Digital Advertising Signage – Princes Highway, Loftus (DA 22/5186)

Biodiversity impact assessment

prepared for

JCDecaux

écologique | environmental consulting

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Document control

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Revision Schedule

Rev No	Date	Description	Issued to
0	27/07/2022	Draft Biodiversity Impact Assessment	JCDecaux, Keylan
1	01/08/2022	Draft Biodiversity Impact Assessment	JCDecaux, Keylan
2	11/08/2022	FINAL Biodiversity Impact Assessment	JCDecaux, Keylan

Contents

1. Introduction

1.1 Background

Sydney Trains is seeking approval from the NSW Department of Planning and Environment (DPE) for the installation and operation of a digital advertising sign. The proposed sign would be located on a cleared parcel of land adjoining the railway line near its crossing under the Princes Highway at Loftus (the subject site).

écologique was commissioned by JCDecaux to respond to a request for further information (RFI) from the Department of Planning and Environment (DPE) Environment and Heritage Group (EHG) as relevant to potential impacts on biodiversity values. Specifically, the EHG has requested that the potential for glare and colour of the signage be considered with regards to wildlife.

1.2 Subject site

The advertising sign will be located on a cleared parcel of land within an established Sydney Trains corridor, near its crossing under the Princes Highway. The Princes Highway is a Transport for NSW (TfNSW) State classified road (Highway No. 1) that travels in a general east-west alignment near the subject site and comprises a dual carriageway with two traffic lanes in both directions, separated by a vegetated median strip.

On approach to the proposed sign, a speed limit of 80 km/h applies to both directions of traffic. There are no pedestrian footpaths along the Princes Highway in proximity to the site and no parking is permitted.

Land surrounding the subject site and in proximity to the road corridor includes:

- A water supply system, electricity substation and a low-density residential neighbourhood located to the north.
- The nearest residential dwelling is approximately 50m north-west from the proposed sign.
- The Royal National Park is located to the south-east of the site.

Figure 1-1 shows the highway approach to the subject site and Figure 1-2 illustrates the subject site context.

Figure 1-1. Approach to location of proposed sign

Coordinate System: MGA Zone 56 (GDA 2022) | Image source: Nearmap 17/05/2022:

Legend

- Sign location
- NPWS_Estate

N

0 15 30 60 90 120

m

Digital Advertising Signage Princes Highway, Loftus

Figure 1-2. Subject site context

1.3 The proposal

The proposed sign will be permanently fixed for viewing by western outbound traffic and will comprise the following:

- Advertising display area 46.99m^2 (12.53m^2 x 3.75m^2).
- Visual Screen Size 39.94m^2 (12.48m^2 x 3.2m^2).
- Road clearance from ground level to the sign 5.0 metres clearance to ground level (Princes Highway).
- Dwell time 25 seconds.
- Visibility and readability from a distance of 110 metres.
- Illumination using LEDs installed within the front face.
- A display static content only. The LED display will not scroll, flash or feature motion pictures or emit intermittent light.
- The signage includes baffles which mitigate upward waste light, resulting in an Upward Light Ratio (ULR) of less than 50%.
- The proposed frame for the sign will be painted eucalypt green, to blend into the surrounding landscape to the north.

Architectural drawings for the sign are shown in Figure 1-3 below.

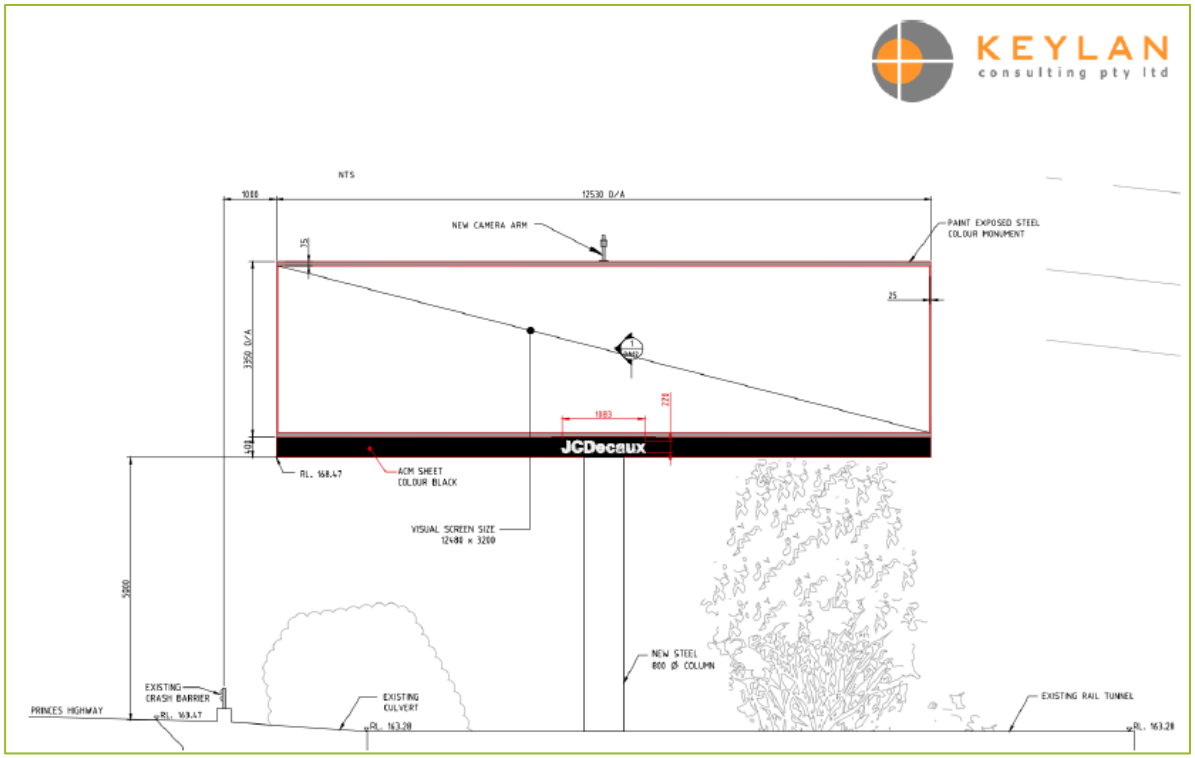


Figure 1-3. Proposed signage dimensions

2. Method of assessment

The scope of works undertaken for this assessment has comprised the following tasks:

1. Desktop assessment:

A desktop-based assessment to compile relevant data and GIS layers to describe the characteristics of the subject site and its surrounds as follows:

- IBRA subregions, soil / geology, NSW (Mitchell) landscapes, and vegetation mapping;
- Bionet Atlas and Bionet Vegetation Classification database searches for threatened species records and threatened species predicted to occur in the vegetation present; and
- Review of high-resolution aerial photography and historical imagery.

2. Subject area assessment:

The outcomes of Task 1 enabled the identification of the prevailing landscape and vegetation characteristics of the locality, which in turn enabled identification of known or predicted threatened species that may rely on the area as habitat.

The landscape and vegetation analysis of the subject area is in line with a Stage 1 assessment of the NSW Biodiversity Assessment Method (BAM). The BAM is part of the Biodiversity Offsets Scheme, which is a legislated framework that is required when addressing impacts on terrestrial biodiversity from development and clearing

The BAM is established for the purposes of assessing the impacts of a proposal on threatened species, ecological communities, and their habitats including native vegetation. The BAM is also used to assess additional (prescribed) biodiversity impacts, such as lighting impacts. Thereby considered appropriate as an assessment method for responding to the RFI.

3. Lighting impact assessment:

Guidelines for lighting impacts on wildlife are limited to the following:

- Commonwealth of Australia (2020) National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds, which identify various aspects of lighting that wildlife is sensitive to; and
- AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting, which apparently recognises the impact of artificial light on biota.

The above guidelines have been considered in the context of the proposal and surrounding environs as far as practical.

The Commonwealth of Australia (2020) guidelines provide theoretical, technical and practical information required to assess if artificial lighting is likely to affect wildlife. Although a strong focus is paid to Matters of National Environmental Significance (MNES) such as marine turtles, seabirds and migratory shorebirds and less relevant to the wildlife recorded from the subject site and surrounds.

The Lighting Impact Assessment prepared by Electrolight (2022) concludes that the that the proposed digital signage complies with all relevant requirements of AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

Additional literature reviewed is also referenced, in Section 4.

4. NPWS guidelines:

Consideration of the guidelines for developments adjacent to NPWS lands (NPWS 2020) is provided in Section 4.

3. Site Characteristics

3.1 Landscape assessment

The Princes Highway is elevated above the subject site and surrounding land with a drop in elevation on the northern side from the top of the tunnel to the to the railway of between 5.2m and 6.6m. It is anticipated that similar if not a greater elevation change occurs on the southern side of the highway, with the proposed sign location approximately 80m to the Royal National Park's boundary in the south.

The subject site is located in the Sydney Basin IBRA region and Sydney Cataract subregion within the Woronora Plateau NSW (Mitchell) landscape. Lucas Heights is the dominant soil landscape Faulconbridge soil landscape occurring to the north of the subject site.

Lucas Heights comprises gently undulating plateau surfaces and ridges, 200–1,000 m wide, with level to gently inclined slopes supporting eucalypt low open-forest and eucalypt low woodland with sclerophyllous shrub understorey.

3.2 Vegetation

3.2.1 Vegetation mapping

Mapping of the Sydney Metropolitan Area's native vegetation (OEH, 2016) indicates five different plant communities (PCTs) within the locality as shown in Figure 3-1 and listed in

OEH (2016) mapped PCT:	PCT since replaced by:	Location
Sydney South exposed sandstone woodland (PCT 1777)	Southern Sydney Scribbly Gum Woodland (PCT 3590) and a smaller proportion to Woronora Plateau Scribbly Gum Woodland (PCT 3598)	PCT 1777 is mapped as the dominant PCT located immediately south of the subject site and highway and comprises a low eucalypt woodland with a diverse heathy understorey found on Hawkesbury sandstone ridgetops in the north-east of the Woronora Plateau.
Sydney hinterland exposed sandstone woodland (PCT 1787)	Largely split into three new PCTs, Sydney Hinterland Enriched Sandstone Bloodwood Forest (PCT 3619), Sydney Coastal Sandstone Bloodwood Shrub Forest (PCT 3593) and Sydney Hinterland Dwarf Apple Low Woodland (PCT 3813).	PCT 1787 is mapped an exposed sandstone community distributed across the central and north-western Woronora Plateau and the western margin of the Hornsby plateau in north-west Sydney. It comprises a low-growing open eucalypt canopy with a dense shrub layer and an open ground cover of sedges and forbs.
Coastal shale-sandstone forest (PCT 1845)	Replaced with Sydney Coastal Shale-Sandstone Forest (PCT 3259).	PCT 1845 is mapped as a dominant PCT to the east of the subject site on both sides of the highway and is often a tall open eucalypt forest with a sparse layer of dry sclerophyllous shrubs and a grassy ground cover.
Coastal sandstone Heath-Mallee (PCT 1824)	Largely split into three new PCTs differentiating the sandstone plateaux north and south of Sydney. New PCT 3814 Woronora Plateau Heath-Mallee represents the largest proportion, and the northern plateaux is split to new PCTs 3586 Northern Sydney	PCT 1824 occurs as a smaller patch to the south of the subject site and highway, and larger area mapped further to the southeast. Ranges from a treeless heath to a low open woodland with mallees and more common on exposed skeletal soils along narrow ridges and exposed slopes of both the Woronora and Hornsby plateaus.

OEH (2016) mapped PCT:	PCT since replaced by:	Location
	Scribbly Gum Woodland and 3807 Northern Sydney Heath-Mallee.	
Coastal upland damp heath swamp (PCT 1803)	PCT 3924 Sydney Coastal Upland Swamp Heath and smaller proportion resolved to other new PCTs including PCT 3812 Sydney Coastal Sandstone Headland Heath	PCT 1803 occurs as a small and isolated patch to the south of the subject site and highway. Is one of two hanging or upland swamp communities within the Sydney metropolitan area, which are distinctive communities found on impeded soils in creek headwaters and other seepage zones

The proposed sign is designed and sited within an existing cleared area and does not require any vegetation removal.

3.2.2 Vegetation condition

Vegetation within the immediate vicinity of the subject site appears to be highly degraded, which is typically expected due to edge effects from highways and railways, in combination with the disturbance of the natural soil landscape when such infrastructure was first constructed.

Photo plates 1 to 8, illustrate the degraded condition of embankment vegetation either side of the highway proximal to the subject site.

Photo 1: Hwy approach to signage (approx. 40-50m east of sign)

Photo 2: Hwy approach to signage (approx. 100m east of sign)

Photo 3: view to from northwest, showing weed infested embankment above National Park (approx. 150m east of sign)

Photo 4: view to from northeast, showing weed infested embankment above National Park (approx. 100m east of sign)

Photo 5: firetrail entrance approximately 200m east of sign

Photo 6: view from east over weed infested embankment and National Park in background

Photo 7: railway north of tunnel showing weed infested embankment on northern side of Hwy

Photo 8: View from east showing weed infested embankment on northern side of Hwy

Historical imagery shown in photo plates 9 to 13 illustrate the disturbance over time from the highway's upgrade and bushfire in 2002.

Photo 9: 1961 pre-highway upgrade

	**Photo 10:** 1978 post highway upgrade and subdivision/development in progress
	**Photo 11:** 1994 post highway upgrade and development established
	**Photo 12:** 2002 showing extent of bushire in National Park to its northern boundary opposite highway and subject site

Legend

- Sign location
- NPWS_Estate
- PCT 1777
- PCT 1787
- PCT 1803
- PCT 1824
- PCT 1845

N

0 20 40 80 120 160

m

Digital Advertising Signage Princes Highway, Loftus

Figure 3-1. Vegetation mapping

Coordinate System: MGA Zone 56 (GDA 2022)

Image source: Nearmap 17/05/2022

Data source: SydneyMetroArea_v3_1_2016_E_4489

3.2 Threatened fauna species

Search of the NSW Bionet database returned records from 37 threatened fauna species including 13 mammal, 19 bird, 2 reptile and 3 amphibian species from a 10km search radius from the subject site. Several additional species were returned but ignored as they consisted of wetland and/or shore bird species, which would not utilise the locality.

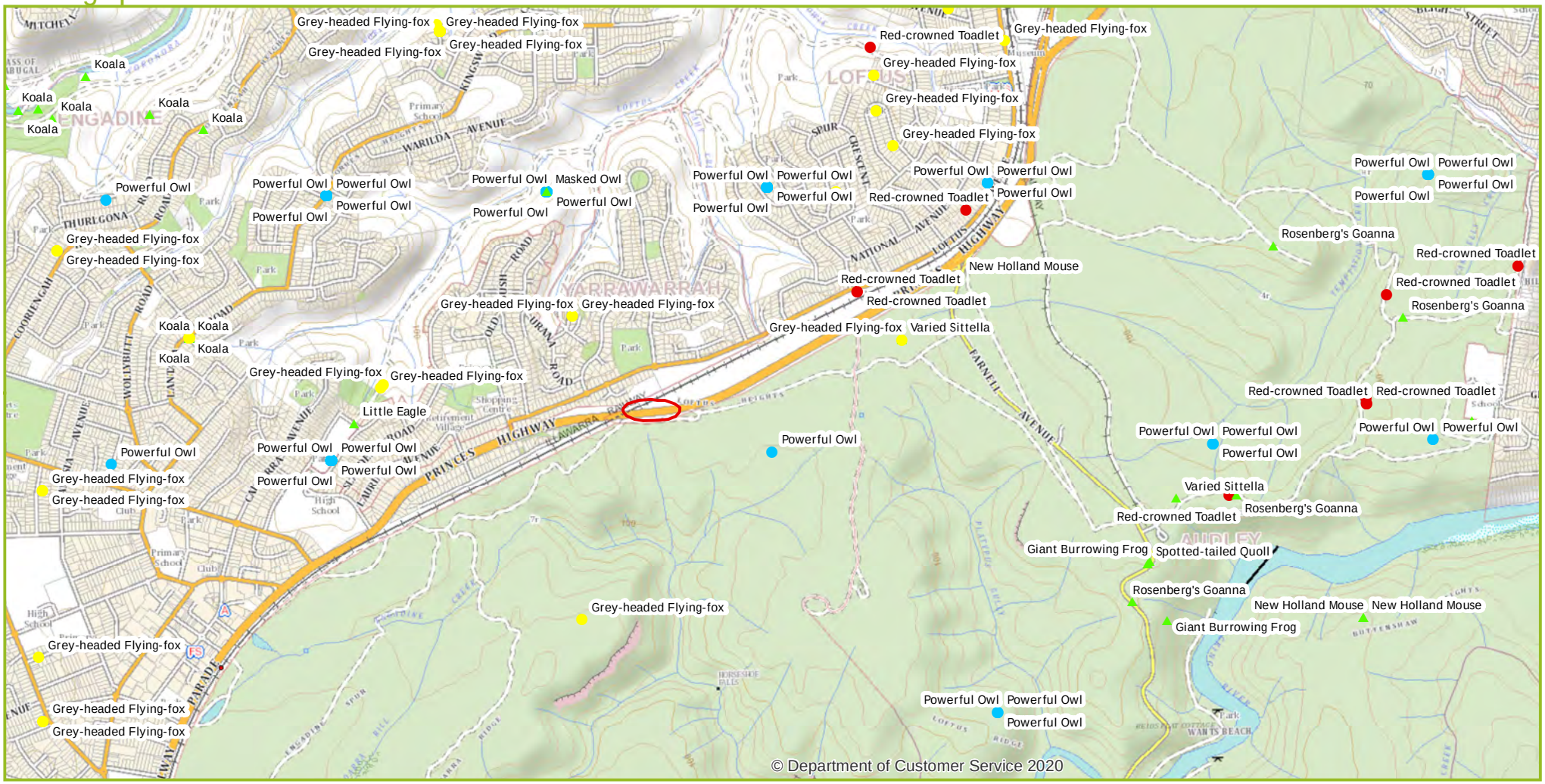
Of the threatened species returned those that are nocturnal and more likely to be sensitive to light impacts or are recorded proximal to the subject site are listed in Table 3-1 below.

Table 3-1. Nocturnal threatened species recorded from the locality

Species name	Common name
Amphibians	
Heleioporus australiacus	Giant Burrowing Frog
Pseudophryne australis	Red-crowned toadlet
Aves	
Ninox strenua	Powerful Owl
Tyto novaehollandiae	Masked Owl
Tyto tenebricosa	Sooty Owl
Mammalia	
Cercartetus nanus	Eastern Pygmy-possum
Chalinolobus dwyeri	Large-eared Pied Bat
Dasyurus maculatus	Spotted-tailed Quoll
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat
Miniopterus australis	Little Bent-winged Bat
Myotis macropus	Southern Myotis
Petaurus australis	Yellow-bellied Glider
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Scoteanax rueppellii	Greater Broad-nosed Bat
Phascolarctos cinereus	Koala
Pseudomys novaehollandiae	New Holland Mouse
Pteropus poliocephalus	Grey-headed Flying-fox

As shown in Figure 3-2 the majority of records proximal to the subject site are that of the Powerful Owl and secondarily the Grey-headed Flying-fox and Red-crowned Toadlet. One record of the Spotted-tailed Quoll from 2007 is located approximately 2.2km to the southeast of the subject site and proximal to the Hacking River. Records of the Eastern Pygmy-possum are located approximately 3km to the southwest and approximately 4km to the southeast, northeast and northwest of the subject site. Few microbat records were found, however this may reflect the species being targeted and the survey methods employed.

The habitat requirements of the species listed in Table 3-1 are summarised in Appendix A.



Digital Advertising Signage Princes Highway, Loftus

Legend

Subject site

N

0 0.2 0.4 0.8 1.2 1.6

km

Figure 3-2. Threatened species records

Coordinate System: MGA Zone 56 (GDA 2022)

Image source: Nearmap 17/05/2022

Data source: Bionet Atlas database records (26/07/2022)

4. Impact Assessment

4.1 Light pollution

Light pollution has the potential to affect the physiology, behaviour and reproduction of a range of animal taxa. Types of effects cited in literature (Commonwealth of Australia 2020, Newport et al. 2014, Rich & Longcore 2006) include the following:

- Changes in foraging and reproductive behaviours.
- Reduction in animal fitness and reduced reproductive success.
- Increased risk of predation.
- Short term benefits for predators from artificial lighting, such as bats foraging on insects concentrating around lights and owls using light pollution to spot rodents, and other small animals who need darkness to search for food safely at night.

  While artificial night lighting may in the short terms seem beneficial for the predators, it could lead to faster disease transmission among predator species and faster depletion of their food source.
- Disorientation in flying birds, particularly during migration, and cause them to divert from efficient migratory routes or collide with infrastructure.

4.2 Fauna habitat availability

Vegetation immediately adjacent to the subject site is dominated by weeds growing on disturbed soils of the highway's embankments. Vegetation within the estimated visible range of the proposed sign is predominantly low-growing open eucalypt canopy with a dense shrub layer and an open ground cover of sedges and forbs.

Historical imagery from 1961 to 1970 shows the northern side of the subject site cleared and negligible canopy species on the southern side of the subject site. By the 1990s the northern side of the subject site is more densely vegetated, while the southern side remains relatively constant.

In 2002 imagery the impacts of a bushfire in the National Park are evident up to the extent of its boundary (approximately 80m to the south of the subject site). Canopy species that would be most directly affected from the sign's operation, while mature, are not of an age sufficient to have formed hollows that would support forest owls.

The dense shrub layer, in particular heath species, may provide suitable foraging habitat for species such as the Eastern Pygmy Possum. However, the embankment and drop in elevation from the highway to lower areas of habitat provides a lateral buffer of between 15m and 20m lateral and additional 5-6m vertical drop in elevation. Thereby providing additional screening from light pollution.

Any resident fauna that utilise vegetation either side of the highway are likely to be tolerant of both noise and light pollution given the decades in which the highway has been operating.

It is considered likely that fauna species sensitive to noise and light pollution would prefer the adjacent vast expanse of National Park with more intact vegetation and habitat features available.

Predatory species such as owls and bats that forage within the locality would already be impacted by light pollution from neighbouring development.

4.3 NPWS guidelines

Councils and other consent authorities need to consider the issues identified in Table 4-1 when assessing proposals adjacent to NPWS land:

Table 4-1. Consideration of NPWS issues

Issue	Consideration
Erosion and sediment control	Not applicable, refer Statement of Environmental Effects (SEE)
Stormwater runoff	Not applicable, refer Statement of Environmental Effects (SEE)
Wastewater	Not applicable, the proposal will not generate wastewater
Management implications relating to pests, weeds and edge effects	Not applicable, the proposal is located in cleared area within an established rail corridor.
Fire and the location of asset protection zones	Not applicable, the proposal is located in cleared area within an established rail corridor.
Boundary encroachments and access through NPWS lands	Not applicable, the proposal does not require access and will not require encroachment into NPWS lands
Visual, odour, noise, vibration, air quality and amenity impacts	Refer Sections 4.1 and 5 for visual impacts as they relate to light pollution and wildlife. Other amenity impacts are addressed in the proposal's SEE
Threats to ecological connectivity and groundwater-dependent ecosystems	Not applicable, the proposal will not require any vegetation or habitat clearing
Cultural heritage	Addressed in SEE
Road network design and its implications for continued access to the park	Not applicable, the park is not accessible from the subject site, the railway or road corridor at this location. In particular, stopping of vehicles is prohibited in this stretch of the highway.

5. Conclusion

The proposed sign will be permanently fixed for viewing by western outbound traffic and therefore potential impacts on land surrounding the subject site would only occur to the south-east.

As the sign operates all night, it has been assessed against the more stringent post-curfew limits (i.e., between 11pm and 6am daily) and complies with all relevant requirements of AS4282-2019 Control of the Obtrusive Effects of Outdoor Lighting.

The proposed sign includes baffles which mitigate upward waste light, resulting in an Upward Light Ratio (ULR) of less than 50%, or 'sky glow', which is a consideration noted by the Commonwealth of Australia (2020).

The maximum luminance of the proposed sign has been determined by Electrolight (2022) as visually consistent with the existing ambient lighting. This includes 'sky glow', which when considered cumulatively as recommended by the Commonwealth of Australia (2020), the proposal will not result in an increase above that existing.

The height of the sign above the railway tunnel is 5m at its lowest point and 8.5m at its highest point. The visibility of the sign estimated along the highway is approximately 225 m, which coincides with a 5-6m drop in elevation from the road to the National Park to the southeast and lateral distance of between 15-20m from the highway edge to the park's boundary. Thereby offering a vertical and lateral buffer zone to any habitat proximal to the edge of the National Park.

As described in Section 4.2, the habitat available to the south-east of the subject site is substantially degraded and considered unlikely to provide habitat important to any threatened species.

An assessment of indirect/prescribed impacts as required under the BAM has concluded that the proposed sign is unlikely to result in a significant impact to wildlife and is considered to be a low-risk consequence.

The assessment of indirect/prescribed impacts is provided in Appendix B.

6. References

Commonwealth of Australia (2020) National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds. January 2020 Version 1.0

Department of Environment, Climate Change and Water NSW (2009) Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

Department of the Environment, Water, Heritage and the Arts (2013) Significant Impact Guidelines 1.1 - Matters of National Environmental Significance. EPBC Act Policy Statement. Commonwealth of Australia has published guidelines (version 1.1, 2013)

Department of Sustainability and Environment (2010) Conservation Advice for *Pseudomys novaehollandiae* (New Holland Mouse) (s266B of the *Environment Protection and Biodiversity Conservation Act 1999*). Approved by the Minister on 14 July 2010

Electrolight Australia (2022) Lighting Impact Assessment Outdoor Signage at Princes Highway, Loftus, NSW (Outbound). Prepared for JCDecaux dated 22 March 2022.

Newport J, Shorthouse D J, Manning A D (2014) The effects of light and noise from urban development on biodiversity: Implications for protected areas in Australia, in *Ecological Management and Restoration*. Vol 15. September 2014. Ecological Society of Australia and Wiley Publishing Asia Pty Ltd

NPWS (2020) Developments adjacent to NPWS lands: Guidelines for consent and planning authorities, National Parks and Wildlife Service, Department of Planning Industry and Environment, Sydney, NSW.

OEH (2016) The Native Vegetation of the Sydney Metropolitan Area. Volume 1: Technical Report. Version 3.0. Office of Environment and Heritage Sydney.

Rich C & Longcore T (2006) Effects of Artificial Night Lighting on Terrestrial Mammals. In Ecological Consequences of Artificial Night Lighting. Island Press. Covelo, California. Pages 15-42.

Appendix A. Habitat summary table

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Amphibia					
Heleioporus australiacus	Giant Burrowing Frog	V	V	2.2	Found in heath, woodland and open dry sclerophyll forest on a variety of soils except clay based. Spends more than 95% of its time in non-breeding habitat up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Breeding habitat is generally soaks or pools in first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water
Pseudophryne australis	Red-crowned Toadlet	V		1	Open forests, mostly on Hawkesbury and Narrabeen Sandstones, inhabiting periodically wet drainage lines below sandstone ridges, often with shale lenses/cappings. Shelters under rocks, masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Not recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.
Reptilia					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	6	Largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 km of Sydney. Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500m of escarpments in summer.
Varanus rosenbergi	Rosenberg's Goanna	V		2	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Aves					
Ninox strenua	Powerful Owl	V		0.56	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. Roosts by day in dense vegetation comprising species such as Turpentine, Black She-oak, Blackwood, Rough-barked Apple, Cherry Ballart and a number of eucalypt species. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Where hollow trees and prey have been depleted, the owls need up to 4000 ha. Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.
Tyto novaehollandiae	Masked Owl	V		1	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.
Tyto tenebricosa	Sooty Owl	V		2	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum or Sugar Glider. Nests in very large tree-hollows.

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Mammalia					
Cercartetus nanus	Eastern Pygmy-possum	V		2.8	Found in a broad range of habitats from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. They may occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); tree hollows are favoured for nest-building but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	7.2	Found mainly in areas with extensive cliffs and caves. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (Petrochelidon ariel), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Dasyurus maculatus	Spotted-tailed Quoll	V	E	2.2	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls use hollow-bearing trees, fallen logs, other animal burrows, small caves and rock outcrops as den sites. Mostly nocturnal, although will hunt during the day; spend most of the time on the ground, although also an excellent climber and will hunt possums and gliders in tree hollows and prey on roosting birds. Use communal 'latrine sites', often on flat rocks among boulder fields, rocky cliff-faces or along rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. A generalist predator with a preference for medium-sized (500g-5kg) mammals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects. Also eats carrion and takes domestic fowl. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares. Are known to traverse their home ranges along densely vegetated creeklines.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V		3.8	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.
Miniopterus australis	Little Bent-winged Bat	V		3.8	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day and at night forage for small insects beneath the canopy of densely vegetated habitats. Appears to depend on large colonies to provide the high temperatures needed to rear its young. Males and juveniles disperse in summer. Only five nursery sites /maternity colonies are known in Australia.

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		2.5	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Hunt in forested areas, catching moths and other flying insects above the tree tops.
Myotis macropus	Southern Myotis	V		3.3	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	0.5	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Site fidelity to camps is high; some camps have been used for over a century. Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		4.5	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.

Scientific name	Common name	BC Act	EPBC Act	Distance to subject site (km)	Habitat requirements
Scoteanax rueppellii	Greater Broad-nosed Bat	V		4.5	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.
Phascolarctos cinereus	Koala	E	E	2	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery.
Pseudomys novaehollandiae	New Holland Mouse		V	1.5	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. It is a social animal, living predominantly in burrows shared with other individuals. Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.

Appendix B. Indirect/Prescribed impact assessment

Prescribed impact assessment

The proposal does not involve the removal of vegetation or potential habitat as a direct impact. This assessment has been undertaken to determine whether light pollution, an indirect or 'prescribed impact' identified under the BC Reg, will result in a significant impact.

Specifically, Section 8.2 of the NSW Biodiversity Assessment Method (BAM) requires an assessment of indirect impacts on native vegetation, threatened ecological communities, threatened species and their habitat. The following table responds to the sections of the BAM as relevant to the impact of light pollution.

Indirect impact	Duration	Biodiversity values impacted	Consequence
Reduced viability of adjacent habitat due to:			
Noise pollution	Long term (light spill)	General environment	The immediate surrounding environment does not contain areas of high biodiversity value and is located with an existing highly modified environment, which contains: • A four-lane highway, which provides for a steady stream of traffic day and night • A railway line, in which the proposed sign would be installed within cleared land and not require the removal of any native vegetation or fauna habitat • The proposed sign will be permanently fixed for viewing by western outbound traffic and therefore potential impacts on land surrounding the subject site would only occur to the south-east • Land to the south of the highway comprises: ▪ a weed infested embankment that drops in elevation approximately 5-6m to the natural surface area of the National Park to the southeast of the subject site ▪ a fire trail runs more or less parallel with the toe of the embankment and the boundary of the National Park, which in combination with the historical disturbance of the highway's construction and typical edge effects associated with cleared access tracks, has resulted in a lowered condition of vegetation and habitat within the immediate area of the National Park

Indirect impact	Duration	Biodiversity values impacted	Consequence
Noise pollution	Long term (light spill)	Potential occurrence of threatened species	Assessment of threatened species recorded from a 10km search radius of the subject site (including likely threatened species that would occur in the mapped PCTs within the locality), has determined the following: • Land to the south and southeast of the highway, which the proposed sign's illumination would be visible is unlikely to provide habitat of importance to any of the threatened species considered for the following reasons: ▪ the maximum luminance of the proposed sign has been determined by Electrolight (2022) as visually consistent with the existing ambient lighting. This includes the existing highly trafficable highway ▪ the embankment and drop in elevation from the highway to lower areas of habitat provides a lateral buffer of between 15m and 20m lateral and additional 5-6m vertical drop in elevation. Thereby providing additional screening from light pollution. ▪ by virtue of the dominant vegetation types within the National Park and degradation at this locality, there is a lack of mature aged canopy species and lack of habitat features that would support or be important to threatened species predicted to occur or known to occur across the wider landscape.
Noise pollution	Long term (light spill)	Potential occurrence of individual threatened species	Assessment of nocturnal species most sensitive to light pollution is provided in the following 'test of significance'.

Section 7.3 of the BC Act "test of significance"

Threatened species impact assessment is an integral part of environmental impact assessment. The objective of section 7.3 of the BC Act, the 'test of significance' provides a standardised and transparent consideration of threatened species and ecological communities, and their habitats, through the development assessment process.

(a) in the case of a threatened species, whether the proposed development or activity 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 potential for light pollution as a result of the proposed sign has been assessed by Electrolight (2022) to be visually consistent with the existing ambient lighting. This includes 'sky glow', which when considered cumulatively as recommended by the Commonwealth of Australia (2020), the proposal will not result in an increase above that existing.

Vegetation immediately adjacent to the subject site is dominated by weeds growing on disturbed soils of the highway's embankments. The embankment ranges in width from the highway from 15 to 20m and 5 to 6m in elevation, which includes a fire access trail. The lateral and vertical extent of the embankment and fire trail provides an additional buffer in addition to the width of the highway over which light pollution would decrease.

Vegetation within the National Park Historical to the south of the fire trail consists of low growing sclerophyll shrub/heath communities and lacks sufficiently aged trees that would provide hollows for owl, many bat and arboreal mammal species.

The shrub/heath communities may provide habitat for ground dwelling mammals and rodents, and amphibians and reptiles (such as the Eastern Pygmy Possum).

However, it is considered that any resident fauna that utilise vegetation either side of the highway are likely to be tolerant of both noise and light pollution given the decades in which the highway has been operating.

It is also considered likely that fauna species sensitive to noise and light pollution would prefer the adjacent vast expanse of National Park with more intact vegetation and habitat features available.

Predatory species such as owls and bats that forage within the locality would already be impacted by light pollution from neighbouring development.

Therefore, the proposal is not likely to have an adverse effect on the life cycle of any threatened species such that a viable local population of these species is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(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

The proposal will not result in the removal of vegetation or habitat.

(c) in relation to the habitat of a threatened species or ecological community:

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

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

NOT APPLICABLE

The proposal will not result in the removal of vegetation or habitat.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

NOT APPLICABLE

There are no declared areas of outstanding biodiversity within the study area.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

NOT APPLICABLE

Light pollution is not listed as a key threatened process in NSW.

EPBC Act "significance of impact assessment"

Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (MNES). The Commonwealth of Australia has published guidelines (version 1.1, 2013) that are to be applied in order to determine whether an action is likely to have a significant impact on MNES.

Under these guidelines, a significant impact on the environment is a real or remote chance or possibility that the impact will eventuate.

Two vulnerable species are recorded within the dominant vegetation communities proximal to the subject site:

- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result the nine aspects summarised below:

***Pseudomys novaehollandiae* (New Holland Mouse)**	
1. Lead to a long-term decrease in the size of an important population of a species	One record of the species was recorded as roadkill approximately 500m from the subject site in 2007. The remaining records are from 2009 to southeast and opposite side of Hacking River. The home range of the species ranges from 0.44 to 1.4 ha, which is substantially distanced from the sign's visibility extent. Should other populations occur within the visibility of the sign, it is considered unlikely that the proposal would lead to a long term decrease of the species populations due to the existing disturbed environment in terms of noise and light and potential for roadkill.
2. Reduce the area of occupancy of an important population	The proposal will not result in the removal of habitat for the species.
3. Fragment an existing important population into two or more populations	The proposal will not result in the fragmentation of this species populations (if present).

***Pseudomys novaehollandiae* (New Holland Mouse)**	
4. Adversely affect habitat critical to the survival of a species	Due to the largely granivorous diet of the species, sites where the New Holland Mouse is found are often high in floristic diversity. The habitat that would be affected by the proposal is highly degraded and unlikely to be critical to the survival of the species.
5. Disrupt the breeding cycle of an important population	The timing of breeding is related to abundance and quality of food, which in turn is related to rainfall patterns and fire succession. Due to the highly degraded nature of the potential habitat that would be affected, it is considered unlikely that the proposal would disrupt the breeding cycle of an important population of this species.
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal will not result in the removal of habitat for the species.
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal is located in a cleared area within an established rail corridor and is unlikely to result in any invasive species becoming established, above that which already exist.
8. Introduce disease that may cause the species to decline	The proposal is a relatively small construction activity that has a very low risk of introducing disease to areas of habitat important to this species.
9. Interfere substantially with the recovery of the species	The proposal will not result in any conflicts with the recovery objectives and actions cited in the conservation advice for the species (Department of Sustainability and Environment 2010).

***Pteropus poliocephalus* (Grey-headed Flying-fox)**	
1. Lead to a long-term decrease in the size of an important population of a species	The subject site and surrounds provide limited canopy trees that would provide foraging habitat for the species. No breeding camps for the species are identified proximal to the subject site nor within the National Park. The nearest national breeding camp is located in Kareela, approximately 7kms to the northeast of the subject site.
2. Reduce the area of occupancy of an important population	The proposal will not result in the removal of habitat for the species.
3. Fragment an existing important population into two or more populations	The proposal will not result in the fragmentation of this species populations.
4. Adversely affect habitat critical to the survival of a species	The subject site does not provide habitat critical to the survival of the species.
5. Disrupt the breeding cycle of an important population	The proposal will not disrupt the breeding cycle of the species population at Kareela.
6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal will not result in the removal of habitat for the species.

***Pteropus poliocephalus* (Grey-headed Flying-fox)**	
7. Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal is located in a cleared area within an established rail corridor and is unlikely to result in any invasive species becoming established, above that which already exist.
8. Introduce disease that may cause the species to decline	The proposal is a relatively small construction activity that has a very low risk of introducing disease to areas of habitat important to this species.
9. Interfere substantially with the recovery of the species	The proposal will not result in any conflicts with the recovery objectives and actions cited in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2010).

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