerable under the TSC Act.

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,

Numerous scattered records of the species are present throughout the locality. The Powerful Owl is a bird of prey which generally requires a dense canopy and shrub layer for foraging and roosting and large tree hollows for nesting. The Subject Site does not support nesting habitat however some occasional foraging habitat is present. The habitat to be removed as part of the proposal represents a very small portion of potential foraging habitat available in the locality.

The Powerful Owl is a highly mobile species that accesses resources from across a wide area and this species would not depend upon resources contained on the Subject Site for its survival. The proposal is not considered to affect the life cycle of this species such that a viable local population is placed 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,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(v) 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

(vi) 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.

Not applicable.

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

(vii) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(viii) 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

(ix) 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.

The proposal will remove approximately 0.05 ha of native vegetation habitat within the Subject Site and modify a further 0.15 ha which represents marginal potential foraging and roosting habitat for this species. However, this is not optimum habitat as part of the understorey which provides cover for its prey species has been cleared. More optimum potential foraging and roosting habitat will remain to the east of the Subject Site and within other reserves in the locality such as Ku-ring-gai Chase National Park.

As the habitat within the Subject Site is set within a residential area, it is not anticipated that further fragmentation or isolation will occur as a result of the proposal. Attunga Reserve is already surrounded by residential development, and the proposed action will remove a relatively small area of sub-optimal habitat adjacent to the reserve.

Habitat on the Subject Site is not important for the Powerful Owl in the locality as it is a relatively small area of vegetation. Much larger areas of potential habitat occur throughout the wider locality in reserves such as the adjacent Attunga Reserve and Ku-ring-gai National Park further west of the Subject Site.

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

No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

A recovery plan has been prepared for large forest owls, including the Powerful Owl. The ultimate aim of the recovery plan is to ensure that the species it covers persist in the wild in NSW in each region where they presently occur (DEC (NSW), 2006). The proposal is not considered to threaten the objectives of this plan. No Threat Abatement Plan exists for this species.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal's actions would constitute the key threatening process of "Clearing of native vegetation". The vegetation to be removed on the Subject Site only constitutes marginal habitat for the Powerful Owl. Therefore, the process of "Clearing of native vegetation" on the Subject Site is not likely to significantly affect this species.

Conclusion

The proposed development would result in the removal of a small area of native vegetation that potentially provides some foraging habitat for the Powerful Owl. Any local population of this species is unlikely to depend on the resources contained on the Subject Site for its survival and large areas of suitable habitat remain in the locality with much of that being in conservation reserves. Such reserves will remain in perpetuity and contain far higher habitat value than the marginal habitat proposed to be removed from the Subject Site. Therefore, the proposal is not considered to significantly impact the Powerful Owl.

8.2.4 Microchiropteran bats

All microchiropteran bat species have been assessed together due to similar foraging and roosting requirements.

i. Hollow Roosting Species

The following species roost predominantly in tree hollows:

- Eastern Freetail-bat (*Mormopterus norfolkensis*); and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

The Eastern Freetail-bat (*Mormopterus norfolkensis*) is listed as Vulnerable under the TSC Act. It is distributed along the east coast from southern QLD to southern NSW. The species inhabits dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts singly and communally, mainly in tree hollows but will also roost under decorticating bark or in man-made structures.

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is listed as Vulnerable under the TSC Act. It occurs from the Atherton Tableland to north-eastern Victoria. It is found in various habitats being most commonly found in tall wet forest. The species predominantly roosts in tree hollows but also roosts in buildings. The Greater Broad-nosed Bat flies approximately 3 to 6m above creek and river corridors.

These two species are assessed as having possible occurrence on the Subject Site as suitable foraging habitat is present. There are no trees with hollows on the Subject Site. However, these species are also known to utilise man-made structures for roosting. An old fibrous cement building and crevices in large rocks provide potential roost habitat within the Subject Site.

ii. Cave Roosting Species

The following species roost predominantly in caves and man-made structures:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Little Bentwing-bat (*Miniopterus australis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*); and
- Southern Myotis (*Myotis macropus*).

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is listed as Vulnerable under the TSC Act and EPBC Act. It occurs from Rockhampton, Queensland to Bungonia, NSW in well-timbered areas with gullies. The Large-eared Pied Bat roosts in caves, as well as crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*).

The Little Bentwing-bat (*Miniopterus australis*) is listed as Vulnerable under the TSC Act. It is found in various well-timbered areas such as rainforests, wet and dry sclerophyll forest and dense coastal forests from Cape York, Queensland to Wollongong, NSW. The Little Bentwing-bat roosts in caves, as well as tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day.

The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) is listed as Vulnerable under the TSC Act. The Eastern Bentwing-bat occurs along the east and north-west coasts of Australia. It roosts in caves, derelict mines, stormwater tunnels, buildings and other manmade structures. It forages above the canopy in forested areas. The Eastern Bentwing-bat forms maternity colonies in caves and populations usually centre on such caves.

The Southern Myotis (*Myotis macropus*) is listed as Vulnerable under the TSC Act. It is found from the north-west through to western Victoria along the coast. It forages over pools and streams. The Southern Myotis roosts in groups of 10-15 close to water in caves, but can also roost in mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.

All four species are assessed as having possible occurrence on the Subject Site as suitable foraging habitat is present. An old fibrous cement building and crevices in large rocks provide potential roost habitat within the Subject Site for all of these species.

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,

There are no hollow-bearing trees within the Subject Site, however an old fibrous cement building and crevices in large rocks provide potential roost habitat within the Subject Site for all microchiropteran bat species. The area of 0.05 ha of potential foraging habitat on the Subject Site to be removed is small. Microchiropteran bats are highly mobile and would have the ability to utilise surrounding habitat in the wider locality. Therefore the proposal is not likely to place a viable local population of these species 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,

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(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.

Not applicable.

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.

Approximately 0.05ha of potential foraging habitat within the Subject Site is proposed to be removed, and a further 0.15ha will be modified. No hollow-bearing trees are present on the Subject Site. However, an old fibrous cement building and crevices in large rocks provide potential roost habitat.

As the habitat within the Subject Site is set within a residential area, it is not anticipated that further fragmentation or isolation will occur as a result of the proposal. Further to that, these species are highly mobile and able to travel large distances between foraging sites. Attunga Reserve is already surrounded by residential development, and the proposed action will remove a relatively small area of sub-optimal habitat adjacent to the reserve.

Habitat on the Subject Site is not important for these species in the locality as it is a relatively small area of potential foraging and sub-optimal roosting habitat available on a seasonal basis. Much larger areas of potential habitat occur throughout the wider locality in reserves such as the adjacent Attunga Reserve and Ku-ring-gai National Park further west of the Subject Site.

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

No critical habitat for these species has currently been identified by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

No specific recovery plan has been prepared for these species in NSW. No specific Threat Abatement Plans are relevant to these species, however the Action Plan for Australian Bats provides a recovery outline (Duncan *et al.*, 1999).

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal's actions would constitute the key threatening process of "Clearing of native vegetation". The vegetation to be removed on the Subject Site constitutes marginal potential foraging and roosting habitat for these species. Therefore, the process of "Clearing of native vegetation" on the Subject Site is not likely to significantly affect these species.

Conclusion

The proposed development would result in the removal of a small area of native vegetation that potentially provides some foraging and roosting habitat for microchiropteran bat species. Any local populations of these species are unlikely to depend on the resources contained on the Subject Site for their survival. Large areas of suitable habitat occur in the locality with much of that being in conservation reserves. Such reserves will remain in perpetuity and contain far higher habitat value than the marginal habitat proposed to be removed from the Subject Site. Therefore, the proposal is not considered to significantly impact these species.

8.2.5 Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill

The population of Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill is listed as Endangered under the TSC Act. The population occurs on the Barrenjoey Peninsula within the Pittwater LGA. The Squirrel Glider is found in various habitats including low scrub eucalypt woodland, banksia thicket and tall wet eucalypt forests bordering on rainforest. The population in Pittwater is likely to feed predominantly on *Banksia integrifolia*, *B. serrata*, *Corymbia maculata* and *Eucalyptus paniculata*. The species will also make incisions in trees to obtain sap or gum. The species dens in tree hollows.

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,

Not applicable.

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,

The Squirrel Glider requires flowering trees and shrubs for foraging, and hollow-bearing trees for denning. The Subject Site supports potential foraging habitat but no denning habitat. The species would be more likely to utilise the Subject Site as part of a larger foraging range, where more optimum habitat is present in larger tracts of vegetation such as within Attunga Reserve, Stapleton Park and Angophora Reserve. The habitat to be removed as part of the proposal represents a very small portion of potential foraging habitat available in the locality. The proposal is not considered to affect the life cycle of this species such that a viable local population is placed at risk of extinction.

c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(iii) 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

(iv) 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.

Not applicable.

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

(iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(v) 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

(vi) 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.

Approximately 0.05ha of marginal potential foraging habitat occurring on the edge of Attunga Reserve within the Subject Site is proposed to be removed, and a further 0.15 ha will be modified. More optimum potential foraging and also potential denning habitat occurs to the east of the Subject Site in Attunga Reserve and within other reserves in the locality such as Ku-ring-gai Chase National Park.

As the habitat within the Subject Site is set within a residential area, it is not anticipated that further fragmentation or isolation will occur as a result of the proposal. Attunga Reserve is already surrounded by residential development, and the proposed action will remove a relatively small area of sub-optimal foraging habitat adjacent to the reserve.

Habitat on the Subject Site is not important for the Squirrel Glider in the locality as it is a relatively small area of vegetation. Much larger areas of potential habitat occur throughout the wider locality in reserves such as the adjacent Attunga Reserve and other reserves such as Stapleton Park and Angophora Reserve.

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

No critical habitat for this species has currently been identified by the Director-General of the OEH.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plans,

No recovery plan or threat abatement plans have been prepared for this population.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal's actions would constitute the key threatening process of "Clearing of native vegetation". The vegetation to be removed on the Subject Site only constitutes marginal foraging habitat and no breeding habitat for the Squirrel Glider. Therefore, the process of "Clearing of native vegetation" on the Subject Site is not likely to significantly affect this species.

Conclusion

The proposed development would result in the removal of a small area of native vegetation that potentially provides some foraging habitat for the Squirrel Glider. The local population of this species is unlikely to depend on the resources contained on the Subject Site for its survival and large areas of suitable habitat occur in the locality with much of that being in conservation reserves. Such reserves will remain in perpetuity and contain far higher habitat value than the marginal habitat proposed to be removed from the Subject Site. Therefore, the proposal is not considered to significantly impact the population of Squirrel Glider.

Chapter 9

Additional Information

This chapter covers the following Director General's Requirements:

DGR 9 ADDITIONAL INFORMATION

9.1 Qualifications and Experience

DGR 9.1 Qualifications and experience

> *A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement (Section 110(4)).*

The Cumberland Ecology staff involved with the compilation of this SIS have many years of experience in ecology, flora and fauna assessments and threatened species legislation. The sub-consultants are specialist in their area of expertise. The details of the qualifications of key Cumberland Ecology staff involved in the preparation of this SIS, and relevant sub-consultants, are provided in **Appendix E**.

9.2 Other Approvals

DGR 9.2 Other approvals required for the development or activity

> *A list of any approvals that must be obtained under any other Act or law before the action may 'be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community (Section 110(2)(j) and Section 110(3)(g)).*

The proposal will be assessed under Part 5 of the Environmental Planning and Assessment Act 1979. The development application will be lodged concurrently with this SIS.

A referral to the Minister for Sustainability, Environment, Water, Populations and Communities will be prepared to assess the project under the EPBC Act, due to potential impacts to Littoral Rainforest, which is a Matter of National Environmental Significance.

9.3 Licensing Matters Relating to Conducting Surveys

DGR 9.3 *Licensing matters relating to the survey*

Cumberland Ecology currently holds the following licences:

- Scientific licence (Section 132 C) (National Parks and Wildlife Act 1974)

9.4 Section 110(5) Reports

DGR 9.4 *Section 110(5) Reports*

Impact assessment was conducted after due consideration for the Environmental Impact Assessment Guidelines for relevant threatened species and the condition of potential habitats in the study area. Section 110 (5) reports utilised in preparation of this SIS are included in the References section of the SIS.

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Chapter 10

Conclusion

The proposed development involves subdivision of Lot 1 DP 408800 to create four new housing lots and provides for indicative building pads, Asset Protection Zones (APZ's) and ancillary works.

The proposed development has been significantly refined to avoid impacts to native vegetation through a number of measures. This includes the proposed creation of larger than allowable lot sizes, reducing the total number of lots and developed area across the Subject Site. Building footprints, ancillary works, and APZ's have been tightly clustered and centred on the most disturbed portions of the Subject Site, to maximise the area of intact Littoral Rainforest that is retained and to reduce impacts from clearing and edge effects.

As part of the preparation of the current DA, there has been consultation with Rural Fire Service (RFS) to refine the road alignment, and the use of permeable road surfaces. This has included avoidance of significant rock outcrops and boulders and also mature trees, particularly Cabbage Tree Palms to the greatest extent possible.

The development proposal has focused on retention of the best quality Littoral Rainforest on the upslope parts of the Subject Site, and maintaining a wide corridor that links remnant vegetation east to west, and in to Attunga Reserve.

Avoidance measures have also considered the alternatives to the proposed development, including not proceeding, under a 'Do Nothing' scenario. If no development occurs, the remnant native vegetation within the Subject Site, Littoral Rainforest, is likely to persist in the short term *in situ*, although the condition is likely to continue to degrade over time. Further development of the locality is inevitable, as is an increased threat of weed invasion, and introduction of pest species. Weed invasion is a key threatening process for this community.

The Subject Site has been maintained as a residence and native garden by the current owner, and weed control measures have been implemented according to this use. If development does not occur on the Subject Site, funding associated with the proposed development, earmarked to fund the management of all retained native vegetation across the Subject Site under a VMP, will be lost. The spread of 'transformer weeds' listed as a key threat to the long-term survival of Littoral Rainforest (Threatened Species Scientific Committee, 2008) is likely to continue throughout the Subject Site and adjoining lands if no actively management is funded.

Nonetheless, the proposed subdivision on the Subject Site will result in the complete removal of a total area of 0.05 ha (6%) of all Littoral Rainforest present, which is made up of 0.04 ha of good quality, and 0.01 ha of poor quality Littoral Rainforest. Additionally, a further

0.15 ha (17%) of the total area of Littoral Rainforest will be modified as part of an APZ and other purposes, which is made up of 0.10 ha of good quality vegetation and 0.04 ha of poor quality examples of this community.

The Littoral Rainforest present on the Subject Site represents a portion of the total patch present in the Study Area, which includes the adjoining Attunga Reserve. The loss of Littoral Rainforest on the Subject Site represents approximately 3% of the total patch present in the Study Area, and the APZ / modified zones make up approximately 7% of the total patch present in the Study Area. The 0.65 ha of Littoral Rainforest retained on the Subject Site, including the northern corridor of vegetation, will retain connectivity to vegetation in the Study Area and broader locality post development. Littoral Rainforest retained on the Subject Site will be actively managed under a VMP to restore the degraded areas and maintain the integrity of the Littoral Rainforest patch present in the Study Area.

There is expected to be a minor net loss of canopy cover on the Subject Site, however, this includes exotic canopy cover consisting of large Coral Trees (*Erythrina x sykesii*) (6% of all canopy cover present on the Subject Site), which will be removed under the proposal. The removal of the exotic canopy species will allow for supplementary replanting of Littoral Rainforest tree species within the APZs, drainage depression, and other areas of Littoral Rainforest retained onsite. The VMP has been prepared to assist in the restoration of Littoral Rainforest both within the area of subdivision, and the adjoining lots, to ensure that the values of the Littoral Rainforest are maintained.

The loss of native vegetation will result in the removal of potential foraging and roosting habitat for a number of threatened fauna species known or likely to occur in the habitats present, including Powerful Owl, Barking Owl, Grey-headed Flying-fox, threatened microbats Eastern Bentwing-bat and Little Bentwing-bat and Superb Fruit-dove. The endangered population of Squirrel Glider on the Barrenjoey Peninsula may utilise the vegetation present on the Subject Site as part of a movement corridor, however, there are no hollows present for denning and the vegetation provides only limited forging habitat. However, these species are highly mobile, and the Subject Site would only represent a small area of the total home range for each of these fauna species. This is particularly the case for threatened owls, the fruit-dove and the bats. The large majority of this corridor will be retained and actively managed for conservation.

Therefore, while the proposed development will result in the loss of habitat for threatened species, populations and communities, as listed under the TSC Act and EPBC Act, the highest quality habitats will be retained on the Subject Site and actively managed under a fully funded VMP. When considered in terms of the improvements in condition that can be achieved through implementation of the VMP, and prescribed mitigation measures to improve the water quality and control flow of run-off on the site, no significant impact is expected to occur to any species, populations or ecological communities, as listed under the TSC Act and EPBC Act. Furthermore, the long term security of the Littoral Rainforest present on the Subject Site will be confirmed by the establishment of a protective covenant (S88B) placed each of the new lots under the proposed subdivision. This will ensure that this EEC is not significantly impacted in the Study Area.

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Chapter 11

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