APPENDIX 3

MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE
IMPACT ASSESSMENTS

Impact assessments are provided for Matters of National Environmental Significance (MNES) that have been recorded on or near the project area, or whose potential habitat may be impacted by works. These include the following threatened community, three vulnerable species of flora and fauna, and four migratory species of birds:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
- *Syzygium paniculatum* Magenta Lilly Pilly
- *Pteropus poliocephalus* Grey-headed Flying-fox
- *Pseudomys novaehollandiae* New Holland Mouse
- *Pandion cristatus* Eastern Osprey
- *Haliaeetus leucogaster* White-bellied Sea-eagle
- *Monarcha melanopsis* Black-faced Monarch
- *Rhipidura rufifrons* Rufous Fantail

These impact assessments have been undertaken according to relevant guidelines (DEWHA 2009). The "significant impact criteria" applicable to each relevant category of MNES are discussed below.

Endangered communities

The significance of the impact of an action on endangered or critically endangered ecological communities is judged by the degree of impact on the following factors:

- Extent;
- Fragmentation;
- Critical habitat and critical abiotic features of its habitat;
- Species composition;
- Condition; and
- Recovery strategies.

One of the important criteria – critical habitat - requires further definition. Such habitat may be, but not limited to, habitat identified in a recovery plan for the ecological community as critical for that ecological community; and / or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. "Habitat critical to the survival" of a listed ecological community (DEWHA 2009) refers to areas that are necessary:

- for the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or
- for the recovery of the ecological community.

Vulnerable species

The significance of the impact of an action on a vulnerable species is judged by the degree impact on the following factors:

- Size, area of occupancy or fragmentation of an important population;

- Critical habitat;
- Breeding cycle of an important population;
- Availability or quality of habitat;
- Invasive species;
- Disease; and
- Recovery strategies.

A threshold question therefore is whether the subject population is part of an "important population". An "important population" is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

Also, critical habitat requires further definition. Such habitat may be, but not limited to, habitat identified in a recovery plan for the species as critical for that species; and / or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. "Habitat critical to the survival" of a listed vulnerable species (DEWHA 2009) refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal;
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators);
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

Migratory species

The significance of the impact of an action on a vulnerable species is judged by the degree impact on the following factors:

- Area of important habitat;
- Invasive species in important habitat; and
- Life cycle of an ecologically significant proportion of the population.

These factors require definition of three terms: "important habitat", "ecologically significant proportion" and "population".

An area of **important habitat** is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The **population** of a migratory species is the entire population or any geographically separate part of the population.

An **ecologically significant proportion** varies according to the species in question, as it depends on life cycle characteristics and population sizes. It is to be evaluated on a case-by-case basis and should include consideration of *inter alia* its population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

Other definitions relied upon for this assessment include (largely as per DECC 2007[1]):

Broader study area: the physical area within 10 kilometres of the subject site.
Composition: both the plant and animal species present, and the physical structure of the ecological community. Note that while many ecological communities are identified primarily by their vascular plant composition, an ecological community consists of all plants and animals as defined under the Threatened Species Conservation Act that occur in that ecological community.
Direct impacts: are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal / plant itself and the removal of suitable habitat.
Indirect impacts: occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.
Life cycle: the series or stages of reproduction, growth, development, ageing and death of an organism.
Local area: the physical area within 2 kilometres of the subject site.
Local occurrence: the ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
Local population of a threatened plant species: comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
Local population of migratory or nomadic fauna species: comprises those individuals that are likely to occur in the study area from time to time.
Local population of resident fauna species: comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
Local population: the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
Locality: the same meaning as ascribed to local population of a species or local occurrence of an ecological community.
Project area: the area within which the study was conducted, in this case being the road reserve and crown land parcel alongside Wilfred Barrett Drive.
Risk of extinction (community): the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the ecological community, and includes changes to ecological function.

[1] Department of Environment and Climate Change NSW (2007) Threatened species assessment guidelines: The assessment of significance. NSW Government, Sydney

Risk of extinction (population): the likelihood that the local population will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the viability of that population.
Study area: the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
Subject site: the area directly affected by the proposal.
Viable: the capacity to successfully complete each stage of the life cycle under normal conditions.

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia

This community is listed as Critically Endangered under the EPBC Act (1999). An equivalent community is also listed as an Endangered Ecological Community under the schedules of the NSW Threatened Species Conservation Act (1995).

Littoral Rainforest is, in general, a closed forest that occurs in close proximity to the sea (TSSC 2008a). It occurs in numerous small stands and comprises less than 1% of the total area of Rainforest in NSW (NSW Scientific Committee 2004). The canopy may be patchy or closed, and protects less tolerant species in the understorey from salt-laden winds (TSSC 2008a). This community is generally taller in sheltered sites and in hind dunes (NSW Scientific Committee 2004).

Littoral Rainforest has considerable floristic variation between stands from the south coast to the north coast and, in some areas, localised variants are recognised (NSW Scientific Committee 2004). This community has seen significant fragmentation and decline due to sandmining, coastal development and agriculture. The main key threats to this community include clearing of native vegetation, coastal development, weed invasion, visitor disturbance, animal grazing, fire and the effects of fragmentation (TSSC 2008a).

Vegetation mapping across the (then) Wyong LGA by Bell (2008) depicts this vegetation community on the peninsula between The Entrance and Norah Head as occupying 140 hectares. Most of this occurrence is protected within Wyrrabalong National Park. The supporting Technical Report for that mapping (Bell 2002) recognises Littoral Rainforest as two constituent Map Units: MU 11 Coastal Sand Scrub-Littoral Rainforest and MU 12 Coastal Sand Littoral Rainforest.

MU 12 Coastal Sand Littoral Rainforest occurs in coastal areas on Quaternary Pleistocene Sand deposits, in sheltered but well drained areas. Mesic rainforest species comprise this community, including *Alphitonia excelsa* Red Ash, *Cupaniopsis anacardioides* Tuckeroo, *Polyscias elegans* Celery Wood, *Endiandra sieberi* Hard Corkwood, *Livistona australis* Cabbage Tree Palm, *Acacia maidenii* Maiden's Wattle, and *Glochidion ferdinandi* var. *ferdinandi* Cheese Tree. Emergent species present may include *Eucalyptus botryoides* Bangalay, *Banksia integrifolia* subsp. *integrifolia* Coast Banksia, *Melaleuca quinquenervia* Broad-leaved Paperbark, or *Banksia serrata* Old Man Banksia. Large populations of the vulnerable *Syzygium paniculatum* Magenta Lilly Pilly are also present in this type.

MU 11 Coastal Sand Scrub-Littoral Rainforest is an ecotonal community between the littoral rainforest of Map Unit 12 Coastal Sand Littoral Rainforest, and Map Unit 6 Coastal Sand Holocene Banksia Scrub. It also occurs in coastal areas on Quaternary Pleistocene Sand deposits, and in relatively sheltered but well drained areas. However, mesic rainforest species comprise a small component of this community (e.g. *Cupaniopsis anacardioides* Tuckeroo, *Melia azedarach* White Cedar), with the balance comprised of species such as *Myrsine variabilis* Muttonwood, *Pittosporum undulatum* Sweet Pittosporum, *Dodonaea triquetra*, *Banksia serrata* Old Man Banksia, and *Acacia longifolia*. Emergent species present may *include Eucalyptus botryoides, Banksia integrifolia subsp. integrifolia,* or *Banksia serrata*. It also often

This community occurs in the project area in two forms: (i) Littoral Rainforest with a diverse structure of trees, palms, vines, and a sparse understorey and (ii) Littoral Rainforest Vine Thicket dominated by native vines. These are an amalgam of the Map Units 11 and 12 mapped and described by Bell (2002, 2008). The parts that contain many "scrub" species (characterised as Map Unit 11) occur on drier areas, such as dune crests and exposed dune slopes. The more mesic sections (characterised as Map Unit 12) occur in the more sheltered positions such as the swales.

Together, they constitute the Endangered Ecological Community *sensu* TSC Act, and occupy 9.92 hectares of the project area.

The entity listed under the EPBC Act must satisfy a similar set of key diagnostic criteria of place, geographic and topographic position, structure and floristic composition. However, an additional critical component of the definition of this MNES are condition thresholds (TSSC 2008a):

> *"The listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community comprises those patches that meet the key diagnostic characteristics (above) and the condition thresholds presented below.*
>
> - *Small patches can be resilient and viable, but the minimum size of a patch needs to be 0.1 ha; AND*
> - *The cover of transformer weed species (as identified in Attachment A) is 70% or less. Transformer weeds are highly invasive taxa with the potential to seriously alter the structure and function of the ecological community. This threshold recognises the relative resilience and recoverability of the ecological community to invasion by weed species; AND*
> - *The patch must have:*
>   - *at least 25% of the native plant species diversity characteristic of this ecological community in that bioregion (Attachment A); OR*
>   - *at least 30% canopy cover of one rainforest canopy (either tree or shrub) species (Attachment A, excluding Banksia and Eucalyptus species that may be part of the ecological community)"*

The vegetation on site delineated as Littoral Rainforest (both sub-types) qualifies as the EPBC-listed MNES as it satisfies all of the diagnostic criteria, detailed in the table below:

Key Diagnostic Criterion	Site	Conclusion
Occur in IBRA Bioregions Cape York Peninsula, Wet Tropics, Central Mackay Coast, South Eastern Queensland, NSW North Coast, Sydney Basin and South East Corner.	Located within the Sydney Basin.	Qualifies
Occur within two kilometres of the east coast, including offshore islands, or adjacent to a large body of salt water, such as an estuary, where they are subject to maritime influence.	Located on a narrow sandy peninsula 750 metres from the coast and 1 kilometre from Tuggerah Lake foreshore.	Qualifies
The structure of the ecological community typically is a closed canopy of trees that can be interspersed with canopy gaps that are common in exposed situations or with storm events. Usually, several vegetation strata are present. However, where there is extreme exposure to salt laden winds, these strata may merge into a height continuum rather than occurring as distinct vegetation layers. The canopy forms a mosaic due to canopy	The structure displays various features: Closed upper canopy – particularly where *Livistona australis* Cabbage Tree Palm is dominant Dense upper canopy – often dominated by *Endiandra sieberi* Hard Corkwood, *Livistona australis*	Qualifies

Key Diagnostic Criterion	Site	Conclusion
regeneration, typically in the form of basal coppice following canopy decapitation due to prevailing salt laden winds and storm events. Wind sheared canopy can be present on the frontal section leading to closed secondary canopies. Emergents may be present, for example, species from the genera Araucaria (northern bioregions only), Banksia or Eucalyptus. The ground stratum of the vegetation typically is very sparse.	Cabbage Tree Palm, *Eucalyptus botryoides* Bangalay Where the upper canopy has been opened, it is overtaken by native vines such as *Cissus hypoglauca, Cissus antarctica, Smilax australis.* Understorey layers are variously present and include juvenile trees of the canopy species, plus small trees *Acmena smithii*, *Syzygium paniculatum, Myrsine variabilis* and vines. Ground layer is sparse, but usually represented by grasses and graminoids.	
The ecological community contains a range of plant life forms including trees, shrubs, vines, herbs, ferns and epiphytes. To the north, most plant species diversity is in the tree and shrub (i.e. canopy) layers rather than in lower strata. The converse generally occurs from the Sydney Basin Bioregion southwards. Feather palms, fan palms, large leaved vascular epiphytes and species that exhibit buttressing are generally rare. Ground ferns and vascular epiphytes are lower in diversity in littoral rainforests compared to most other rainforest types		
Plants with xeromorphic and succulent features are generally more common in littoral rainforest than in hinterland rainforest types. Canopy stem sizes also tend to be smaller compared to that in hinterland rainforest. Trunks rarely host mosses though lichens are usually common	Eucalypts and Banksias are common features. Of the mature trees measured along the route in the Littoral Rainforest, only one was >95 cm DBH. No mosses were observed but lichens on trunks were common.	Qualifies
Whilst species can be regionally predictable, there may be considerable variation in the composition of individual stands of the ecological community within any given bioregion. Attachment A (TSSC 2008b) provides a list of flora species for each relevant bioregion	The majority of the listed species were present: • Of the 18 tree species listed, 11 were observed on site. • Of the 4 shrub species listed, 4 were observed on site. • Of the 9 vine species listed, 8 were observed on site. • Of the 1 fern species listed, 0 were observed on site.	Qualifies
Minimum patch size needs to be 0.1 hectares	Patch size is 9.92 hectares in the project area and is part of a patch of 140 hectares in extent.	Qualifies
Cover of transformer weeds is 70% or less	Of the 7 transformer weeds listed, 4 were observed across the project area and 3 of those within the Littoral Rainforest: *Asparagus aethiopicus, Chrysanthemoides monilifera* and *Lantana camara.* However, none of these weeds were dominant in the Littoral Rainforest, occurring only occasionally. The densest patches of Lantana were in evidence in the vine thickets, but did not dominate.	Qualifies
The patch must have at least 25% of the native plant species diversity characteristic of this ecological community in that bioregion OR at least 30% canopy cover of one rainforest canopy (either tree or shrub) species as per Attachment A (TSSC 2008b)	Of the listed species, 72% occur within the subject site.	Qualifies

Therefore, the 9.92 hectares delineated as Littoral Rainforest in the project area is a representative of the Commonwealth-listed entity. The direct impact of the proposed works is as follows:

Total in Project Area (ha)	Permanent Loss (ha)		Temporary Loss (ha)		Total permanent loss (ha)	Total rehabilitated (ha)	Total untouched (ha)
	Pathway	Rest Areas	Pathway Curtilage	Construction Tracks			
9.920	0.759	0.005	1.012	0.027	0.764 (7.7% of Project Area)	1.039 (10.5% of Project Area)	8.117 (81.8% of Project Area)

The curtilage along the edge of the pathway will be cleared and otherwise disturbed during construction. Construction of the path to the north has demonstrated that a width of 2 metres either side is sufficient. Tracks to facilitate the construction of elevated sections of the pathway will also need to be cleared and disturbed during works. After construction is complete, these areas will be rehabilitated using local provenance material under an Approved Management Plan. Species for planting are to include at least 18 *Syzygium paniculatum* Magenta Lilly Pilly and at least 24 *Banksia integrifolia* Coast Banksia to offset losses of these species in Littoral Rainforest. Weed control will be the major management strategy in the rehabilitated areas.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

reduce the extent of an ecological community,

Response:

This community will be directly impacted by the pathway as it passes through it for approximately 2 kilometres, permanently removing 0.759 hectares of this community for the path itself plus approximately 0.005 hectares for rest areas. The edges alongside the pathway and access construction tracks will be also be cleared and disturbed during works across 1.039 hectares. However, the edges and construction tracks will be rehabilitated with appropriate species after works are complete and managed under an Approved Management Plan. Overall, 82% of the occurrence of this community in the project area will remain untouched.

Importantly, the Littoral Rainforest of the project area is within a larger occurrence of this vegetation type, with 140 hectares mapped by Bell (2002, 2008) on the sand spit between Norah Head and The Entrance. The area to be permanently removed for the pathway and rest areas is 0.5% of this occurrence and the area to be temporarily disturbed and then rehabilitated is 0.7% of this occurrence.

Thus, this ecological community's extent will be reduced by 0.7646 hectares, or 0.5% of its local occurrence.

fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads, or transmission lines

Response:

Clearing is required for the construction of a 3-metre-wide pathway within the project area. This will result in the removal of canopy trees, mid storey trees and vines as well as ground layer vegetation.

Being only narrow, the proposed clearing is not considered likely to fragment this community within the project area to any appreciable extent. Tree canopies will remain close, if not directly connected across the pathway, and such a narrow opening is unlikely to prevent the movement of any animals known to inhabit this area, pollinators of rainforest species or seed vectors. Water will pass over it and wind actions will not be impeded.

The Littoral Rainforest in this area already has walking paths passing through it in Wyrrabalong National Park (e.g. Lilly Pilly Loop Trail), and this has not caused any noticeable deterioration.

Also, in order to minimise any fragmentation impacts, the pathway has been located close to Wilfred Barratt Drive whenever practicable.

adversely affect habitat critical to the survival of an ecological community

Response:

No critical habitat for this species has been declared or defined. The area of Littoral Rainforest in Wyrrabalong National Park and environs is the largest expanse of this community on the Central Coast of NSW. The area to be removed and modified by the proposal is very small in this context and unlikely to interfere with its persistence in the project area or in the locality.

modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

Response:

Approximately 0.764 hectares of this community will be removed by the proposal, mostly by the construction of a concrete pathway at-grade. The known aquifer to the north of the proposal will not be impacted.

Critical abiotic components of its habitat include its proximity to the sea, substrate and topographic factors. The proposal will not alter any of these features.

cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

Response:

The small area to be removed will not change the overall species composition of this critically endangered ecological community. The rehabilitation actions to be implemented in the pathway curtilage and construction tracks will use local provenance material as per an Approved

Management Plan. Key replacement plantings include *Syzygium paniculatum* Magenta Lilly Pilly and *Banksia integrifolia* Coast Banksia at a ratio of at least 3:1. The remainder of the plantings will mimic the floristic and structural diversity of the extant Littoral Rainforest.

cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

assisting invasive species, that are harmful to the listed ecological community, to become established, or

Response:

This community on site is in very good condition and exhibits little impact from invasive species. The narrow band of this community to be removed for the proposal will not contribute further in the spread of invasive species, particularly as the curtilage and construction tracks will be rehabilitated as per an Approved Management Plan, which will include weed control as a key management strategy.

causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community,

Response:

Vegetation management and weed control will use best practice bush regeneration techniques. While this might involve the use of herbicides (such as glyphosate), such chemicals will only be used by experienced practitioners for on-label purposes and with all necessary precautions.

The use of the pathway by pedestrians and cyclists are is unlikely to result in the introduction of chemicals or pollutants.

interfere with the recovery of an ecological community.

Response:

No recovery plan for this community currently exists. The extent of this community on site is in good condition and the extent will only be slightly altered by the proposal.

Significant threats to the persistence of this community (DEWHA 2009) and the relevance of the proposal are discussed below.

Clearing, disturbance, modification. The area to be alienated is relatively small and potential edge effects will be controlled by vegetation management. The implementation of the works or the presence of the pathway will not threaten the persistence of the expanse of 140 hectares of this community.

Inappropriately placed tracks and amenities. The track's path has been painstakingly located in order to avoid and minimise impacts on this community and other important ecological features (such as threatened species or hollow-bearing trees).

Invasive weeds. Transformer weeds such as Lantana and Boneseed occur on site. They are currently not being controlled. However, the Approved Management Plan to be implemented as part of the rehabilitation of the curtilage and construction tracks for the pathway will provide an opportunity to introduce weed control measures. Also, the pathway provides educational opportunities for the users of the pathway. Such community engagement has the potential to spur government and volunteer agencies to implement further management actions.
Inappropriate fire regimes. The degree of exposure of the vegetation to inappropriate fire regimes is not significantly altered by the construction of the track.
Trampling, browsing and grazing by feral animals and livestock. Not applicable

SUMMARY

Overall, it has been established that only minor impacts will occur as a result of the proposed pathway construction and ongoing use, with important indicators of community persistence remaining intact:

1. This community occurs across 140 hectares on the sand spit and its extent is largely unaffected by the proposal, which will result in a permanent loss of only 0.5% of its local occurrence. Most of its local occurrence is in reserved land (Wyrrabalong National Park) and its shape has a large area-to-boundary ratio. This patch is therefore less exposed and more resilient to edge effect disturbances such as weed invasion and other human impacts;
2. The community is made up of several age cohorts. For example, mature and juvenile individuals of canopy species (e.g. *Livistona australis* Cabbage Tree Palm) and mid storey species (e.g. *Syzygium paniculatum* Magenta Lilly Pilly) are in evidence. The dynamic and resilient nature of the community is demonstrated also by the occupation of canopy openings by dense thickets of native vines. Multi-stemmed individuals of *Syzygium paniculatum* Magenta Lilly Pilly recovering after fire (Robert Payne, personal communication) are further evidence of its resilience;
3. Good faunal habitat is available (e.g. coarse woody debris on the ground, hollow-bearing trees) and it is part of a larger wildlife corridor;
4. The patch has a high species richness of flora and fauna;
5. Threatened species are supported by this community and in adjacent habitats;
6. Only small weedy patches occur in this community and can be managed; and
7. The connectivity to other surrounding native vegetation is maintained.

It is considered therefore that the impact of the proposal on this community is not significant due to the small scale of the losses. The ameliorative measures (rehabilitation of the disturbed curtilage and ongoing weed management) are considered sufficient to control ongoing potential impacts. Moreover, the proposed pathway provides the opportunity to engage the community with this vegetation and its habitat. For example, educational signage strategically placed at rest areas can deliver an important conservation message.

Notwithstanding this conclusion regarding a non-significant impact, the matter has been referred due to there being a direct impact on a Critically Endangered Community.

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Syzygium paniculatum Magenta Lily Pilly

Syzygium paniculatum Magenta Lilly Pilly is listed as Vulnerable under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is listed as Endangered under Schedule 1 of the Threatened Species Conservation Act (1995).

It is a small to medium sized rainforest species that grows up to 18 metres in height (OEH 2012). It has flaking bark (Wilson 1991) and a dense crown of opposite, lanceolate glossy leaves (Fairley and Moore 1989) that are paler underneath (NSW NPWS 2001a). Clusters of white flowers are produced at the end of each branch, between November and February, but tend to occur in two distinct flushes (NSW NPWS 2001a). The deep magenta fruits, which may be spherical or egg-shaped, mature in May (DECCW 2009). Without fruit, it is difficult to differentiate this species from *Syzygium australe* Brush Cherry (NSW NPWS 2001b) with which it often co-occurs.

This species is restricted to NSW but is distributed in widely separated localities along a narrow coastal strip between Bulahdelah and Jervis Bay (Wilson 1991). It has a total population of approximately 1,200 individual plants (TSSC 2008).

It occurs on sandy soil or stabilised sand dunes in coastal area (Hyland 1983), and is known to occur within the Critically Endangered Ecological Community Littoral Rainforest and coastal vine thickets of Eastern Australia.

On the Central Coast of New South Wales, this species occurs on Quaternary gravels, sands, silts and clays (NSW NPWS 2001a). Further south, this species occurs on sandy grey soils over sandstone (NSW NPWS 2001a). Suitable vegetation types for this species on the Central Coast include riverside gallery rainforests and remnant littoral rainforest communities on gravels, sands, silts and clays (OEH 2017a). On the south coast, it is found in littoral rainforest on sandy soils or stabilised dunes near to the sea (Wilson 1991).

Recognised threats to the life cycle of this species include habitat changes, weeds and fire (NSW NPWS 2001b). Changes to the hydrology of local catchments as it may alter the habitat condition for existing populations and also impact on seed dispersal mechanisms and recruitment. Weed invasions will similarly prevent seedlings from reaching maturity and ultimately result in a gradual decline of the population. Fire is likely to kill individuals of this species and frequent fires will lead to a decline in recruitment and ultimately the loss of local populations.

Local populations are defined for this species as those individuals within the same catchment (NSW NPWS 2001b). As it is a long-lived species with potentially large seed dispersal areas, even small populations should be regarded as viable if the conditions enable successful recruitment (NSW NPWS 2001b).

A Recovery Plan has been prepared for this species (OEH 2012) and that plan identifies five metapopulations, which is based on a 30 kilometre foraging range of the *Pteropus poliocephalus* Grey-headed Flying-fox. The Central Coast hosts one of these metapopulations within which is 24 subpopulations. One of these subpopulations within the Central Coast is protected in Wyrrabalong National Park.

OEH has declared that the conservation of this species can be secured by management of specific key sites (2017b). The Wyrrabalong National Park subpopulation is one of the three Key Management Sites so identified, the other two being Wamberal Lagoon and Great Lakes. Identified threats for this subpopulation include:

- Inappropriate fire regimes;
- Weeds; and
- Development.

Conservation management actions identified include fire planning, site-based weed control, monitoring of habitat condition, and monitoring of species diversity (OEH 2017b).

During survey, 28 individuals were observed in and adjacent to the pathway. The observed population within the project area greatly exceeds this number, with Payne (1997) recording 49 adult trees in this area and 106 mature trees across the Central Coast metapopulation. All of the individuals recorded in the project area during survey occurred within Littoral Rainforest.

The subpopulation to which the individuals of the project area belong are deemed to be an *important population* as they are part of a reasonably large population (in the order of at least 50 known plants), represents almost half of the known metapopulation, is within an identified Key Management Site, are protected in the largest patch of protected Littoral Rainforest on the Central Coast, have exhibited resilience to disturbances (such as fire) and are reproducing naturally. The persistence of this subpopulation is considered important for the long-term survival and recovery of the species.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

lead to a long-term decrease in the size of an important population of a species

Response:

Locations of 28 individuals were recorded on and immediately adjacent to the pathway during survey. More individuals were observed in areas where the pathway route was abandoned, and Payne has estimated at least 49 mature individuals in this population.

Despite painstaking route selection on foot, the chosen pathway route will unavoidably require the removal of 1 mature tree and 5 juveniles.

These losses are to be compensated by the planting of individuals from local provenance material at a ratio of at least 3:1 in suitable habitat in the rehabilitated curtilage and construction tracks.

These plantings are to be maintained under an Approved Management Plan, so that the long term size of the important population will be maintained or improved.

reduce the area of occupancy of an important population

Response:

Suitable habitat for this species is widely available within the local area. The area of suitable and known habitat to be removed by the proposal is small and is unlikely to reduce the overall area of occupancy by this species.

Potential suitable habitat for this species (Littoral Rainforest) occurs in a large uninterrupted patch of 140 hectares (Bell 2002, 2008), of which the project area is a part. Only a small area of suitable habitat will be removed - 0.764 hectares or 0.5% of the available habitat. A further 1.0396 hectares (0.7%) will be disturbed and then rehabilitated along the edges of the pathway.

The loss of the "area of occupancy" is confined to that occupied by the 6 individuals to be removed and the 0.5% of the available local habitat.

fragment an existing important population into two or more populations

Response:

The pathway will not fragment the population: the pathway is narrow and easily traversed by pollinators, propagules and their vectors and other processes that contribute to the life cycle of this species. Physical canopy connectivity will also be largely maintained.

adversely affect habitat critical to the survival of a species

Response:

No critical habitat for this species has been declared.

Habitat critical to its survival include areas that contain Littoral Rainforest and the large expanse of reserved habitat within Wyrrabalong National Park is likely to be very important for the persistence of this subpopulation. Only a very small percentage of such habitat will be impacted (0.5% lost, 0.7% disturbed and then rehabilitated). This is unlikely to threaten the existence or function of this habitat.

disrupt the breeding cycle of an important population

Response:

Recognised threats to the life cycle of this species include habitat condition, weeds, fire, and hydrological changes. Alterations to the movement of water through the landscape may alter both the habitat available and seed dispersal mechanisms and recruitment. Weed invasions may prevent seedlings from reaching maturity and ultimately result in a gradual decline of the population. Fire may kill individuals of this species and frequent fires will lead to a decline in recruitment and ultimately the loss of local populations.

However, the proposal will not contribute to any of these recognised threats.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Response:

The proposal will require the removal of 6 individuals and 0.764 hectares of suitable habitat for this species within the Littoral Rainforest in the project area, which represents only 0.5% of the total area of habitat available to this population. Further, 1.039 hectares or 0.7% of this available habitat will be disturbed and then rehabilitated.

These losses and modifications are not of a scale likely to lead to a decline of this species.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Response:

Weed species are known to compete with this species for water, nutrients and sunlight.

The proposal will not further increase the likelihood of such invasive species as it will implement weed control measures in areas where no such controls are currently being undertaken, as part of the Approved Management Plan.

introduce disease that may cause the species to decline, or

Response:

This species is known to be affected by Myrtle Rust and has been reportedly identified as a known host of this pathogen. There are no other recorded diseases to which this species is susceptible.

Best practice hygiene controls for Myrtle Rust will be applied as part of the Construction Environmental Management Plan (or similar) as well as in the vegetation controls implemented in the Approved Management Plan.

interfere substantially with the recovery of the species.

Response:

A national recovery plan for this species was established in 2012 in order to help protect known subpopulations of this threatened species. Specific objectives include:

- ensuring a coordinated and efficient approach to the implementation of recovery efforts;
- establishing the full extent of the distribution of the species;
- increasing the understanding of its biology and ecology;
- minimising the decline of the species through *in situ* habitat protection and management;
- reducing impacts of Myrtle Rust on this species and its habitat;
- maintaining a representative *ex situ* collection of this species; and

- raising awareness of the conservation significance of this species and involving the broader community in the recovery program.

The proposal is consistent with many of these strategies:

- the subpopulation has been further explored as part of the survey and assessment process;
- *in situ* habitat protection and management is proposed for the majority of the individuals observed in the project area;
- Myrtle Rust will be addressed by best practice control protocols in an Approved Management Plan; and
- The proposal allows for the engagement and education of the broader community who will use the shared pathway.

SUMMARY

Six individuals (5 juveniles, 1 adult) and the potential habitat of this species within the pathway footprint will be directly impacted. Retained individuals adjacent to the pathway may also experience indirect impacts arising from the opening up of otherwise closed forest habitat. However, this species is not necessarily threatened by at least some degree of disturbance. For example, it is known to coppice after fire, with many trees in the project area being multi-stemmed. Also, like many rainforest species, seedling progression may rely on the canopy opening up (OEH 2012), as seedlings beneath adult canopy are thought to be short-lived (Benson and McDougall 1998).

The road reserve supports 9.920 hectares of Littoral Rainforest, this being potential habitat for this species. The pathway will pass through this vegetation over a distance of approximately 2 kilometres, permanently removing 0.759 hectares of potential habitat for this species. The edges alongside the pathway and access construction tracks will be also be cleared and disturbed during works across 1.039 hectares. However, the edges and construction tracks will be rehabilitated with appropriate species after works are complete and managed under an Approved Management Plan. Planting of at least 18 individuals from local provenance material will be part of this rehabilitation. Overall, 82% of the potential and realised habitat of this species in the project area will remain untouched.

It is important to note that the project area contains only a small part of the Littoral Rainforest on the sand spit. The latest vegetation mapping (Bell 2008) shows this vegetation type as occupying 140 hectares. Therefore, the degree of permanent loss of this community is in the order of 0.5% of what is available to the local population, with a further 0.7% to be temporarily cleared and then rehabilitated.

It is considered here that the impact of the proposal on this species is not significant due to the small scale of the losses and the majority of those losses being of small juvenile trees. The ameliorative measures (rehabilitation of the disturbed curtilage and ongoing weed management) are considered sufficient to control ongoing potential impacts. Also, plantings at a ratio of 3:1 is considered sufficient to offset those losses.

Additionally, the proposed pathway provides the opportunity to engage the local community with the value of this species, its habitat and threats. For example, educational signage strategically placed at rest areas can deliver an important conservation message.

Notwithstanding this conclusion regarding a non-significant impact, the matter is referred due to there being a direct impact on a listed species.

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***Pteropus poliocephalus* Grey-headed Flying-fox**

The Grey-headed Flying-fox is listed as Vulnerable under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is also listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995).

It is a large flying-fox with a white or greyish head, reddish mantle around the neck and thick, shaggy fur extending to the ankles (Strahan 1995). This species has a distribution along eastern coastal Australia from Rockhampton in Queensland to western Victoria (Churchill 2008). The Grey-headed Flying-fox occurs in a variety of habitats including subtropical and temperate rainforests, sclerophyll forests, woodlands, as well as urban areas (OEH 2016a). It also frequents mangroves, paperbark swamps and cultivated areas (Churchill 1998). It is usually seen in large, noisy colonies, or in day 'camps' usually placed close to water in gullies with dense forest canopies (Tidemann 1995). Most births occur around October (Strahan 1995).

This is a highly mobile species, and camps are regularly moved in response to local food availability (Churchill 1998). Most births occur around October (Strahan 1995). They forage widely at night for rainforest fruits and native blossoms (Strahan 1995), and are likely to be an important pollinator for many native species (Tidemann 1995). Seventy-five percent of foraging forays are within 20 kilometres of the camp but some individuals may commute 50 kilometres to a productive food sources (Tidemann et al. 2008).

A camp known to contain up to 50,000 individuals occurs in Morisset, which is approximately 22 kilometres north west of the site. The site is therefore within range to be used as a regular foraging location.

They have been recorded as feeding on 201 plant species of 50 families, with almost half of these in the Myrtaceae (Churchill 2008) but the pollen and nectar of Eucalyptus, Melaleuca and Banksia (Eby 2000) are their principal foods. Native figs are also important and they also appear to eat the salt glands from mangrove trees (Churchill 2008).

The availability of native fruits, nectar and pollen varies over time and throughout the range of the species. This species is highly nomadic in response to the uneven distribution of their food plants, sometimes travelling hundreds of kilometres to find suitable resources and / or feeding in domestic gardens, parks and orchards. Such characteristics make it very difficult to define key habitat areas (Eby and Lunney 2002). Also, the areas that offer foraging resources at any time are small and vary in location between years (Eby and Lunney 2002).

Although variable, a general pattern of movement can be discerned. Almost half of the eucalypt species used by the Grey-headed Flying-fox flower in summer and such summer-flowering species are distributed throughout their range. Thus, in summer, this species is generally widely dispersed.

However, the winter-flowering species they use are largely restricted to the woodlands of the western slopes or the lowland coastal communities (Eby and Lunney 2002). Thus, they are usually highly aggregated in winter, depending on where the nectar is flowing.

The site provides just such suitable foraging habitat in the winter-flowering *Banksia integrifolia* Coast Banksia. The remainder of the vegetation also provides many foraging resources including Myrtaceae blossom (e.g. *Angophora costata* in spring, *Eucalyptus botryoides* in late summer) and autumn-winter rainforest fruits (e.g. *Livistona australis*, *Acmena smithii*, *Syzygium paniculatum*).

The majority of suitable foraging habitat for this species in the local area occurs in Wyrrabalong National Park.

This species was not recorded during survey, despite *Angophora costata* being in flower at the time. However, it is known to forage in the trees along the Tuggerah Lake foreshore in Wyrrabalong National Park (Mjadwesch Environmental Service Support 2013) and is likely to use suitable resources in the project area.

Populations of this species are all intimately inter-related and are considered "contagious" to the point where it is considered to exist as a single national population covering its entire range (Department of the Environment 2015). Therefore, all populations must be regarded as important populations.

Nationally-important camps are defined as those that contain ≥ 10,000 Grey-headed Flying-foxes in more than one year in the last 10 years, or have been occupied by more than 2,500 grey-headed flying-foxes permanently or seasonally every year for the last 10 years (Department of the Environment 2015). Strict application of these rules does not recognise the Morisset camp as nationally-important, although it is on the cusp of recognition, with survey data indicating it was occupied by 2,500 to 9,999 individuals in December 2013, 500 to 2,499 individuals in February 2015 and November 2015, and then swelling to 50,000+ individuals in February 2016.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

lead to a long-term decrease in the size of an important population of a species, or

Response:

The site provides suitable foraging habitat for this highly mobile species. Specifically, the proposal requires the removal of 8 winter-flowering *Banksia integrifolia*. More generally, the proposal will remove potential foraging resources across the entire pathway footprint. However, this is a small percentage of available habitats in the local area, most of which are in permanent conservation reserves.

The 8 Banksias to be removed will also be offset by plantings of at least 24 trees. The temporary removal of 8 trees and the permanent removal of 1.135 hectares of potential foraging habitat in a narrow ribbon is unlikely to lead to a long term decrease of the population of this highly mobile species.

fragment an existing important population into two or more populations, or

Response:

This is a highly mobile species that can exploit widely-separated resources in a single foraging foray. The proposal will remove habitat in a narrow band alongside Wilfred Barrett Drive, which will not impede movement of this species or significantly fragment its habitat.

adversely affect habitat critical to the survival of a species, or

Response:

Habitat critical to the survival of species can include foraging, breeding, roosting or dispersal habitat. Most of the potential habitat will be retained across the project area and most foraging habitat in the local area is within a secure conservation reserve. The project area does not provide habitat for breeding or roosting.

However, winter-flowering trees of coastal habitats are of critical importance to this species and the proposal will remove 8 mature trees of *Banksia integrifolia*. These will be replaced by offset plantings at a ratio of at least 3:1.

disrupt the breeding cycle of an important population, or

Response:

Breeding cycle disruption is caused by interference with breeding habitat or wholesale removal of foraging habitat near breeding camps. The proposal will not result in any such action.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or

Response:

The small scale of habitat loss and disruption is unlikely to result in a decline in this species.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat, or

Response:

The project area contains many serious weeds, with the greatest infestations being in the Banksia Scrub vegetation. The development proposal will result in the suppression and control of many of these weeds.

The proposal will not further increase the likelihood of such invasive species becoming established as it will implement weed control measures in areas where no such controls are currently being undertaken, as part of the Approved Management Plan.

introduce disease that may cause the species to decline

Response:

Although they are a vector for human disease, there is little reported regarding disease affecting this species. Parasites are few, principally bat-flies, nematodes and protozoans.

Despite this dearth of information, it is unlikely that the development will influence the level of disease in this species.

interferes substantially with the recovery of the species.

Response:

The most recent Draft Recovery Plan (Department of Environment and Energy 2017) identifies the primary known threat to the survival of this species as loss and degradation of foraging and roosting habitat. Moderate threats include conflict with people, but this is increasing in urban areas. The level of threat caused by electrocution on power lines and entanglement in netting and barbed-wire fences is unknown. The impact of climate change is also unknown but increasing temperatures and drought conditions are likely to degrade foraging and roosting habitat, influence the frequency of foraging in commercial orchards, cause heat stress and increase heat related mortality. Just such heat-related mortality occurred during the heatwaves in the summer of 2016-17 (personal observation).

The Draft Recovery Plan (Department of Environment and Energy 2017) has identified 9 objectives:

1. Identify, protect and enhance native foraging habitat critical to the survival of the Grey-headed Flying-fox;
2. Identify, protect and enhance roosting habitat of Grey-headed Flying-fox camps;
3. Determine population trends in Grey-headed Flying-foxes so as to monitor the species' national distribution and conservation status;
4. Build community capacity to coexist with flying-foxes and minimise the impacts on urban settlements from existing camps without resorting to dispersal;
5. Increase public awareness and understanding of Grey-headed Flying-foxes and the recovery program, and involve the community in the recovery program where appropriate;
6. Improve the management of Grey-headed Flying-fox camps in sensitive areas;
7. Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture;
8. Support research activities that will improve the conservation status and management of Grey-headed Flying-foxes; and
9. Assess and reduce the impact on Grey-headed Flying-foxes of electrocution on power lines, and entanglement in netting and on barbed-wire.

The proposed pathway construction and use will not interfere with any of these recovery objectives.

SUMMARY

Potential foraging habitat for this species occurs across the project area and some will be removed in the subject site. This is comprised of the 8 winter-flowering *Banksia integrifolia* trees and the 1.135 hectares of native vegetation that will be permanently cleared for the works.

This species was not observed on site during survey, but is known to forage in suitable habitat in the adjacent Wyrrabalong National Park.

The small scale of these potential impacts is considered unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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***Pseudomys novaehollandiae* New Holland Mouse**

The New Holland Mouse is listed as Vulnerable under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is not listed under the Threatened Species Conservation Act (1995).

It is a small, burrowing native rodent known to inhabit woodlands, heathlands, vegetated sand dunes and forests with a heathy understorey. This species is social in its habits, sharing burrows with other individuals. Its home range has been estimated between 0.44 to 1.4 hectares. This species is a post-fire specialist and reaches peak abundance during early- to mid-stage vegetation regenerating after fire (TSSC 2010).

The species is nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal. It is likely that the species spends considerable time foraging aboveground for food, predisposing it to predation by native predators and introduced species (TSSC 2010b).

It once had a continuous range on mainland Australia, but it has suffered a significant range contraction since European settlement (TSSC 2010b).

Across the species' range, the total population of mature individuals was estimated to be less than 10,000 in 2008 (Menkhorst et al. 2008).

A preliminary survey of Wyrrabalong National Park established the presence of this species in the Red Gum Forest (O'Brien 1993, quoted in Mjadwesch Environmental Service Support 2013). It was considered a regionally significant finding, and targeted surveys and specific fire management actions have subsequently been implemented (Doug Beckers, NSW NPWS, personal communication).

Threats to this species include loss of habitat, weed invasion, inappropriate fire regimes, threats from invasive species and *Phytophthora* (TSSC 2010b).

This species was not recorded in the project area during survey. However, a population is known to occur in the surrounding Wyrrabalong National Park and individuals probably use suitable parts of the project area. An active mosaic burn program by NSW NPWS is in place that, among other conservation management objectives, serves to maintain post-fire heath and open forest habitat suitable for this species.

The northern end of the project area has been incorporated in this management regime, and the project area supports suitable post-fire habitat in 4.2 hectares of Banksia-Apple Forest that was burnt in August 2014. However, the potential and realised habitat for this species is not confined to the project area, but occurs at least in the other blocks of vegetation that have been burnt less than 6 years previously: 86.7 hectares burnt September 2012, 17.6 hectares burnt August 2013 and 72.2 hectares burnt August 2014 of which the subject site is a part.

The proposal will permanently alienate 0.192 hectares of suitable habitat for the pathway and rest areas along a length of approximately 700 metres. A further 0.31 hectares will be temporarily

cleared and disturbed in the path's curtilage and on temporary construction tracks, but these areas will be rehabilitated with suitable local provenance material.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

lead to a long-term decrease in the size of an important population of a species

Response:

The area of suitable habitat to be removed and modified is small in regards to what is available and protected in the local area. The suitable habitat in the project area is part of the area managed by NSW NPWS for the conservation of this species.

The permanent loss of a narrow band of habitat for a length of 700 metres is unlikely to lead to a long-term decrease in the size of the population of this species.

reduce the area of occupancy of an important population

Response:

The area of occupancy of this species in the local area includes at least the 176.5 hectares of suitable vegetation with an appropriate fire regime, of which the project area is a part. The works will require the permanent loss of 0.1962 hectares of this habitat, which is only 0.1%.

fragment an existing important population into two or more populations

Response:

The ultimate width of the at-grade portions of the pathway is only 3 metres. This species is adapted to early to mid seral stage post-fire vegetation and therefore is presumably able to cross open areas of this scale.

adversely affect habitat critical to the survival of a species

Response:

No critical habitat for this species has been declared.

Critical components of habitat for this species includes suitable woodland / heathland vegetation with an appropriate fire regime. The pathway is within the area that is managed by NSW NPWS for the conservation of this species. The pathway will not prevent the continuation of such management.

disrupt the breeding cycle of an important population

Response:

The small scale of loss of habitat for this species (0.1% of that mapped) is considered unlikely to disrupt its breeding cycle.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Response:

The pathway will remove only 0.1% of mapped suitable habitat in the area of occupancy of this population. This is considered too small a change to result in a decline of the species.

Further, it will temporarily modify 0.2% of that habitat. The 3 metre wide pathway presents a potential barrier to movement. This is not considered likely to interfere with the movement of this species as it is adapted to open areas.

The quality of habitat is largely dependent on the degree of weed infestation and the fire regime. The weeds in the subject site will be controlled post-construction under and Approved Management Plan and the fire regime is managed by NSW NPWS for the conservation of this species.

The proposal is unlikely to result in the decline of this species.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Response:

Opening up of vegetation and the construction of tracks through forest generally provides enhanced access for introduced predators. However, the site is alongside a major roadway (Wilfred Barrett Drive) and there is already a well-established network of tracks in the Adjacent National Park. The European Red Fox was observed in a camera trap for this survey.

Thus, the population is already under predation pressure and management actions undertaken by NSW NPWS would be relevant to the suitable habitat within the project area.

introduce disease that may cause the species to decline, or

Response:

This species is known to be indirectly impacted by the fungal disease *Phytophthora*, due to resultant dieback of vegetation (TSSC 2010b). However, this disease is unlikely to be introduced by the proposal into the very dry and sandy substrate of the works area.

interfere substantially with the recovery of the species.

Response:

No recovery plan or threat abatement plan has been adopted for this species. Priority actions have been detailed (TSSC 2010a) that fall into 7 broad categories:

- **Regional planning approach**. Recommends use of landscape scale management strategies and regional planning to maintain connectivity.
    - Response: The project area is managed at a landscape scale by NSW NPWS. It also lies within an area of recognised wildlife corridor, most of which is reserved and under active conservation management
- **Habitat loss, disturbance and modification**. This action relies on population monitoring, land acquisition and implementation of conservation management plans.
    - Response: As part of this survey and assessment process, survey was undertaken. Appropriate habitats within the project area is managed for conservation purposes by the NSW NPWS.
- **Invasive weeds.** It is recommended that weeds are identified and controlled, and that chemicals used are not harmful to this species.
    - Response: The degree of weediness in appropriate habitat for this species in the project area is minimal. Weed management will be implemented along the curtilage of the pathway as part of the Approved Management Plan. Best practice bush regeneration techniques will be used.
- **Predation or competition.** Actions detailed in relevant threat abatement pans are to be implemented.
    - Response: Fox control in this area is implemented by the NSW NPWS.
- **Fire.** Identify and implement suitable fire regimes and encourage inter-agency co-operation.
    - Response: Conservation fire management is implemented for this rea by the NSW NPWS.
- **Diseases, fungi and parasites.** Suitable protocols to control Phytophthora are to implemented where this is known to occur.
    - Response: No Phytophthora outbreaks are known in this area.
- **Conservation information.** The general community is to be made aware of the plight of this species and encouraged to participate in conservation management actions, as appropriate.
    - Response: The pathway provides an opportunity for community education and engagement through signage in the rest areas.

SUMMARY

This species was not recorded in the project area during survey. However, a population is known to occur in the surrounding Wyrrabalong National Park and individuals probably use suitable parts of the project area. An active mosaic burn program by NSW NPWS is in place that, among other conservation management objectives, serves to maintain post-fire heath and open forest habitat suitable for this species.

The northern end of the project area has been incorporated in this management regime, and the project area supports suitable post-fire habitat in 4.2 hectares of Banksia-Apple Forest that was burnt in August 2014. However, the potential and realised habitat for this species is not confined to the project area, but occurs at least in the other blocks of vegetation that have been burnt less

than 6 years previously: 86.7 hectares burnt September 2012, 17.6 hectares burnt August 2013 and 72.2 hectares burnt August 2014 of which the subject site is a part.

The proposal will permanently alienate 0.192 hectares of suitable habitat for the pathway and rest areas along a length of approximately 700 metres. A further 0.31 hectares will be temporarily cleared and disturbed in the path's curtilage and on temporary construction tracks, but these areas will be rehabilitated with suitable local provenance material.

It is considered that the proposal is unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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Pandion cristatus Eastern Osprey

Pandion cristatus Eastern Osprey is listed as a Migratory species under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995).

The Eastern Osprey is a medium to large fishing hawk with narrow wings (Hollands 2003). This species is recorded along most of coastal Australia except for Tasmania, Victoria and eastern South Australia (OEH 2013). This species usually remains along the coastal fringe, nesting high in dead trees, but occasionally occurs further inland along the larger rivers (Pizzey 1980).

Ospreys are often seen hovering or patrolling over water, diving into the water to capture its prey (Slater et al. 1995), or grasping it from the surface with its feet (Pizzey and Knight 1997). They occur as single birds or dispersed pairs within large foraging and breeding territories, defended against other Ospreys, with active nests usually more than 1 kilometre apart (Bischoff 2001).

Optimal habitat for the Osprey is a shallow estuary or other water body containing sufficient fish of 25-35cm in length, a vantage point and feeding platform such as a tall dead tree or sometimes a human-built structure, and a tall dead tree for nesting, with suitable nesting material in the form of a stand of preferred vegetation nearby. Feeding perches near the nest are used by the male during the breeding cycle, and by the fledgling Ospreys (Clancy 1991).

Breeding adults are resident; juveniles are dispersive. Nests are usually built in tall dead or dead-topped live trees, but are also built on rocky foreshores and islands, cliff faces, telegraph poles and occasionally transmission towers. Ospreys construct stick nests from standing dead wood and line them with grass, bark and seaweed. *Melaleuca quinquenervia* Broad-leaf Paperbark and *Casuarina glauca* Swamp Oak are commonly used for nesting material. The presence nearby of a stand of vegetation suitable for nesting material is probably a critical factor in the selection of a nest site. Nests are situated up to 30 metres above ground level and are usually within 1 – 2 kilometres of water, often on elevated land (Clancy 1991).

The breeding season in NSW, from nest construction to fledging, occurs from March to November (Rose 2000). It is thought that this species is declining in southern areas of its distribution, largely due to pesticides (Pizzey 1980, Slater et al. 1995) but in NSW the population appears to be increasing and expanding southwards (NSW Scientific Committee 2009).

The Osprey is sensitive to pollution, particularly pesticides. Water pollution, hydrological modifications and increased turbidity may affect this species by a reduction in quality or quantity of food resources or in foraging efficiency. Some Ospreys are killed or injured by entanglement in fishing line, and by electrocution or collision with power lines. Removal or disturbance of nesting sites, feeding platforms or the vegetation providing nesting materials reduces the number of sites containing the critical elements for breeding success. Birds are very sensitive to disturbance during the breeding season and it is recommended that 100 metre buffer to nests on public land is observed and activity is reduced within 100 metres of nests on private land (OEH 2017b).

Four nesting pairs are known to occur on the Central Coast, the closest to the subject site located near The Entrance bridge. Local birdwatchers have reported that a pair is currently nesting in a Norfolk Island Pine adjacent to the boatshed on the southern side of The Entrance Bridge.

This species was not observed in the project area, but an individual was observed foraging along the Tuggerah Lake foreshore during this survey and during previous surveys of the adjacent National Park in 2012 and 2013 by Mjadwesch Environmental Service Support (2013). This species is often observed foraging in the waterways around the site and an individual was also noted by Keystone Ecological at The Entrance bridge in February 2017.

The trees in the project area are generally unsuitable for this species, except perhaps for the tallest trees in the Banksia-Apple Forest. No such trees will be removed.

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

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Response:

No trees suitable for this species will be removed by the proposal.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

Response:

The habitat modification that will result from this development is not likely to introduce or favour invasive species that will be harmful to this species or its habitat.

seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Response:

The nearest nesting pair is in a Norfolk Island Pine adjacent to the boatshed on the southern side of The Entrance Bridge. The proposed works will not impact on this area or relevant foraging habitat.

SUMMARY

This species was not observed in the project area, but an individual was observed foraging along the Tuggerah Lake foreshore during this survey and previous surveys.

The site provides marginal potential roosting habitat only, as the trees in the project area are generally unsuitable for this species, except perhaps for the tallest trees in the Banksia-Apple Forest. No such trees will be removed.

There is unlikely to be any kind of impact on potential habitat for this species as a result of the development of the proposed pathway.
It is considered that the proposal is unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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Haliaeetus leucogaster White-bellied Sea-eagle

Haliaeetus leucogaster White-bellied Sea-eagle is a Migratory species listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is also a Vulnerable species listed under the Threatened Species Conservation Act (1995).

The White-bellied Sea-Eagle is a large raptor with long, broad wings covering a wingspan of 180 to 220 centimetres (Department of the Environment 2015). They have a white head, breast and abdomen with the tail being pale grey with a white tip (VIC Department of Sustainability and Environment 2003).

They are opportunistic carnivores feeding on a variety of small animals including fish, birds, reptiles, mammals and crustaceans (Green 1959; Quinn 1969; Smith 1985). They hunt from a perch or whilst in flight. Prey is usually carried to a feeding platform, consumed flight or eaten on the ground.

As a migratory species, they occur mostly along the coastline with their nests usually found near water in tall trees. They are also known to nest on remote edge cliffs (VIC Department of Sustainability and Environment 2003).

Distribution of this migratory species is enormous with records in the northern hemisphere. The White-bellied Sea-Eagle has been recorded from India to China and south through to Asia, New Guinea and Australia (Department of the Environment 2015).

The main threats to this species are loss of habitat due to land development, and the disturbance of nesting pairs due to human activity (Bilney and Emison 1983; Clunie 1994; Dennis and Lashmar 1996; Mooney and Brothers 1986). The White-bellied Sea-Eagle is sensitive to disturbance during nesting especially in the early stages of the breeding season. Potential threats to this species include poisoning, shooting, competition with Aquila audax Wedge-tailed Eagle and the deterioration of inland water resources.

The area of suitable habitat on site will be minimally altered with no suitable trees to be removed. The area of vegetation to be removed represents a small, yet unimportant area of habitat for a species that requires tall open perches, wetlands and water.

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

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Response:

No trees suitable for this species will be removed by the proposal. The habitat to be removed by the proposal is judged not to be important for this species.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

Response:

The habitat modification that will result from this development is not likely to introduce or favour invasive species that will be harmful to this species or its habitat. The proposal will remove several exotic weeds along the pathway (such as *Lantana camara* Lantana) thus, reducing the probability of invasive weeds establishing further.

seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Response:

The area of suitable habitat on site will be minimally altered with no suitable trees to be removed. The area of vegetation to be removed represents a small, yet unimportant area of habitat for a species that requires tall open perches, wetlands and water.

The vegetation to be modified by the proposal is unlikely to disrupt the life cycle of this species.

SUMMARY

This species was not observed in the project area but has been recorded foraging in Tuggerah Lake and observed within the hind dunes of Magenta Beach in Wyrrabalong National Park (Mjadwesch Environmental Service Support 2013).

The project area provides potential roosting / nesting sites in the largest trees, such as the *Angophora costata* Smooth-barked Apple in the Banksia-Apple Forest around the northern section of the pathway. No such trees will be impacted by the proposed works.

It is considered that the proposal is unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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***Monarcha melanopsis* Black-faced Monarch**

Monarcha melanopsis Black-faced Monarch is a Terrestrial Migratory species listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is not listed under the Threatened Species Conservation Act (1995).

It is a wet forest specialist, found mainly in rainforest and wet sclerophyll forest, especially in sheltered gullies and slopes with a dense understorey of ferns and/or shrubs. It nests near the tops of trees that have large leaves, in the canopy of small saplings, or in lower shrubs (Birds Australia 2002, Campbell 1900, Marchant 1986, North 1901—14).

Foraging occurs mostly within 6 metres of the ground in rainforest and also open eucalypt forest (Department of the Environment 2016). Their diet consists of spiders, beetles, grasshoppers, and an array of insects (Barker and Vestjens 1990, Blakers et al. 1984, MacGillivary 1914, North 1901-1914, Officer 1969).

This species migrates to eastern Australia during spring to autumn and return to eastern Papua New Guinea during the winter (Blakers et al. 1984).

An individual was observed foraging and another heard calling in the Littoral Rainforest during survey of the project area. This species is recorded regularly by local birdwatchers, with 12 records in the Atlas of Living Australia from Wyrrabalong National Park alone.

Suitable foraging and breeding habitat occurs across most of the project area in the Littoral Rainforest. The small area of potential habitat to be removed or disturbed by the construction of the pathway is unlikely to prevent the use of this area for foraging or breeding by this species.

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

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Response:

Draft guidelines for Migratory species impact assessment (Department of the Environment 2015) define thresholds for loss or modification of important habitat. These guidelines propose that a loss of 2,600 hectares of habitat is likely to result in a significant impact for this species.

The area of suitable habitat to be disrupted by the proposal is well below this threshold, being only 1.803 hectares of Littoral Rainforest, comprising 0.764 hectares permanently removed and 1.039 hectares removed and then rehabilitated. This vegetation will also be interrupted in a long narrow ribbon.

The area and configuration of habitat loss is considered unlikely to destroy or isolate an area of important habitat for this species.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

Response:

The occurrence of *Rattus rattus* Black Rat and invasive vine species are known to be harmful to this species. The habitat modification that will result from this development is not likely to introduce or favour invasive species that will be harmful to this species or its habitat. The proposal will remove several exotic weeds along the pathway (such as *Lantana camara* Lantana) thus, reducing the probability of invasive weeds establishing.

seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Response:

The ecologically significant proportion of a population for this species is defined in the relevant guideline (Department of Environment 2015) as 4,600 individuals. The same guidelines propose that a significant impact will probably be triggered if 465 individuals are affected.

The site provides suitable habitat for this species in the Littoral Rainforest occurring on site. The suitable vegetation to be removed represents a small area of what is widely available in the local area. Over 80% of the available suitable habitat in the project area will remain untouched, and 99.5% of that on the sand spit.

The proposal is unlikely to disrupt the life cycle of this species.

SUMMARY

Suitable foraging and breeding habitat occurs across most of the project area in the Littoral Rainforest. The small area of potential habitat to be removed or disturbed by the construction of the pathway is unlikely to prevent the use of this area by this species for foraging or breeding.

It is considered that the proposal is unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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***Rhipidura rufifrons* Rufous Fantail**

Rhipidura rufifrons Rufous Fantail is a Terrestrial Migratory species listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). It is not listed under the Threatened Species Conservation Act (1995).

This species occurs in wet sclerophyll forests, often in gullies that are dominated by eucalypts, including *Eucalyptus microcorys* Tallowwood, *Eucalyptus cypellocarpa* Mountain Grey Gum, *Eucalyptus radiata* Narrow-leaved Peppermint, *Eucalyptus pilularis* Blackbutt and *Eucalyptus resinifera* Red Mahogany (Department of the Environment 2016).

Important habitat features for this species include moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands.

Foraging occurs mostly within the low to middle layers in forest and sometimes in or below the canopy or on the ground (Higgins et al. 2006). Foraging is done mostly aerially by sallying but can also glean from foliage and fallen debris. Their food source is predominantly insects with spiders also sometimes consumed (Cameron 1985).

The area of suitable potential habitat on the subject site for this species will be minimally impacted by the proposal. The area of vegetation to be removed by the proposal represents a small, yet unimportant area of habitat for the *Rhipidura rufifrons* Rufous Fantail.

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

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Response:

The proposed development will remove a small area of Littoral rainforests and coastal vine thickets of eastern Australia for the proposed development. The area to be modified will not be substantial and will maintain important ecological features for this species (i.e. foraging habitat).

The habitat to be removed by the proposal is judged not to be important for this species.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

Response:

The occurrence of *Rattus rattus* Black Rat and invasive vine species are known to be harmful to this species. The habitat modification that will result from this development is not likely to

introduce or favour invasive species that will be harmful to this species or its habitat. The proposal will remove several exotic weeds along the pathway (such as *Lantana camara* Lantana) thus, reducing the probability of invasive weeds establishing.

seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Response:

The ecologically significant proportion of a population for this species is defined in the relevant guideline (Department of Environment 2015) as 48,000 individuals. The same guidelines propose that a significant impact will probably be triggered if 3,400 individuals are affected.

The site provides suitable habitat for this species in the Littoral Rainforest occurring on site. The suitable vegetation to be removed represents a small area of what is widely available in the local area. Over 80% of the available suitable habitat in the project area will remain untouched, and 99.5% of that on the sand spit.

The vegetation to be modified by the proposal is unlikely to disrupt an ecologically significant proportion of the population.

SUMMARY

An individual was observed foraging in the vine thickets of the Littoral Rainforest. Suitable foraging and breeding habitat occurs across the entire project area and undoubtedly hosts more than the individual observed during survey. Although few records are listed in BioNet or ALA databases, local birdwatchers report this species regularly in this area in the summer, with reports to eBird in 2006, 2012 and 2015 (http://www.eremaea.com/).

The small area of potential habitat to be removed or disturbed by the construction of the pathway is unlikely to prevent the use of this area by this species for foraging or breeding, nor does it represent an ecologically important area of habitat.

It is considered that the proposal is unlikely to result in any significant threat to the long-term survival of this species.

A referral to the Department is considered unnecessary for this species.

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