Nocturnal Fauna Survey

and

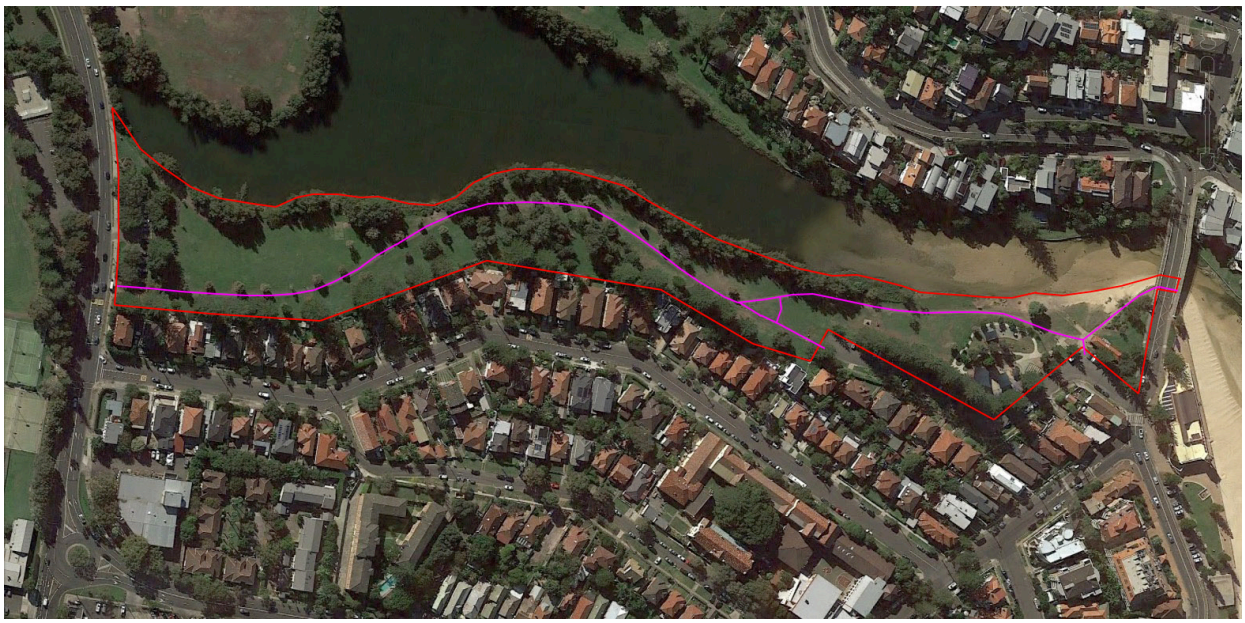
Assessment of Ecological Impact

of

New Pedestrian Lighting

at

Lagoon Park, Manly



by

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August 2016

Prepared for

Parks and Reserves
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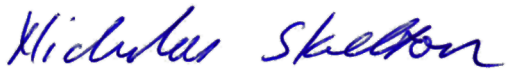

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1 Introduction

1.1 Background

This report describes the findings of a nocturnal fauna survey of Lagoon Park and assesses the impact of proposed low-intensity lighting of the pathway on the fauna of the park.

The solar powered lighting is to improve public safety and assist night-time navigation along the 600m of existing pathway. The path is heavily used during the day and in the evenings by bike riders, joggers, walkers and dog walkers and provides east-west access through the park linking to other pathways.

Lagoon Park is a narrow east-west shaped area containing scattered trees in a mown exotic grass lawn, a children's playground, swings, tables and benches, a BBQ, buildings, car parks and estuarine vegetation on the northern side adjacent to Manly Lagoon.

Two types of lighting are being considered, either; low bollard type posts with taller poles for solar power supply or a taller lights along the path that have built in solar power supplies.

The pathway lighting installation is proposed by Northern Beaches Council to improve the public facilities in the Council managed park and are consistent with the plan of management for Lagoon Park.

1.2 The Study Site

The Study Site is Lagoon Park at Manly which is within the Northern Beaches local government area. Lagoon Park has an area of 3 hectares, consisting of both Community Land and Crown Land, which is managed as one area by Council. The park boundaries are Manly Lagoon to the north, Pittwater Road to the west, Queenscliff Bridge (Bridge Road) to the east and an urban area of Manly to the south. The image on the cover of this report is an aerial photograph showing the site and it's context in the locality. The Site boundary is shown in red and the path shown in magenta in Map 1 and on the aerial photo on the report cover. Map 1 and photographs 1 and 2 show the recreational and habitat features of the site.

A shared cycleway and pedestrian pathway provides east to the west access through the park. The asphalt path is approximately 1.8m wide with sweeping curves and a dashed white line running along the centre. There is a car parking area at either end of the pathway and the pathway connects to other paths. The park also contains rubbish bins, picnic tables, exercise equipment, a shed, an electricity transformer and public toilets. This public reserve is frequented by walkers, cyclists and used as an off leash dog exercise area. Dogs are permitted off leash in all areas of the park except for within 10 metres of the playground, picnic and BBQ facilities.

The topography of the site is flat and low lying with average ground levels 1-2m AHD and parts of the area adjacent to the lagoon regularly flood.

The geographic co-ordinates of the site are -33.785°S and 151.284°E.

1.3 The Habitat on the Site

The vegetation at Lagoon Park comprises mature trees along the edges and a central woodland. The tree species include *Banksia integrifolia, Eucalyptus robusta, Araucaria heterophylla, Cupaniopsis anacardioides, Agonis flexuosa* with a mown exotic grass ground cover. The lagoon edge is vegetated with *Casuarina glauca* trees and the mangrove A*vicennia marina* with a reed bed of sedges and rushes dominated by *Phragmites australis*. These habitats can be seen in Photographs 1 and 2.

The original vegetation at the Site would have been Estuarine Swamp Oak Forest and Estuarine Reedland on the banks of the lagoon. The dominant trees would naturally be *Eucalyptus robusta*, *Banksia integrifolia, Melaleuca quinquinervia*, A*vicennia marina* and *Casuarina glauca*.

Parts of the surrounding area are still mapped as these communities (SydneyMetroArea_V2, OEH 2013). Both these vegetation types are components of the Endangered Ecological Community, Swamp

Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions listed under the TSC Act 1995.

1.4 Disturbance History

The site has a long history of disturbance and human occupation since European settlement. The impacts on Lagoon Park have been land filling of the lagoon, removal of trees and vegetation, addition of soil nutrients, changed hydrology, changed water quality, planting of exotic species, invasion of weeds. These disturbances have resulted in a loss of ecological value and resilience. The eastern section of the Park was temporarily established as a garbage tip in the 1920's and by the 1930's, there has been residential development along Eurobin Street and Cameron Ave, which define the Park's southern boundary.

1.5 Ecological Values in the Locality

The dominant habitat feature of the locality is the adjacent Manly Lagoon that is a brackish lagoon that is open to the sea at Queenscliff Beach. The landuses in the catchment of the lagoon includes Manly Dam, the urban areas Manly Vale, Allambie and Brookvale, golf courses, playing fields, roads and some light industrial use. The headwater of the catchment is remnant bushland.

Manly Lagoon is an estuarine environment that is used by aquatic and estuarine fauna including invertebrates, fish and birds. West of Lagoon Park are areas of medium quality habitat that are Manly Golf Course and playing fields and further west is a large area of bushland that is Manly Dam Reserve and Garigal National Park. Due to the proximity of the site to the estuarine lagoon, the sea, and the vegetation that occurs on this site, this area has particularly high ecological habitat potential. This type of habitat is rare in NSW but there are several examples in the northern beaches with Narrabeen Lakes being the largest example.

The locality has a long history of use and the natural environment has been extensively changed since European settlement. The bushland in the area has been degraded by clearing for development, stormwater run-off, dumping, planting of garden species, weed invasion and human access. This site has been extensively filled, reducing the amount of swamp and the surface area of the lagoon. Manly Lagoon is exposed to numerous pollution sources and does not meet national aquatic ecosystem guideline levels for water quality (WSC 2004).

1.6 Literature Review

There is a plan of Management for Lagoon Park (2001 Manly Council) that includes a landscape master plan. The water body of Manly Lagoon has had extensive environmental studies and has an Intergraded Catchment Management Strategy (WSC 2004). The reports describe the water quality and characteristics of the catchment. Most of the reports on the lagoon are in connection with a pollution event and as a consequence are about the benthic invertebrate fauna the fish and the chemistry of the lagoon. An extensive reference list occurs in this document, including a large number of water quality reports and invertebrate studies. A Manly Dam Catchment Bibliography, was completed in 2002 by Ken Higgs.

The ecology of the locality of the site is described in 3 reports; an Exotic Vegetation Management Strategy for Manly Lagoon (1996 Skelton. N) which includes a survey of the non-aquatic flora and fauna in some parts of the Manly Lagoon habitat, a frog diversity study for the Manly Lagoon Catchment (Etz. S et al 2002) and a report titled Fauna and Fauna of Manly Councils Bushland Reserves by Skelton, N., P. Wong and E. Donner in 2004.

Photograph 1: The pathway and surrounding vegetation in the central section of Lagoon Park.

Photograph 2: East end of lagoon park looking west showing the esturine beach that is used extensively for off leash dog walking.

1.7 The Proposed Lighting

The proposal is to install either pole or bollard solar powered lighting along the pathway through Lagoon Park to improve safety and navigation. The pathway runs in an east-west direction through the central axis of Lagoon Park for a length of approximately 600m from Bridge Road in the east to the Pittwater Road carpark in the west, with a side branch to the end of Cameron Avenue.

There are two type of lights that may be used the currently preferred option is the shorter bollard style EDGE series lights. There are currently trial lights of both types along the central part of the pathway. The bollard lights (EDGE series) are spaced 6m apart with one taller pole for the solar panel. There are two of the taller pole lights (AE2).

1.7.1 Bollard navigation lights: EDGE Series

- With this option there will be 24 lights installed along the path
- The light spread from the trial bollards measure 4m x 12m.
- EDGE Series bollards have a maximum brightness of 600 lumens at 8 watts.
- The height of these lights is 0.95m
- The bollards are not fitted with solar panels, solar power is supplied by taller solar panel poles installed for every four bollards.

Photograph 3 shows the bollard lights and solar power pole and Photograph 6 shows the light spill of the trial lights. Appendix C is the technical specifications of these bollard lights.

1.7.2 Pole safety Lights: AE2 (All-In-One)

- With this option there will be 14 lights installed along the path
- Direct light spread from the trial poles currently installed in Lagoon Park measure 9m x 38mWith approximately 600m of pathway within Lagoon Park, assuming no gap in light spread between each pole and taking into account the fork in the pathway on the eastern side, 14 light poles would need to be installed.
- There are two models of this light available a 25w power (max 10w output) light and 40w (max 20w output) light.
- AE2 All-In-One poles have a maximum brightness of 1200 or 2400 lumens depending on the model, though can be dimmed permanently or when not triggered by a sensor
- The AE2 lights are available in 25w or 40w power source versions.
- Depending on the model, these are recommended to be installed between 5-8m high which changes the area of light spill and the distance between poles.
- Installation distance is recommended to be between 23-35 m

Photograph 4 shows a pole light and Photograph 7 shows the light spill of the trial light. Appendix D is the technical specifications of these bollard lights.

Photograph 3: The trial bollard EDGE type light with solar power pole in background.

Photograph 4: The trial pole AE2 type light.

2 Methods

2.1 Desk-top Assessment

2.1.1 Literature Search

Relevant information was obtained from literature, scientific journals, online ecological databases, online high-resolution aerial photo libraries, historical aerial photo libraries and the Internet and incorporated into appropriate sections of this report.

2.1.2 Aerial Photos and Vegetation Maps

Aerial images and vegetation maps were assessed to determine local context, wildlife corridors, features on the site, historic changes to vegetation and disturbance, and for planning fieldwork.

2.1.3 Historic Fauna Records Search

Historic fauna records (BioNet, EPBC Protected Matters database, Birdlife Australia Atlas, Atlas of living Australia) were queried to ascertain past native species found at the site. The data were then combined with local knowledge and the habitat conditions on the site to compile a list of animal species for specific targeting during the fieldwork and to be considered in the assessment. Historic fauna records have been incorporated into Table 2 and Threatened species records are also incorporated into Table 1.

2.2 Field Survey Methods

2.2.1 Fauna Survey Methods

The fauna field surveys were conducted by experienced ecologists over seven (7) nights and one (1) day over a 20-day period between 08/08/2016 – 26/08/2016.

During the survey period the weather was mostly fine and calm, the exception was the two days 8th and the 22nd of August when thee had been rain earlier in the day and moderate wind. The maximum daily temperature during the survey period was between 15°C and 25°C and the minimum temperatures were between 10°C and 13°C.

The field survey involved the following procedures:

- Initial familiarisation with the site and its extent;
- Assessment of the physical characteristics of the site;
- Assessment of the habitats on the site;
- Identification of fauna through sightings and calls
- Search for scats, remains, nests, dreys, bones, feathers, fur, diggings, scratches, tracks, owl white-wash and food sources;
- Examination of trees for scratchings, sap-feeding notches and hollows;
- Call playback of Owl calls;
- Spotlighting to search for nocturnal species
- Detailed search for targeted threatened species that are listed in Table 1;
- Photography of the site.

2.2.3 Targeted Threatened Species Search

Table 1: Targeted Threatened Fauna Species

Common Name	Genus and Species	TSC Act status	EPBC Act status	Records within 5km
Reptiles				
Rosenberg's Goanna	*Varanus rosenbergi*	V,P		34
Birds				
Barking Owl	*Ninox connivens*	V,P,3		1
Black Bittern	*Ixobrychus flavicollis*	V,P		4
Bush Stone-curlew	*Burhinus grallarius*	E1,P		8
Curlew Sandpiper	*Calidris ferruginea*	E1,P	CE,C,J,K	2
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V,P		5
Eastern Curlew	*Numenius madagascariensis*	P	CE,C,J,K	2
Eastern Osprey	*Pandion cristatus*	V,P,3		3
Eastern Reef Egret	*Egretta sacra*	P	C	6
Flesh-footed Shearwater	*Ardenna carneipes*	V,P	J,K	2
Fork-tailed Swift	*Apus pacificus*	P	C,J,K	1
Glossy Black-Cockatoo	^^*Calyptorhynchus lathami*	V,P,2		21
Great Knot	*Calidris tenuirostris*	V,P	CE,C,J,K	4
Greater Sand-plover	*Charadrius leschenaultii*	V,P	V,C,J,K	1
Grey Plover	*Pluvialis squatarola*	P	C,J,K	4
Grey-tailed Tattler	*Tringa brevipes*	P	C,J,K	4
Latham's Snipe	*Gallinago hardwickii*	P	C,J,K	1
Lesser Sand-plover	*Charadrius mongolus*	V,P	E,C,J,K	1
Little Eagle	*Hieraaetus morphnoides*	V,P		3
Little Lorikeet	*Glossopsitta pusilla*	V,P		2
Little Tern	*Sternula albifrons*	E1,P	C,J,K	2
Marsh Sandpiper	*Tringa stagnatilis*	P	C,J,K	1
Masked Owl	*Tyto novaehollandiae*	V,P,3		2
Pacific Golden Plover	*Pluvialis fulva*	P	C,J,K	3

Common Name	Genus and Species	TSC Act status	EPBC Act status	Records within 5km
Pied Oystercatcher	*Haematopus longirostris*	E1,P		5
Powerful Owl	*Ninox strenua*	V,P,3		106
Red Knot	*Calidris canutus*	P	C,J,K	1
Red-necked Stint	*Calidris ruficollis*	P	C,J,K	10
Regent Honeyeater	*Anthochaera phrygia*	E4A,P	CE	2
Ruddy Turnstone	*Arenaria interpres*	P	C,J,K	6
Ruff	*Philomachus pugnax*	P	C,J,K	2
Sanderling	*Calidris alba*	V,P	C,J,K	7
Sooty Owl	*Tyto tenebricosa*	V,P,3		2
Sooty Oystercatcher	*Haematopus fuliginosus*	V,P		16
Sooty Tern	*Onychoprion fuscata*	V,P		2
Square-tailed Kite	*Lophoictinia isura*	V,P,3		1
Superb Fruit-Dove	*Ptilinopus superbus*	V,P		2
Swift Parrot	*Lathamus discolor*	E1,P,3	CE	4
Varied Sittella	*Daphoenositta chrysoptera*	V,P		2
Wandering Tattler	*Tringa incana*	P	J	6
Wedge-tailed Shearwater	*Ardenna pacificus*	P	J	9
Whimbrel	*Numenius phaeopus*	P	C,J,K	2
White Tern	*Gygis alba*	V,P		1
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	P	C	15
White-throated Needletail	*Hirundapus caudacutus*	P	C,J,K	6
White-winged Black Tern	*Chlidonias leucopterus*	P	C,J,K	1
Wompoo Fruit-Dove	*Ptilinopus magnificus*	V,P		2
Mammals				
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V,P		52
Eastern Freetail-bat	*Mormopterus norfolkensis*	V,P		1
Eastern Pygmy-possum	*Cercartetus nanus*	V,P		62
Grey-headed Flying-fox	*Pteropus poliocephalus*	V,P	V	68

Common Name	Genus and Species	TSC Act status	EPBC Act status	Records within 5km
Koala	*Phascolarctos cinereus*	V,P	V	3
Little Bentwing-bat	*Miniopterus australis*	V,P		7
Southern Myotis	*Myotis macropus*	V,P		8
Spotted-tailed Quoll	*Dasyurus maculatus*	V,P	E	3

BioNet Atlas of NSW Wildlife, Report generated on 15/08/2016

Key for TSC Act Status

Status	Status	Status Notes
P	Protected Animal	Fauna not listed in Schedule 11 of the NPW Act 1974.
V	Vulnerable	Schedule 2, TSC Act 1995, Likely to become endangered unless the circumstances & factors threatening its survival or evolutionary development cease to operate.
E1	Endangered	Schedule 1, part 1, TSC Act 1995, Likely to become extinct in nature in NSW unless the circumstances and factors threatening its survival or evolutionary stop, in immediate danger of extinction
E2	Endangered Population	Schedule 1, part 2, TSC Act 1995 Population where, numbers have been reduced to such a critical level, or its habitat has been so drastically reduced, that it is in immediate danger of extinction
E4	Extinct	Schedule 1, part 4, TSC Act 1995, Species that have not been located in nature during the preceding 50 years despite searching of known and likely habitats
3	Category 3 sensitive species	Species are classed as of medium sensitivity, and provision of precise locations would subject the species to medium risk from threats such as collection/deliberate damage.

Key for EPBC Act Status

Code	Description	Definition under the EPBC Act 1999, and Migratory Birds agreement.
C	CAMBA	China-Australia Migratory Bird Agreement: Refers to species listed in the Bilateral Agreement between the Government of Australia and the Government of The People's Republic of China for the protection of Migratory Birds and their Environment (Subdivision A of Division 1 of Part 5, Commonwealth EPBC Act 1999.)
E	Endangered	Refers to a native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (Subdivision A of Division 2 of Part 13, Commonwealth EPBC Act 1999).
J	JAMBA	Japan-Australia Migratory Bird Agreement: Refers to species listed in the Bilateral Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (Subdivision A of Division 1 of Part 5, Commonwealth EPBC Act 1999).
K	ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement: Refers to species listed in the Bilateral Agreement between the Government of Australia and the Government of the Republic of Korea for the protection of the Migratory Birds and their Environment (Subdivision A of Division 1 of Part 5, Commonwealth EPBC Act 1999.)
V	Vulnerable	Refers to a native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (Subdivision A of Division 1 of Part 13, Commonwealth EPBC Act 1999).
X	Extinct	Refers to a native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died (Subdivision A of Division 1 of Part 13, Commonwealth EPBC Act 1999).

2.3 Qualifications and Experience of the Field Ecologist and Authors

The main author and the principal field ecologist was Nick Skelton. Shari May and Anika Skelton assisted on one field survey each. Shari and Sophia Mueller Sewell assisted with the writing and were responsible for data base searches and literature research.

Nicholas Skelton's formal qualifications include a Bachelor of Science with Honours (B. Sc. (Hons) USyd) and a Masters in Applied Science (M. App. Sc. in Vegetation Management UNSW). Nick has been an environmental scientist for more than 20 years, including a university lecturer, research ecologist and consultant ecologist. His work is focused on the Sydney bioregion and he has published many papers in independently reviewed journals on the ecology of Sydney. He has expert knowledge of the local soils, the climate of this area and the local indigenous plants and animals as a result of over 900 ecological surveys. Nick is a member of the relevant professional organisations including a practising member of the Ecological Consultants Association of NSW, Ecological Society of Australia, AURISA, Royal Zoological Society and Birds Australia. He is licensed by OEH and NSW Department of Primary Industries to carry out surveys on threatened plants and animals and he is a certified BioBanking and Biocertification assessor. Further details can be found at www.ecology.net.au. Sophia Mueller Sewell and Shari May's qualifications include and Bachelor of Science (B. Sc. (Environmental Biology).

2.4 Relevant Ecological Legislation

All native terrestrial fauna are protected by the National Parks Act, Threatened species have additional protection provided by the NSW Threatened Species Conservation Act and the Federal, Environment Protection and Biodiversity Conservation Act. This report records exotic and native terrestrial fauna and assess the impact of the proposal on native fauna with an emphasis on Threatened species.

The Threatened Species Conservation Act 1995 and the Environment Protection and Biodiversity Conservation Act 1999 list the threatened flora and fauna species, populations and ecological communities that are threatened in NSW. These Acts also describes key threatening processes, critical habitat and recovery plans. The former Manly Local Government Area contains six (6) endangered and twenty-eight (28) vulnerable fauna species, as well as two (2) endangered populations. Some of these are known to occur near the site or in similar habitat. This report determines the Threatened species that have suitable habitat at the site and targeted surveys were carried out and the likely impacts of the proposal are assessed. As well as threatened species the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) also protects other 'matter of National Environmental Significance (NES)', Matters of national environmental significance identified in the Act are: world heritage properties, national heritage places, RAMSAR wetlands, nationally threatened species and ecological communities, migratory species protected under international agreements, Commonwealth marine environment, Great Barrier Reef Marine Park, nuclear actions and water resources in relation to coal seam gas and large coal mining developments. This report assesses the relevant parts of these ecological legislation.

2.5 Assumptions and Limitations

- The fauna survey was limited to a single season in a single year. The use of the area by other species is assessed and discussed in respect to the suitability of the habitat and historical records.
- Proximity to residential areas limited the survey methods that could be used. Trapping, motion detecting cameras and hair tubes could not be used on this site.
- This report is a terrestrial biodiversity report and does not include an assessment of aquatic species or the aquatic environment.
- It can never be proven that additional threatened species have not, do not or will not use the site as habitat. The conclusions drawn in this report are a result of surveys, observation and experience.
- This report should be read in its entirety and no part should be taken out of context.

3 Results

3.1 Wildlife Corridors

Wildlife corridors form important connections between remnant patches of bushland. They allow exchange of genetic material (pollen, seeds, spores, animals etc.) between areas of habitat in the landscape and between fragmented remnants. Wildlife corridors allow cross breeding and repopulation of isolated areas where local extinctions may have temporarily occurred. The site is not an important part of a wildlife corridor but is linked to a large area of bushland to the west via the riparian corridor along the creek lines. The connectivity elements of the habitat are trees along the foreshore and adjacent to the urban areas which will not be impacted by the light spill.

3.2 Fauna Habitat within the Site

The fauna habitat features on the site are a mown exotic lawn that provides habitat for long-nosed Bandicoots.

Planted and remnant native trees around the boundaries of the site and in a woodland in the centre which provides habitat to arboreal fauna such as birds, with flowering *Banksia integrifolia* and *Eucalyptus robusta* which are valuable foraging and nectar sources for flying-foxes, possums and birds. The numerous *Casuarina glauca* and Norfolk Island Pine trees have low habitat value. The trees were found to provide roosts for several species of diurnal birds. No hollow bearing trees were found on the site. There are hollow like structures in the properties to the south, which would be suitable for nest/roosts possums, rats and some species of microbat.

The only mid canopy vegetation is a few shrubs in the north-west and north-east corners which provide shelter for small birds and possums.

The reed beds and beach along the northern edge of the site and scattered mangroves are foraging habitat for estuarine birds and the native Water Rat. The native Water Rat is likely to be nesting in the drains.

The park is an off leash dog exercise area. Although it is a requirement to pick up dog faeces there are many dog faeces found in the park particularly in the areas adjacent to the houses. The smell of predators is known to deter ground dwelling mammals.

The site does not contain any caves, sandstone floaters or exposed sandstone bedrock however the low bridges at Pittwater Rd is known to be a roost for microbats in the summer. There is a small concrete shed and other structures along the northern bank of the lagoon that are potential microbat habitat. Not microbats were using these roosts during the survey period. The wall in shed/amenities building at the eastern end on the site is currently being used by a rat. The bridge at the north-eastern corner has rats living in the light fittings under the deck.

The site is likely to be used as part of large home range for many native fauna species.

3.3 Fauna Species Recorded

Twenty-two species (thirty-eight records) were found during the 18-day surveying period. Seventy two records of 47 different species of fauna have been recorded previously at the study site or on adjacent land. The majority of the fauna species that have been recorded were diurnal birds including several species listed as migratory or marine under the EPBC Act. The most abundant species recorded during the nocturnal survey were the Threatened Grey-headed Flying-fox that were foraging in the banksia trees.

Off leash dogs were observed using the site during every survey visit and were more common during the day time survey.

Four NSW listed threatened species have been recorded on or adjacent to the site. The Grey-headed Flying-fox (*Pteropus poliocephalus),* Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) were observed and detected on the site during the survey and the Powerful Owl (*Ninox strenua* Bionet*),* and the Black Bittern (*Ixobrychus flavicollis,* Warringah Council*)* were from previous records.

Photograph 5: Native Water Rat footprints in the wet sand at the beach a Lagoon Park

3.4 Threatened Fauna Species

There are reliable records of microbats roosting under the Pittwater Road bridge and it is possible that there is another roost in the small old building underneath Bridge Road bridge. No evidence was found during the surveys of the roosts being used. It is likely that these roosts are for the summertime only. The most likely bats using the roosts is the Southern Myotis (Myotis macropus), which often roosts under bridges or the Eastern Bentwing Bat (Miniopterus schreibersii oceanensis) which was detected on the site during the survey using an Anabat detector. There is a known Eastern Bentwing roost in the drains under Warringah Mall and another bat roost at the Gun Emplacement at North Head. Bats from these roosts could forage at the site, most likely during the summer months.

Grey-headed Flying-fox (*Pteropus poliocephalus*) were the most common nocturnal animal found during the field surveys. Several individuals were found on every site visit. A dead Grey-headed Flying-fox (*Pteropus poliocephalus*) was found in one of the trees on the site during the survey. The flying-fox had been tagged as part of a flying-fox monitoring survey. The appropriate authorities were informed of the tag colours.

The list of threatened and non-threatened fauna species found during the field survey or that were recorded at the site are listed in Table 2. An assessment of the likelihood of occurrence of the threatened fauna that have suitable habitat on the site is Table 3.

3.5 Historic Records of Fauna and Habitat at or near the Site

Several threatened species are known to occur within the locality and there are records of the Threatened Powerful Owl adjacent to the site.

The site is not mapped as an important site for migratory or wetland birds, it is not a government listed (OEH) Ramsar site and is not mapped as an Important Bird Area (IBA) by Birdlife Australia. A list of Threatened Species that could potentially occur on the site is Table 1.

BioNet Threatened Species Search

There are 1,028 records from 91 different threatened fauna species recorded within a 10km by 10km area around the site. Some of these records are aquatic or marine species. Since this survey only

included terrestrial species, aquatic species have not been included in Table 1. Species that do not have suitable habitat on the site or that are not local native species are not listed. The high number of records is indicative of the high habitat value of the environmental conditions within the locality and the area's importance to the conservation of native flora and fauna.

Atlas of living Australia

A search of the Atlas of Living Australia Database contained 2 records. The Eastern Great Egret (*Ardea modesta*) from June 2015 and the Masked Lapwing (*Vanellus miles*) from September 2013. Fauna recorded on the site are listed in Table 2.

Migratory and Wetland Birds search

A search of the CAMBA and JAMBA databases found that the site was not known to be an important site for migratory bird species. Recent bird atlas records could not be accessed due to the website being under maintenance.

Northern Beaches Council Data

Northern Beaches Council bird data from between 2006 and 2011 shows a total of 29 records bird species at the site and nearby Hinkler Park. The birds found include several migratory species such as the Great Egret (*Ardea alba)* and the Little Egret (*Egretta garzetta)* in June 2006, several wading birds such as the Gallinago sp and the Spoon Bill (*Platalea regia)* and the Threatened Black Bittern (*Ixobrychus flavicollis)* from July 2011. Fauna recorded on the site or the adjacent Hinckler Park are listed in Table 2.


Hinkler Park
Shrubs
Mangroves
Reed Beds
Exercise Equipment
Swings
West Carpark
Pittwater Road
Keirlie Park
Manly Lagoon
Woodland
Reed Beds
Mangroves
Shallows
BBQ
Shrubs
Shed and Toilets
Transformer
Playground
Queenscliff Beach
Cameron Ave
Map 1, Study Site
Lagoon Park
Features and Habitats
Nocturnal Fauna Survey

Table 2: Fauna Found During Survey or Historically Recorded Near the Site

Nocturnal Fauna Survey Manly Lagoon Park, GIS Environmental Consultants, 2016

Ground Dwelling Mammals

Common Name	*Species*	Date	Type/Source	Notes
Back Rat	*Rattus rattus*	12-Aug-16	Observed	Under the Queenscliff bridge
Back Rat	*Rattus rattus*	Every Survey Visit	Scats, Nest	In shed/toilet Block
Domestic Dog	*Canis lupus familiaris*	Every Survey Visit	Observed, Several	Off leash in whole of park lots of scats especially on southern edge adjacent to houses
Long-nosed Bandicoot	*Perameles nasuta*	2014	Bionet	
Long-nosed Bandicoot	*Perameles nasuta*	2016	Bionet	
Long-nosed Bandicoot	*Perameles nasuta*	8-Aug-16	Diggings	Along southern edge adjacent to houses
Long-nosed Bandicoot	*Perameles nasuta*	9-Aug-16	Diggings	Along southern edge adjacent to houses
Long-nosed Bandicoot	*Perameles nasuta*	12-Aug-16	Diggings	Along southern edge adjacent to houses
Long-nosed Bandicoot	*Perameles nasuta*	16-Aug-16	Diggings	Along southern edge adjacent to houses
Long-nosed Bandicoot	*Perameles nasuta*	25-Aug-16	Diggings	Along southern edge adjacent to houses
Water Rat	*Hydromys chrysogaster*	8-Aug-16	Tracks	Tracks in wet sand along lagoon edge on beach
Water Rat	*Hydromys chrysogaster*	9-Aug-16	Tracks	Tracks in wet sand along lagoon edge on beach
Water Rat	*Hydromys chrysogaster*	18-Aug-16	Tracks	Tracks in wet sand along lagoon edge on beach
Water Rat	*Hydromys chrysogaster*	25-Aug-16	Tracks	Tracks in wet sand along lagoon edge on beach

Aboreal Mammals

Common Name	*Species*	Date	Type/Source	Notes
Brush-tailed Possum	*Trichosurus vulpecula*	9/08/16	Observed	Southern side adjacent to houses
Ring-tailed possum	*Pseudocheirus peregrinus*	16/08/16	Dead carcus and a live one	Near Playground
Ring-tailed possum	*Pseudocheirus peregrinus*	8/08/16	Observed	Near Playground

Nocturnal Birds

Common Name	*Species*	Date	Type/Source	Notes
Powerful Owl	*Ninox strenua*	2013	BioNet	**Threatened Species, TSC Act.** Recorded on north side of Lagoon and elseware in catchment.

Flying-foxes

Common Name	*Species*	Date	Type/Source	Notes
Grey-headed Flying-fox	Pteropus poliocephalus	Every Survey Visit	Observed, between 4 and 12 a night	**Threatened, TSC EPBC Acts,** Manly (6-20) individuals seen each night mostly feeding in the Banksia trees that were in flowers and a dead tagged one hanging in a tree

Black Flying-fox	Pteropus alecto	16-Aug-16	Observed	Only one of this species seen this night
Black Flying-fox	Pteropus alecto	18-Aug-16	Observed	

Microbats

Common Name	*Species*	Date	Type/Source	Notes
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	11-Aug-16	Ultrasonic Bat Detector	**Threatened, Vulnerable TSC Act**, 5 recordings, 43-46Mhz small downward tail on uneven call
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	12-Aug-16	Ultrasonic Bat Detector	**Threatened, Vulnerable TSC Act**, 2 recordings, 43-46Mhz small downward tail on uneven call

Diurnal Birds

Common Name	*Species*	Date	Type/Source	Notes
Australian Magpie	*Cracticus tibicen*	11-Aug-16	Observed	Asleep
Azure Kingfisher	*Alcedo azurea*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Black Bittern	*Ixobrychus flavicollis*	20-Jul-11	Warringah Council Record	**Threatened TSC Act.** Hinkler Park and north side of Lagoon
Buff banded Rail	*Gallirallus philippensis*	25-Aug-16	Observed night time feeding	
Buff banded Rail	*Gallirallus philippensis*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Cattle Egret	*Ardea ibis*	20-Jul-11	Warringah Council Record	**Migratory EPBC Act, Hinkler Park and north side of Lagoon**
Chestnut Teal	*Anas castanea*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Darter	*Anhinga melanogaster*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Domestic Duck	*Anas sp.*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Crested Pigeon	*Ocyphaps lophotes*	18-Aug-16	Observed	Asleep perched in tree
Dusky Moorhen	*Gallinula tenebrosa*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Eastern Rosella	*Platycercus eximius*	16-Aug-16	Observed asleep perched in tree	
Great Cormorant	*Phalacrocorax carbo*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Great Egret	*Ardea alba*	11-Aug-16	Observed	**Migratory EPBC Act**
Great Egret	*Ardea alba*	20-Jul-11	Warringah Council Record	**Migratory EPBC Act,** Hinkler Park and north side of Lagoon
Great Egret	*Ardea alba*	20-Jun-06	Sean Granger	**Migratory EPBC Act,** Located near Queenscliff Bridge, shallow water / sandflats
Grey Teal	*Anas gracilis*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Kookaburra	*Dacelo novaeguineae*	11-Aug-16	Observed	Asleep perched in a tree
Kookaburra	*Dacelo novaeguineae*	11-Aug-16	Observed	Day time
Little-black Cormorant	*Phalacrocorax sulcirostris*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Little Egret	*Egretta garzetta*	21-Jun-06	Sean Granger	**Migratory EPBC Act,** Located near Queenscliff Bridge, shallow water / sandflats
Little-pied Cormorant	*Phalacrocorax melanoleucos*	11-Aug-16	Observed	Fishing in lagoon and coming ashore
Little-pied Cormorant	*Phalacrocorax melanoleucos*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Masked Lap-wing (plover)	*Venellus miles*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Masked Lap-wing (plover)	*Venellus miles*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Nankeen Night Heron	*Nycticorax caledonicus*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon

Noisey Minor	*Manorina melanocephala*	11-Aug-16	Observed	Day time
Pacific Black Duck	*Anas superciliosa*	Every Survey Visit	Observed, several on the Lagoon	
Pacific Black Duck	*Anas superciliosa*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Pelican	*Pelecanus conspicillatus*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Pied Cormorant	*Phalacrocorax varius*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Pied Curawong	*Strepera graculina*	12-Aug-16	Observed	Asleep perched in a tree
Pied Curawong	*Strepera graculina*	11-Aug-16	Observed	Day time
Pied Curawong	*Strepera graculina*	8-Aug-16	Observed	Asleep perched in a tree
Purple Swamphen	*Porphyrio porphyrio*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Rainbow Lorikeet	*Trichoglossus moluccanus*	11-Aug-16	Observed	Day time
Rainbow Lorikeet	*Trichoglossus moluccanus*	8-Aug-16	Heard calls	Heard night time
Red Wattle-bird	*Anthochaera carunculata*	11-Aug-16	Observed	Day time
Rock Dove	*Columba livia*	11-Aug-16	Observed	Day time
Royal Spoonbill	*Platalea relia*	19-Jun-06	Sean Granger	Located near Queenscliff Bridge, shallow water / sandflats
Silver Gull	*Larus novaehollandiae*	11-Aug-16	Observed day time	On beach
Silver Gull	*Larus novaehollandiae*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Snipe - Lathams?	*Gallinago sp.*	1-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Spoon-bill	*Platalea regia*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Striated Heron	*Butorides striatus*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Striated Heron	*Butordorides striatus*	22-Jun-06	Sean Granger	Located near Queenscliff Bridge, shallow water / sandflats
White (Sacred) Ibis	*Threskiornis molucca*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
White-faced Heron	*Egretta (Ardea) novaehollandiae*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon
Willy Wagtail	*Rhipidura leucophrys*	1-Dec-14	BioNet	
Wood Duck	*Chenonetta jubata*	20-Jul-11	Warringah Council Record	Hinkler Park and north side of Lagoon

Table 3: Habitat Suitability Assessment for Threatened Fauna Species

Common Name	Scientific Name	Habitat Preference	Likely Occurrence
Barking Owl	Ninox connivens	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Roost in shaded portions of tree canopies, including tall mid-storey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.	Low. No suitable nesting or roosting habitat on site due to lack of large trees with hollows. No evidence found during survey. Site may, be a part of a large foraging home range. 1 record within 10x10km of the site. No further assessment required.
Black Bittern	Ixobrychus flavicollis	Inhabits estuarine vegetation especially casuarina glauca trees overhanging brackish water and preys on fish and invertebrates.	High. Suitable foraging and nesting or roosting habitat occurs on site. No evidence found during survey. Site may, be a part of a large foraging home range but is unlikely to be large enough to sustain a home territory. No record within 10x10km of the site. No further assessment required.
Glossy Black-Cockatoo	Calyptorhynchus lathami	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of She-oak occur. Feeds almost exclusively on the seeds of several species of She-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	Low. No suitable nesting habitat on site. The species of casuarina is not an optimal food species. No tree hollows on site and limited feeding habitat. Not found during survey. Site may be a part of a large home range. 21 records within 10x10km of the site. No further assessment required.
Powerful Owl	Ninox strenua	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. It roosts by day in dense vegetation. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. Powerful Owls 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.	High. No suitable nesting habitat on site, due to lack of tree hollows. Low suitability roosting habitat on site due to lack of dense vegetation and fresh water pools. No evidence such as white-wash or pellets found during survey. Site likely to be part of a large home range and provides some foraging habitat. 106 records within 10x10km of the site. One record from 2013 in the adjacent urban environment north of the site. Further assessment in the form of a 7-part test required.
Sooty Owl	Tyto tenebricosa	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.	Low. No suitable roosting or nesting habitat on site, due to lack of tree hollows. No evidence such as white-wash or pellets found during survey. Site likely to be part of a large home range. 2 records within 10x10km of the site. No further assessment required.

Swift Parrot	Lathamus discolor	In NSW, mostly occurs on the coast and south west slopes. Migrates to the Australian south-east mainland between March and October. Occur in areas where eucalypt are flowering profusely or where there are abundant lerp infestations.	Low. No suitable breeding habitat or food trees on site. No loss of habitat due to proposed development. Not found during survey. Site may be a part of a large home range. 4 records within 10x10km of the site. No further assessment required.
White-bellied Sea-Eagle	Haliaeetus leucogaster	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the Sea-Eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes and the sea). Breeding has been recorded on the coast, at inland sites, and on offshore islands. The White-bellied Sea-Eagle generally forages over large expanses of open water.	Low. No suitable breeding habitat on site. Not found during survey. Could be part of a large home range. 15 records within 10x10km of the site. No further assessment required.
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Populations disperse within about 300 km range of maternity caves. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.	**High**. Not suitable breeding or roosting habitat within site but roosting habitat likely immediately adjacent. The site is suitable foraging habitat. Site may be a part of a large foraging home range. An Eastern Bentwing-bat ultrasonic call was regularly detected onsite. The recording was compared to the "Bat calls of NSW" (Department of Environment and Conservation). The call was at a frequency of 42-46 and had irregular spacing. 60 records within 10x10km of the site. Records from north head and known roosting site at Warringah Mall. **Further assessment in the form of a 7-part test required.**
Grey-headed Flying-fox	*Pteropus poliocephalus*	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. 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.	**High**. Known roosting sites nearby at Balgowlah, but no roosting habitat within the site. Several individuals were found each survey night. Dead Flying Fox found during the survey. Site is likely to be used as part of a large home range. 68 records within 10x10km of the site. **Further assessment in the form of a 7-part test required.**

Little Bentwing-bat	*Miniopterus australis*	Occur in 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.	Low. Not detected during the field survey. Not suitable breeding or roosting habitat within site but roosting habitat likely immediately adjacent. The site is suitable foraging habitat. Site may be a part of a large foraging home range. 3 records within 10x10km of the site. No further assessment required.
Southern Myotis	*Myotis macropus*	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.	Medium. Not detected during the field survey. Suitable roosting habitat under Pittwater Rd bridge east of the site. The site is suitable foraging habitat. Site may be a part of a large foraging home range. 11 records within 10x10km of the site. No further assessment required.

4 Discussion

4.1 Area Affected by Light Spill

The lights are shielded so there is no direct light spill up or outside of the intended illumination area. The part of the site that will be affected by light spill from the proposed light will be 0.2ha (approximately 7% of Lagoon Park) for the low bollard type lights and 0.4ha (approximately 15%) for the taller lights.

Photographs 6 and 7 show the light spill of the two types of lights proposed to be used.

The land that will be lit is mown exotic grass and asphalt, which is low value habitat, the higher value habitat features on the site will not be lit by the proposed artificial lighting.

The surrounding urban environment and the street lighting along Pittwater Road, Bridge Street and Cameron Ave already emit artificial light spill on Lagoon Park.

The proposal will illuminate 7-15% in the central part of Lagoon Park that is currently low value habitat.

4.2 Intensity of Light

The brightness of the proposed light is 600 lumens for the low bollard type lights and between 1200 and 2400 lumens for the taller lights. The area the bollards illuminate is 48sqm which means the average amount of light reaching each square metre within the illuminated area is 12.5 lux. The area the poles illuminate is 342sqm which means the average amount of light reaching each square metre within the illuminated area is 5.26lux.

The level of illumination of the ground under the lights is about the same as a typical car parking lot or 50 times the conditions under a full moon or 10 to 100 times less than most homes. See table below. A photograph of the actual light spill caused by each of the lighting systems proposed is shown in Photos 6 and 7. This is a low intensity of illumination and these levels are only within the light spill area of each light.

Table 1.1. Illumination from common sources.

Source	*Illumination (lux)*
Full sunlight	103,000
Partly sunny	50,000
Operating table	18,000
Cloudy day	1,000–10,000
Bright office	400–600
Most homes	100–300
Lighted parking lot	10
Full moon under clear conditions	0.1–0.3
Quarter moon	0.01–0.03
Clear starry sky	0.001
Overcast night sky	0.00003–0.0001

4.3 Increased Use of the Park

The lighting of the path is likely to increase the pedestrian use the park and also the amount of dogs being walked. The existing peak night-time use of the park is the few hours after dusk. The proposal may extend the peak use time later into the night. The current use of the pathway in the hours after dusk is already high and additional intensity of use in this time period is unlikely to lead to any additional deterrent for wildlife only the extension of the period of use is likely to change.

The smell and sight of a carnivore such as a dog is known to deter fauna from using an area, which could impact foraging productivity for nocturnal ground dwelling animals such as the Long-nosed Bandicoot and the Water Rat. The fauna species that already occur on the site appear to be habituated to the smell of dogs as the part of the site where they are most commonly found is in the areas most heavily used by dogs.

4.4 Other Potential Changes to Habitat

There will be no habitat features removed by the proposal.

The tall poles may provide habitat for perching of owls or hanging of microbats while foraging.

There are people feeding the wildlife bread and meat and it is likely that the BBQ will attract scavenging. These food resources are mostly on the open parts of the site where ground dwelling an normally arboreal animals may be at higher risk of predation. It is not clear if the proposal would increase or decrease this threat/habitat feature.

Photograph 6: Trial EDGE Series lights at Lagoon Park, Manly

Photograph 7: Trial AE2 lights at Lagoon Park, Manly

4.5 Scientific Studies on Impacts of Artificial Lighting to Fauna

There is deficiency of research data on the impacts of artificial lighting on fauna and very little information on impacts to native Australian fauna. There was an international conference in 2004 on the subject but

it was mostly speculation on what the impact could be and directions for further research rather than research findings. The conference on the impacts of artificial lighting resulted in a book compiling the conference papers and a summary paper by T Longcore and C Rich on the topic (*Ecological Consequences of Artificial Nightlighting* 2006). The review paper concluded that;

"The more subtle influences of artificial night lighting on the behaviour and community ecology of species are less well recognized, and constitute a new focus for research in ecology and a pressing conservation challenge" (Longcore. T and Rich. C 2004)

Similarly, an Australian study on the effects of light on biodiversity by J. Newport et, al. (2014) "found a significant gap in knowledge of the impact of these pollutants on Australian fauna"

The study by Newport et, al. (2014) concluded that:

"Light and noise pollution have the potential to affect physiology, behaviour and reproduction of a range of animal taxa (e.g. turtles, penguins moths and other invertebrates). Types of effects include changes in foraging and reproductive behaviours, reduction in animal fitness increased risk of predation and reduced reproductive success. These could have flow-on consequence at the population and ecosystem levels"

Changes in light conditions can also interfere with predator prey relationships. (Longcore and Rich 2004). Some reports have indicated that artificial lighting can affect the breeding patterns in fauna by causing changes in circadian clocks (Longcore and Rich 2004). Due to the increased risk of predations some fauna such as frogs will become less selective in choosing mates which could lead to a deterioration in survival rates, artificial lighting has also been known to effect the choice of nest sites in some birds (Longcore and Rich 2004).

A study by Santos C.D et al (2010) found that "nocturnal predators may improve their visual skills due to illumination, or feed on concentrations of insects attracted by artificial lights" however "Some diurnal animals like passerines and falcons are also know town to extend their daily activity into the night under artificially improved light conditions. The repercussions of these behavioural changes in ecological systems are largely unknown. Estuaries and coastal wetlands are among habitats most exposed to artificial illumination" (Santos,C.D et al 2010).

Longcore and Rich (2004) have also concluded that "Although it may seem beneficial for diurnal species to be able to forage longer under artificial lights, any gains from increased activity time can be offset by increased predation risk". "Small rodents forage less at high illumination level".

Foxes (*Vulpes vulpes*) were found in one study to walk on or near illuminated waterside areas rather than unlit ones.

There is inadequate research data to draw conclusions regarding the likely impacts that the proposed type and intensity of light proposed may have on the species that occur at this site.

4.6 Assessment of Impacts to Fauna

Ground Dwelling Mammals

Ground dwelling mammals tend to forage near cover such as shrubs, this may account for the low numbers recorded on this site. The proposed lights are in the more open areas of the site and not near the higher habitat value areas of suitable cover.

Although there is currently little scientific evidence it is likely that ground dwelling mammals avoid areas that have artificial lighting and may be deterred by increased pedestrian and dog presence including the smell of dogs. Avoidance behaviour may affect foraging efficiency resulting in less food being consumed and an overall weight loss and reduced reproductive success. There may also higher risk of predation from large owls, cats, dogs or foxes in lit areas as these predators rely on some light being present.

This impact of these factors on the ground dwelling animals on this site such as the native Water Rat, rats and bandicoots is difficult to determine with any certainty. The fauna that were found on this site appear to be already habituated to living with the sight to pedestrians, the smell of dogs and at least some artificial lighting as they were found mostly in the parts of the site where dogs, people and artificial were most prevalent which is adjacent to the urban area and the beach. These individuals are not likely to be further deterred by the proposed path lighting.

There may be other species that are already absence from the site due to these deterrents. The proposed lighting is not likely to have an impact on these species.

If there is an impact of low intensity path lighting then the shorter bollard style lights are likely to have less of an impact to ground dwelling mammals as the area of light spread will be smaller and the light only covers the path area which is low suitability foraging habitat.

Due to existing light spill from surrounding urban areas and the existing high pedestrian and dog use in vicinity of the site, the small additional light spill area, the low habitat value to the area to be illuminated and the low intensity of the proposed lights it is considered that the proposed lights are not likely to have a significant impact on ground dwelling mammals.

Arboreal Mammals

There was very few possums found in the park, this may be due to the better foraging resources available in the adjacent urban area. The possums at the site are likely to be already accustomed to the presence of dogs and people and the light spill from the surrounding urban area.

The dead Ring-tailed possum found was killed by a car, this threat will not be increased by the proposal.

Powerful Owls are very territorial and the predator pressure they apply is more likely to be limited by the availability of nesting and roosting sites rather than catch ability of prey.

The lighting of the path is unlikely to significantly affect the arboreal mammal habitat that currently occurs at the site.

Nocturnal Birds

Because of the lack of shrub layer and ground cover the prey items that occur at the park are limited to the larger mammals such as bandicoots, flying foxes and possums which are only food for the larger Powerful Owl. Other smaller owls such as the Barking Owl and Sooty Owl, night jars and frogmouths are less likely to forage at this site.

There is no clear relevant evidence in the literature regarding the impact of artificial lighting on nocturnal birds.

The presence of light is likely to increase the predation efficiency of owls, however the increase in light, pedestrians and dogs may also deter their prey. The taller pole lights with a larger light spread are likely to be more beneficial to owls by providing a sitting position to watch for prey.

Nocturnal estuarine birds that forage using visual or partially visual means have been found to increase their foraging behaviour activities in areas that are artificially illuminated. This behaviour may have negative effects on some waders in the long-term due to the decreased invertebrates present over the winter available to waders regularly using the area to forage. Other potential negative impacts to estuarine birds being drawn to well-lit urban areas include an increased risk of disturbance, pollutants and predation.

The shorter bollard style lights are likely to have less of a direct impact to waders as the light spread will not reach the lagoon. Increased dog use is likely to be the biggest impact to waders.

Diurnal Birds

Roosting and resting areas for diurnal species are away from the direct light spread. Increased dog use may disturb some ground resting birds such as ducks.

It is considered that the proposed dim low level lighting of the pathways is unlikely to have a significant impact on diurnal birds.

Flying-foxes

Flying-foxes were the most abundant animal found during the survey. There were mostly found in flowering banksia trees and did not seem to show any preference for trees that were darker. Flying-foxes occur abundantly in the urban environment and on the Corso even where there is substantial lighting.

The foraging efficiently of fruit bats such as the Grey-headed Flying-fox is unlikely to be impacted. It is unlikely that the increase in the light will significantly impact the Flying-foxes using the site.

Microbats

Fast flying insectivorous bats such as the Eastern Bentwing-bat have been found to prefer foraging under artificial lighting presumably due to an increased abundance of insect prey in brighter areas (Australian Bat Society 2004). Slow flying bats have been recorded as avoiding areas that are artificially lit (Australian Bat Society 2004). This Site already has substantial light spill and the microbat species that have been found on the site are faster flying species.

The taller light poles and the solar panel poles for the bollard lights may provide a spot for microbats to hang while searching for prey.

The proposed low intensity and small light spill area proposed is not likely to cause significant impact to any microbats.

4.7 Manly LEP 2013 Assessment of Clause 6.5 (3) and (4) relating to Terrestrial Biodiversity

Manly LEP 2013 'Terrestrial Biodiversity Map' shows the subject property is located within an area identified as of 'Terrestrial Biodiversity'.

Therefore, Clause 6.5 of MLEP 2013 applies to this Development Application and the objectives of the clause and in particular, points (3) and (4) must be considered concerning this proposal.

Clause 6.5 (3) Assessment

a) Whether the development is likely to have:

*i. Any adverse impact on the **condition, ecological value and significance** of the fauna and flora on the land?*

Response: The light spill will only directly affect the part of the lagoon park along the pathway. The lights and the subsequent increases dog and pedestrian use may deter some fauna from the site. The predation risk for small ground dwelling mammals who chose to forage under the light may be increased. The foraging efficiency of insectivorous fauna such as microbats which can feed on the insects attracted to the lights, will be improved. Due to the already existing high pedestrian and dog use of the park and the light spell from the adjacent urban area the installation on new lights in the park is unlikely to have a significance adverse impact on the condition ecological value and significance of the fauna on the land.

*Any adverse **impact on the importance of the vegetation** on the land to the habitat and survival of native fauna?*

Response: The proposal will not have any adverse impact on the importance of the vegetation at the site to the habitat and survival of native fauna.

*ii. Any potential to **fragment, disturb or diminish** the biodiversity structure, function and composition of the land?*

Response: There will be no disturbance to the vegetation and habitat at the site. Some fauna may be deterred from using the site due to the increased pedestrian and dog use however as the site already has a high pedestrian and dog use it is likely that the impact will not be significant.

*iii. Any adverse impact on the habitat elements providing **connectivity** on the land?*

Response: The proposal will not remove any habitat on the site. The proposal will not change the access for fauna species to and from the site. The path proposed to be lit runs through the centre of the lagoon park. The connectivity elements of the habitat are trees along the foreshore and adjacent to the urban areas which will not be impacted by the light spill.

*b) Are there appropriate measures proposed to **avoid, minimise or mitigate** the impacts of the development?*

Response: If it is necessary for the path to be lit at night time for safety or navigation then the proposed low illumination and low level is the best kind for the site. This report makes recommendations for appropriate measures to avoid, minimise or mitigate the impacts of the proposal. See the *Ameliorative Conditions and Management Recommendations* sections of this report for further information.

Clause 6.5 (4) Assessment

a) Is the development designed, sited and will be managed to avoid any significant adverse environmental impact? OR

Response: The proposal will use the minimal amount of lights possible to reduce impact on wildlife. The light will only be installed along the pathways where pedestrian use is already quite high and the habitat value is low.

b) If the impact cannot be reasonably avoided by adopting feasible alternatives—is the development designed, sited and will be managed to minimise that impact? OR

Response: The proposal is designed and sited to reduce significant adverse impacts by having minimal changes to the existing disturbed area. The recommendations and ameliorative conditions in this report provide measures to manage and mitigate impacts.

c) *If that impact cannot be minimised—will the development be managed to mitigate that impact?*

Response: N/A

4.8 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) would only become relevant if it was considered that an impact on a 'matter of National Environmental Significance (NES)' were likely, thus providing a trigger for referral of the proposal to the Department of the Environment and Water Resources.

A Protected Matters search was conducted within a 10km radius of the site and the results are attached as Appendix A. A Protected Matters search is a broad scale assessment that includes World Heritage Properties, National Heritage Places, Wetlands of International Importance, Great Barrier Reef Marine Park, Commonwealth Marine Areas, Listed Threatened Ecological communities, Listed Threatened Species, Listed Migratory Species nuclear actions and water resources in relation to coal seam gas and large coal mining developments. The only relevant categories are Threatened species, Threatened Ecological Communities and Migratory species.

The report lists the following ecologically relevant items:

- 10 Threatened Ecological Community
- 86 Threatened species
- 68 Migratory Species

Most of the migratory and aquatic bird species, as well as the fish, sharks and marine mammals are not assessed in this report. This report addresses terrestrial species, which are likely to have potential habitat on the site.

The proposal is unlikely to have an important impact on any ecological matter of National Environmental Significance.

5 Conclusions

The proposed lighting will illuminate 7-15% of the low value habitat in the central part of Lagoon Park with low intensity light. The lighting of the path is likely to increase the pedestrian and dog use of the park. The timing of the human and dog walking will most likely remain concentrated in the early evening however there may be an extension of the timing later into the night.

There is currently little scientific evidence regarding the impact of artificial light on native fauna or the fauna species that occur on this site. It is possible that native animals may avoid areas that have artificial lighting and may be deterred by pedestrian and dog presence including the smell of dogs. Avoidance behaviour may affect foraging efficiency resulting in less food being consumed and an overall weight loss and reduced reproductive success. There may also be a higher risk of predation from cats, dogs or foxes in lit areas as these predators rely on some light being present. The impact of these factors on the animals currently living on this site is difficult to quantify with any certainty. Some general comments and recommendations can be made. The fauna are found on this site appear to be already habituated to living with the sight of pedestrians and dogs, the smell of dogs and at least some artificial lighting as they were mostly found in the parts of the site adjacent to the urban area and the beach, where dogs, people and artificial were most prevalent. Any animals that have a strong aversion to artificial light are not likely to currently occur in the park due the existing light sources. The individuals found in these areas are not likely to be further deterred by the proposed low intensity and small area path lighting.

The wading birds, nocturnal birds and microbats that occur on this site are more likely to be assisted by the proposed additional lighting. The diurnal birds that sleep in the park and the numerous flying-foxes that use the park are not likely change their behaviour due to the proposed lighting.

Neither of the proposed types of low intensity path lighting are likely to have an additional significant impact to the conservation of any fauna species that occurs on the site or is likely to occur on the site.

6 Ameliorative Recommendations

- The habitat value of the park could be enhanced by providing clumps of low dense vegetation to provide shelter for ground dwelling fauna.
- The area under and around the bridges should be investigated for the presence of microbat roosts in summer.
- Trees that have nectar such as *Eucalyptus robusta*, *Banksia integrifolia, Melaleuca quinquinervia*, should be preferentially planted.
- Feeding of wildlife should be discouraged as it may cause health problems and hardship when food is not available.
- Rat baiting should occur only within buildings to avoid killing non target native small mammals and birds.

These recommended actions are likely to have a much larger positive affect than any negative affect caused by the installation of the artificial lighting.

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8 Appendix A. Assessments of Significance (7-Part Tests)

8.1 Assessment of Significance for the Grey-headed Flying-fox (*Pteropus poliocephalus)*

The Grey-headed Flying-fox is listed as a Vulnerable species on Schedule 2 of the NSW *Threatened Species Conservation Act 1995* and as a Vulnerable species under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*

Grey-headed Flying-foxes are generally found within 200km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia.

This species occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps (Eby, 1995). Urban gardens and cultivated fruit crops also provide habitat for this species. Roosting camps are generally located within 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.

Grey-headed Flying-foxes forage on the nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia* (Eby, 2000), and fruits of rainforest trees and vines (OEH, 2001).

Threats to this species include: destruction of habitat by clearing for urban development and agriculture, particularly critical winter foraging habitat in the coastal forests of north east NSW; loss of foraging habitat increases the severity of food shortages leading to starvation of animals, spontaneous abortion and high infant mortality; disturbance at roosting sites, particularly during the last few weeks of pregnancy when females can spontaneously abort; unregulated shooting; electrocution on power lines; competition and hybridization with the Black Flying-fox *Pteropus Alecto* (OEH, 2001).

a) *In the case of a **Threatened Species**, whether the action proposed is likely to have an **adverse effect** on the **lifecycle** of the species such that a **viable local population** of the species is likely to be placed at **risk of extinction**.*

***Response*:**

The home range of this population is likely to include all of the Manly and further into Mosman and Warringah. It is unlikely that the proposal would have a significantly adverse impact on the lifecycle of these species considering that there was no roosting colony on the site and it is unlikely that the light will affect the breeding for this species. The light spill will cover the central part of the park only and the majority of the Grey-headed Flying-fox foraging habitat will not be effected. Many Grey-headed Flying-foxes were found foraging on the site in areas adjacent to the urban environment where there is already of light spill and it is likely that an increase light will not deter the Flying-foxes from using the site.

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

Response:

The Grey-headed Flying-fox is not listed as an Endangered Population; therefore this question is not applicable.

c) *In the case of an Endangered Ecological Community or Critically Endangered Ecological Community, whether the action proposed:*
   - i) *is likely to have an adverse effect on the extent of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction, or*
   - ii) *is likely to substantially and adversely modify the composition of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction.*

Response:

The Grey-headed Flying-fox is not listed as an Endangered Ecological Community or a Critically Endangered Ecological Community; therefore this question is not applicable.

*d) In relation to the **habitat** of a Threatened Species, Population or Ecological Community:*

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

*ii) whether an area of **habitat** is likely to become **fragmented** or **isolated** from other areas of habitat as a result of the proposed action, and*

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

Response:

(i) No habitat will be removed for this proposal. A small area of low value habitat will be directly affected by the light spill. The majority of the Grey-headed Flying-fox habitat on the site will not be affected by the light spill.

(ii) The Proposal would not result in further fragmentation or isolation of habitat from other areas of habitat for this species. Grey-headed Flying-foxes are a highly mobile species.

(iii)There will be no habitat removed for this proposal. The amount of Grey-headed Flying-fox habitat to impacted by the lights is very small and it is likely the flying-foxes will still be able to use the site as they do now. Many Grey-headed Flying-foxes were found foraging on the site in areas adjacent to the urban environment where there is already of light spill and it is likely that an increase light will not deter the Flying-foxes from using the site. There is also a lot of similar habitat east of the site.

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

Response:

No critical habitat has been defined for the Grey-headed Flying-fox under the TSC Act (1995); therefore this question is not applicable.

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

Response:

The Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* sets out the actions necessary to stop the decline of, and support the recovery of this species. The overall objectives of recovery of Grey-headed Flying-foxes are: to reduce the impact of threatening processes, to arrest decline throughout their range; to conserve their functional roles in seed dispersal and pollination of native plants; and to improve the comprehensiveness and reliability of information available to guide recovery.

The proposal is consistent with the objectives of the Draft Recovery Plan.

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

Response:

Key threatening processes of relevance to this species concerning this proposal are:

- **Destruction of habitat by clearing**. No habitat will be cleared for this proposal.
- **Loss of foraging habitat**. No foraging habitat will be lost for this proposal. The foraging efficiency of Grey-headed Flying-foxes at the site is unlikely to be impacted by the lights.
- **Disturbance of roosting habitat (particularly during winter or breeding)**. There were no roosting flying-foxes observed at the site. Grey-headed Flying foxes were observed foraging o the site at

night. Any potential roosting habitat at the site is unlikely to be disturbed as the lights will only impact during night-time hours.

Conclusions of impacts on Grey-headed Flying Fox:

The proposal is unlikely to have a significant adverse effect on the local populations of the Grey-headed Flying-fox.

No roosting or breeding colonies were found at the site

The light spill will cover the central part of the park only and the majority of the Grey-headed Flying-fox foraging habitat will not be effected. Many Grey-headed Flying-foxes were found foraging on the site in areas adjacent to the urban environment where there is already of light spill and it is likely that an increase light will not deter the Flying-foxes from using the site.

This conclusion is dependent on the limitations and assumptions described in this report.

8.2 Assessment of Significance (7-Part Test) for Powerful Owl (*Ninox strenua*)

The Powerful Owl is the largest of the owl species in Australasia and it grows up to 65cm in length, with a wingspan up to 140cm and can weigh up to 1.45 kilograms. The upper parts of the body are dark grey-brown barred with white and pale brown. The barring is finer on the crown and courser on the wings and tail. The facemask is incomplete, dark grey-brown with white streaks. The throat and underparts are cream or pale bluff and barred with grey-brown chevron-shaped markings. The eyes are orange-yellow, the bill bone is grey, a grading to black at the tip. The toes are creamy yellow and claws are dark grey (Schodde and Tidemann, 1986).

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains, suggesting occupancy prior to land clearing (OEH, 2014).

The Powerful Owl inhabits a range of vegetation types, from woodland to open sclerophyll forest to tall open wet forest and rainforest. This species requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Breeding and hunting occur in open or closed sclerophyll forest or woodlands and occasionally hunting occurs in open habitats. It roosts by day in dense vegetation. The main prey items are medium sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider (OEH, 2014).

Estimated minimum population size in NSW is 2000 pairs (Debus 1994a, Kavanagh 1997) or at least 10,000 individuals. There have been 121 records of Powerful Owl within a 5km radius of the site. This site provides foraging habitat. No owl species were observed during the field survey and there are no suitable nesting hollows at the site.

a) *In the case of a Threatened Species, whether the action proposed is likely to have an **adverse effect** on the **lifecycle** of the species such that a **viable local population** of the species is likely to be placed at **risk of extinction**.*

***Response*:**

There is likely to be a local viable population. There are many records of Powerful Owls in the locality and there are areas of vegetation within the locality that are suitable roosting and nesting habitat.

The site and the locality are potential roosting and hunting habitat for the Powerful Owl. The foraging habitat on the site is likely to be a small part of a larger home range and there is a low likelihood that the proposed lighting will interrupt the lifecycle or result in the local extinction of this species. There is no

evidence of the Powerful Owl nesting on the site and the hollows onsite are not suitable for the Powerful Owl.

The increased lighting may increase the hunting efficiency of the Powerful Owl as they can more easily see the prey that forage under the light spill. Some of the Powerful Owl's prey may be deterred by the light or the presence of dogs at the park which will reduce the amount of prey available. It is likely that most of the small mammals at the park are accustomed to the presence of dogs and artificial light form the urban areas and will not be discouraged from using the park. The taller light poles and the solar panel poles may also provide a spot for Powerful Owls to sit while watching for prey.

The proposed lighting of the path will not affect the nesting or roosting of the Powerful Owls in the locality. The lighting may improve the hutting efficiency of the Powerful Owls at the site. Therefore, it is unlikely that the proposed lighting will have a significant adverse effects on the lifecycle of the Powerful Owl such that the viable population will be put a risk of extinction.

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

Response:
The Powerful Owl is not listed as an Endangered Population; therefore, this question is not applicable.

c) *In the case of an Endangered Ecological Community or Critically Endangered Ecological Community, whether the action proposed:*
   - *i) is likely to have an adverse effect on the extent of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction, or*
   - *ii) is likely to substantially and adversely modify the composition of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction.*

Response:
The Powerful Owl is not listed as an Endangered Ecological Community or a Critically Endangered Ecological Community; therefore, this question is not applicable.

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

Response:
(i) No Powerful Owl habitat will be removed or modified as a result of the proposal. The proposed lighting will light the pathway only and not the trees where the owls are likely to sit.

(ii) The proposal will not further fragment and isolate Powerful Owl habitat on this or adjacent properties. Powerful Owls are highly mobile and are unlikely to be deterred by the lights and the presence of dogs and people.

(iii) The site does contain foraging habitat for this species, however, there was no evidence of the species using the site for nesting and breeding. Powerful Owls have been recorded within 100 of the site on the northern side of the lagoon. No Powerful Owl habitat will be removed or modified as result of the proposal. The proposed lighting will light the pathway only and not the trees where the owls are likely to sit. There are other areas of potential Powerful Owl foraging habitat in the vicinity of the site,

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

Response:
No critical habitats have been defined for the Powerful Owl under the TSC Act (1995); therefore, this question is not applicable.

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

Response:

The Office of Environment and Heritage (OEH) has prepared a Recovery Plan for the Large Forest Owls 2006.

Priority Action Statement (PAS) to promote the recovery of Threatened species and the abatement of key threatening processes in New South Wales. The proposal is consistent with the PAS.

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

Response:
The Recovery Plan for large forest owl's states:
Threatening processes
For all three species of large forest owl, threats are listed in perceived order of severity (greatest to least) in NSW.
7.1.1 Habitat clearing and fragmentation
Forest clearing and fragmentation for agriculture, pine plantations, mining, major infrastructure and urban developments permanently remove foraging and breeding habitat, affecting all age classes of owls. Forest clearing is widespread but concentrated in the coastal lowlands and foothills on flatter terrain and on the western slopes. Small (less than 200 ha) forest fragments that are more than 1 km from large areas of forest are not used by Powerful and Sooty Owls, but may provide marginal habitat for non-breeding Masked Owls (Kavanagh 1997, Kavanagh and Stanton 2002). Clearing for agriculture in the mid-west of NSW and the demise of open forest and woodland on the coast are the major threats past and present for the Masked Owl.
The likely ability of the owls to disperse over tens of kilometres through a mosaic of forested and cleared land suggests that there are unlikely to be any barriers to gene flow within NSW. Owl populations are unlikely to have declined or been fragmented to the point where their genetic integrity is threatened. However, loss of habitat may have caused permanent regional declines and local extinctions (Debus 1994, Debus and Chafer 1994, Debus and Rose 1994). The situation has probably stabilised for the Sooty Owl, which now occurs mostly in wet escarpment forests on rugged terrain, or on public land where no further deforestation is taking place.
7.1.2 Logging
Intensive logging of wood-production forests has the potential for removing nest sites and roost sites for owls, and den sites for prey species, unless these trees can be identified and protected. Intensive logging and other silvicultural practices such as timber stand improvement, change the age structure of the forest by removing many of the older, hollow- bearing trees resulting in the development of much younger stands containing as few as 10% of the original number of hollow trees (Gibbons and Lindenmayer 1997).
***Less relevant threats listed are:** Fire, Grazing, Predation, Human hazards, Pest control, Disease and Drought.*

-

Response:

- **Loss of foraging habitat**. No habitat will be removed as a result of this proposal. The lighting of the pathway may improve the hunting efficiency of the owls at the site
- **Loss of hollow-bearing trees**. No hollows were found on the site and no trees will be removed for this proposal.
- **Disturbance of roosting habitat (particularly during winter or breeding)**. The site contains potential suitable roosting habitat for this species, however, no evidence of Powerful Owls roosting or nesting on the site was found during the site survey. The lights will be on during night-time hours and therefore are unlikely to affect any roosting owls.

Therefore, the proposal is unlikely to increase in the impact of a key threatening process to any significant extent.

Conclusions of impacts on the Powerful Owl:

Based on the current proposal described in this report, and taking into consideration the assumptions and limitations described in this report, the proposal is unlikely to have a significant impact on this species.

Further assessment in the form of a Species Impact Statement is not considered necessary for this proposal on this part of the site. This conclusion needs to be read in conjunction with the limitations and assumptions section of this report.

8.3 Assessment of Significance (7-Part Test) for Microbats

Eastern Bentwing-bat (*Miniopterus orianae oceanensis*) The Eastern Bentwing-bat is listed as vulnerable under Schedule 2 of the TSC Act. This species occupies a range of forested environments, including wet and dry sclerophyll forests, along the coastal portion of eastern Australia and through the Northern Territory and Kimberley area (Churchill 1998).

This species has a fast, level flight exhibiting swift shallow dives (Dwyer 1995). It forages from just above the tree canopy, to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component (Churchill 1998). This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behavior and winter hibernation (Gilmore & Parnaby 1994). It is reliant on large nursery caves for the rearing of its young, which occurs between October and February (Churchill 1998), with substantial numbers of bats (up to 150,000 individuals) occupying a common nursery cave during the breeding season. They often return to the same nursery site on an annual basis. The Eastern Bentwing-bat primarily roosts in caves, although it has also been recorded in mines, culverts, storm water channels and buildings (Churchill 1998), and occasionally tree-hollows. It occupies a number of roosts within specific territorial ranges usually within 300 km of the maternity cave (Churchill 1998), and may travel large distances between roost sites (Dwyer 1995).

The Eastern Bentwing-bat is threatened by a number of processes including loss of foraging habitat, damage to or disturbance of roosting caves (particularly during winter or breeding), application of pesticides in or adjacent to foraging areas, and predation by feral cats and foxes (OEH 2012b).

Potential foraging and poor quality roosting habitat for this species exists in the site.

Eastern Freetail-bat (*Mormopterus norfolkensis)* The Eastern Freetail-bat is listed as vulnerable in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This species is found along the east coast from south Queensland to southern NSW. The following information has been sourced from the OEH Threatened Species Profile for Little Bentwing-bats (OEH 2012b): Eastern freetail-bats occur in dry sclerophyll forest, woodland, swamp forest and mangrove forests east of the Great Dividing Range. This species roost mainly in tree hollows but will also roost under bark or in man-made structures. Eastern Freetail-bats are usually solitary but have been recorded roosting communally, and are probably insectivorous.

Threats to the Eastern Freetail-bats included loss of hollow-bearing trees, loss of foraging habitat and the application of pesticides in or adjacent to foraging areas.

Potential foraging and roosting habitat for this species occurs in the study area.

Little Bentwing-bat (*Miniopterus australis*) The Little Bentwing-bat is listed as vulnerable in NSW under Schedule 2 of the TSC Act and nationally under the EPBC Act. This species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. The following information has been sourced from the OEH Threatened Species Profile for Little Bentwing-bats (OEH 2012b): Little Bentwing-bats inhabit moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and Banksia scrub. They are generally found in well-timbered areas. They roost in caves, tunnels, tree hollows, abandoned mines, storm water drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common (Eastern) Bentwing- bat and, in winter, the two species may form mixed clusters. Little is known of the breeding biology of this species. Maternity colonies form in spring but only five nursery sites/maternity colonies are known in Australia. In NSW, the largest of these maternity colonies is in close association with a large maternity colony of Common Bentwing-bats (*Miniopterus schreibersii*) and it appears that the Little Bentwing-bat is dependent on the larger colony to provide the high temperatures needed to rear its young. Males and juveniles disperse in summer.

Threats to Little Bentwing-bats include predation from foxes and feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges. This species is also threatened by disturbance of colonies, especially in nursery or hibernating caves, destruction of caves that provide seasonal or potential roosting sites, changes to habitat, especially surrounding maternity/nursery caves and winter roosts and the use of pesticides.

Potential foraging and roosting habitat for this species occurs in the study area.

h) *In the case of a Threatened Species, whether the action proposed is likely to have an **adverse effect** on the **lifecycle** of the species such that a **viable local population** of the species is likely to be placed at **risk of extinction**.*

***Response*:**

There is likely to be a local viable population. The Eastern Bentwing-bat was detected on the site on two occasions during the survey. There are areas of vegetation within the locality that provide suitable roosting and nesting habitat including the nearby Pittwater Road Bridge and there are records of threatened microbats in the locality.

The microbats using the site for foraging are likely to be fast flying bats which have been known to be attracted to lights and take advantage of the surplus of insects attracted to the light (Australian Bat Society). The low illumination lighting along the pathways will unlikely deter any microbats from using the site

The lighting will not impact any roosting or breeding habitat for microbats and may improve the foraging efficiency for some bats.

The proposed lighting of the pathway is unlikely to have an adverse effect on the lifecycle of any microbats such that the viable local population is likely to be places at risk of extinction.

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

Response:

Micro-bats are not listed as an Endangered Population; therefore, this question is not applicable.

j) *In the case of an Endangered Ecological Community or Critically Endangered Ecological Community, whether the action proposed:*

iii) is likely to have an adverse effect on the extent of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction, or

iv) is likely to substantially and adversely modify the composition of the Ecological Community such that its local occurrence is likely to be placed at risk of extinction.

Response:
Micro-bats are not listed as an Endangered Ecological Community or a Critically Endangered Ecological Community; therefore, this question is not applicable.

*k) In relation to the **habitat** of a Threatened Species, Population or Ecological Community:*

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

*v) whether an area of habitat is likely to become **fragmented** or **isolated** from other areas of habitat as a result of the proposed action, and*

*vi) the **importance** of the habitat to be removed, modified, fragmented or isolated to the **long-term survival** of the species, population or ecological community in the **locality**.*

Response:

(i) No microbat habitat will be removed or modified as a result of the proposal.

(ii) The proposal would not result in further fragmentation or isolation of habitat from other areas of habitat for these species as there is a larger area of potential microbat foraging and roosting habitat south of the site.

(iii) No suitable hollow-bearing trees, caves, or storm water channels were recorded within the subject site. As the lights will be on during the night it is unlikely that they will affect any roosting microbats. The proposal may improve the foraging habitat for microbats by increasing the abundance of insects around the lights.

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

Response:
No critical habitats have been defined for microbats under the TSC Act (1995); therefore, this question is not applicable.

*m) Whether the action proposed is consistent with the objectives or actions of a **recovery plan or threat abatement plan**.*

Response:
There is currently no recovery plan or threat abatement plan for these bats. Steps that should be undertaken to facilitate the conservation and recovery of all of these species include the retention of native vegetation and known roost-sites, maintenance of connectivity among habitats and limiting the use of pesticides. The Proposal is unlikely to impact on the survival of these species.

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

Response:
Key threatening processes of relevance to these micro-bat species concerning this proposal are:

- **Loss of foraging habitat**. The proposal will not remove any habitat for microbats. The lighting may improve the foraging efficiency of the microbats at the site.
- **Loss of hollow-bearing trees**. No hollow bearing tree were found on the site. The proposal will not remove any trees.

- **Disturbance of roosting habitat (particularly during winter or breeding)**. This site may contain some potential roosting habitat for microbats and there is roosting habitat nearby. The lighting of the path will be during nigh time hours only and will not disturb any roosting bats.

Therefore, the proposal is unlikely to increase the impact of a key threatening process to any significant extent.

Conclusions of impacts on Micro-bats:

The proposal described in this report is unlikely to have a significant impact on these species. The lighting will not impact any roosting or breeding habitat for microbats and may improve the foraging efficiency for some bats. This conclusion needs to be read in conjunction with the limitations and assumptions section of this report.

9 Appendix B: EPBC Act 1999 Protected Matters Report

Australian Government

Department of the Environment

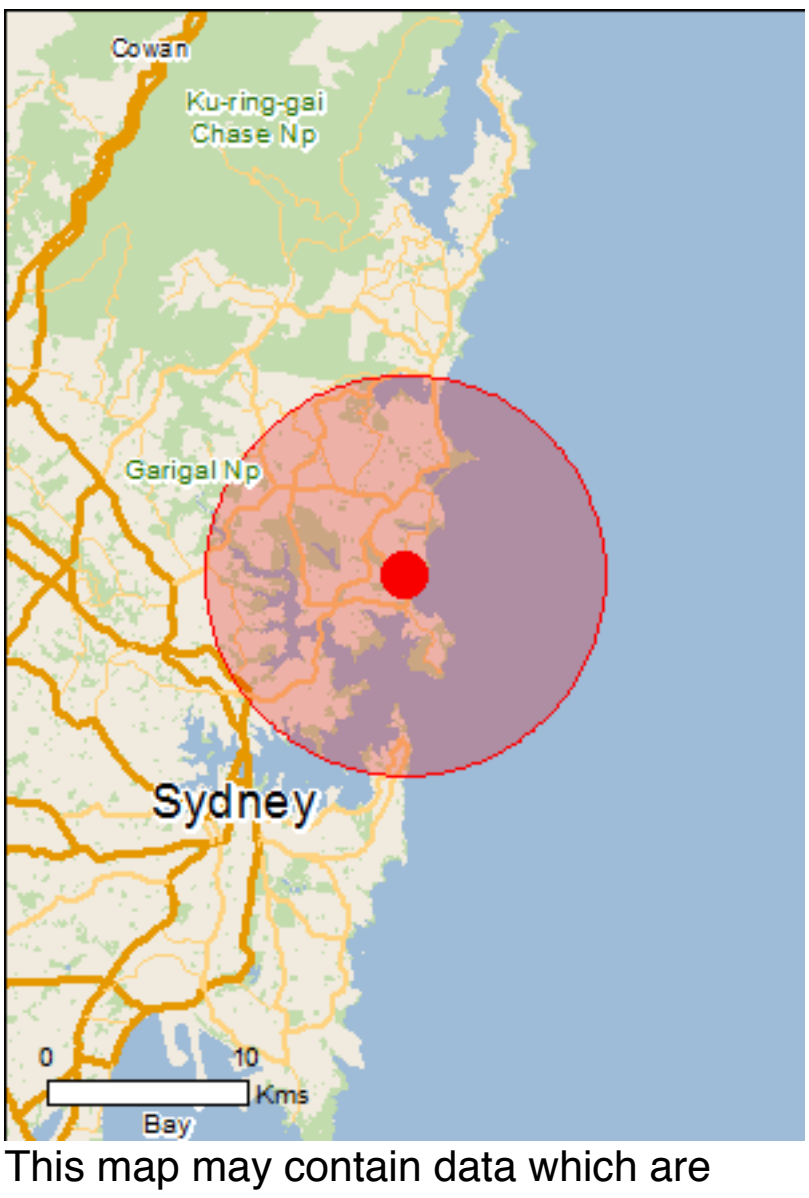
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

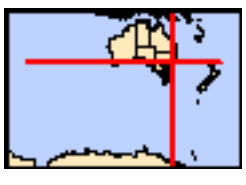
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 07/09/16 12:59:07



Coordinates

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	9
Listed Threatened Species:	78
Listed Migratory Species:	51

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	19
Commonwealth Heritage Places:	26
Listed Marine Species:	71
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	51
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Sydney Opera House - Buffer Zone	NSW	Buffer zone

National Heritage Properties [Resource Information]

Name	State	Status
Historic		
North Head - Sydney	NSW	Listed place

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
Temperate East

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Eastern Suburbs Banksia Scrub of the Sydney Region	Endangered	Community known to occur within area
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion	Endangered	Community likely to occur within area
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may

Name	Status	Type of Presence
		occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Fish		
Epinephelus daemelii Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot (Eastern) [68050]	Endangered	Species or species habitat known to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Petauroides volans		
Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae		
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Acacia bynoeana		
Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat may occur within area
Acacia pubescens		
Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat may occur within area
Acacia terminalis subsp. terminalis		
Sunshine Wattle [64829]	Endangered	Species or species habitat known to occur within area
Allocasuarina glareicola		
[21932]	Endangered	Species or species habitat may occur within area
Allocasuarina portuensis		
Nielsen Park She-oak [21937]	Endangered	Species or species habitat known to occur within area
Asterolasia elegans		
[56780]	Endangered	Species or species habitat may occur within area
Caladenia tessellata		
Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana		
Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii		
Camfield's Stringybark [15460]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Genoplesium baueri Yellow Gnat-orchid [7528]	Endangered	Species or species habitat known to occur within area
Grevillea caleyi Caley's Grevillea [9683]	Endangered	Species or species habitat likely to occur within area
Haloragodendron lucasii Hal [6480]	Endangered	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark [5583]	Vulnerable	Species or species habitat may occur within area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat may occur within area
Microtis angusii Angus's Onion Orchid [64530]	Endangered	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Persoonia hirsuta Hairy Persoonia [19006]	Endangered	Species or species habitat likely to occur within area
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat known to occur within area
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat may occur within area
Prostanthera marifolia Seaforth Mintbush [7555]	Critically Endangered	Species or species habitat known to occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat likely to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Triplarina imbricata [64543]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Hoplocephalus bungaroides		
Broad-headed Snake [1182]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (east coast population)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Species or species habitat known to occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni		
Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus		
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca		
Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sterna albifrons		
Little Tern [813]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
[Lagenorhynchus obscurus](#) Dusky Dolphin [43]		Species or species habitat may occur within area
[Lamna nasus](#) Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
[Manta alfredi](#) Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
[Manta birostris](#) Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Rhincodon typus](#) Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
[Sousa chinensis](#) Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
[Cuculus optatus](#) Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
[Hirundapus caudacutus](#) White-throated Needletail [682]		Species or species habitat known to occur within area
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat likely to occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Postal Corporation
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of Defence Service Homes
Commonwealth Land - Director of War Service Homes
Commonwealth Land - Telstra Corporation Limited
Defence - DEE WHY DEPOT
Defence - DEGAUSSING RANGE
Defence - HMAS PENGUIN
Defence - HMAS PLATYPUS - SPDU FOR DISPOSAL
Defence - HMAS WATSON
Defence - NFI CHOWDER BAY (fuel depot)
Defence - TRAINING SHIP CONDAMINE
Defence - VAUCLUSE TRAINING DEPOT
Defence - WILLOUGHBY TRG DEP

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Army Cottage with return verandah	NSW	Listed place
Barracks Group HMAS Watson	NSW	Listed place
Batteries A83 and C9A	NSW	Listed place
Battery B42	NSW	Listed place
Battery for Five Guns	NSW	Listed place
Chowder Bay Barracks Group	NSW	Listed place
Cliff House	NSW	Listed place
Commonwealth Avenue Defence Housing	NSW	Listed place
Cottage at Macquarie Lighthouse	NSW	Listed place
Customs Marine Centre	NSW	Listed place
Defence site - Georges Heights and Middle Head	NSW	Listed place
Golf Clubhouse (former)	NSW	Listed place
HMAS Penguin	NSW	Listed place
Headquarters 8th Brigade Precinct	NSW	Listed place
Headquarters Training Command Precinct	NSW	Listed place
Macquarie Lighthouse	NSW	Listed place

Name	State	Status
Macquarie Lighthouse Group	NSW	Listed place
Macquarie Lighthouse Surrounding Wall	NSW	Listed place
Marine Biological Station (former)	NSW	Listed place
Military Road Framework - Defence Land	NSW	Listed place
Navy Refuelling Depot and Caretakers House	NSW	Listed place
North Head Artillery Barracks	NSW	Listed place
Officers Mess, HQ Training Command	NSW	Listed place
Shark Point Battery	NSW	Listed place
Ten Terminal Regiment Headquarters and AusAid Training Centre	NSW	Listed place
Thirty Terminal Squadron Precinct	NSW	Listed place

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta (sensu stricto)		
Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche eremita		
Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		
Acentronura tentaculata		
Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Festucalex cinctus		
Girdled Pipefish [66214]		Species or species habitat may occur within area
Filicampus tigris		
Tiger Pipefish [66217]		Species or species habitat may occur within area
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys penicillus		
Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus abdominalis		
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus whitei		
White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]		Species or species habitat may occur within area
Histiogamphelus briggsii		
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Lissocampus runa		
Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata		
Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Notiocampus ruber		
Red Pipefish [66265]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Dugong dugon Dugong [28]		Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known

Name	Threatened	Type of Presence
		to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Garigal	NSW
Sydney Harbour	NSW

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Asparagus scandens Asparagus Fern, Climbing Asparagus Fern [23255]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. rotundata Bitou Bush [16332]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.78501 151.2842

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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10 Appendix C: Bollard Type Lighting Specifications

Controlled Lighting:

Another key feature of the EDGE series is how it cleverly conceals the LED module that is recessed within the bollard to avoid 'rear & upward' spill light, it controls the output of the light by projecting it 'downwards' directly onto the pathway and utilising a high quality 'glass optic' lens to distribute light 'asymmetrically' either side of the bollard. This maximises the luminous efficacy of the LED output ensuring light is controlled and comfortable to pedestrians and nearby wild life.

Key Benefits:

- Extra Low Voltage allows for 'OFF GRID' Solar Powered connectivity
- Easy and low cost installation compared to mains powered lighting systems
- Controlled lighting output perfect for pathways and pedestrian access areas
- Robust construction with vandal resistant LED module recessed within bollard head
- Architectural & Aesthetically pleasing design with choice of powder coating colours
- CREE 'LED' technology provides 'bright & crisp' illumination with 10 years effective life

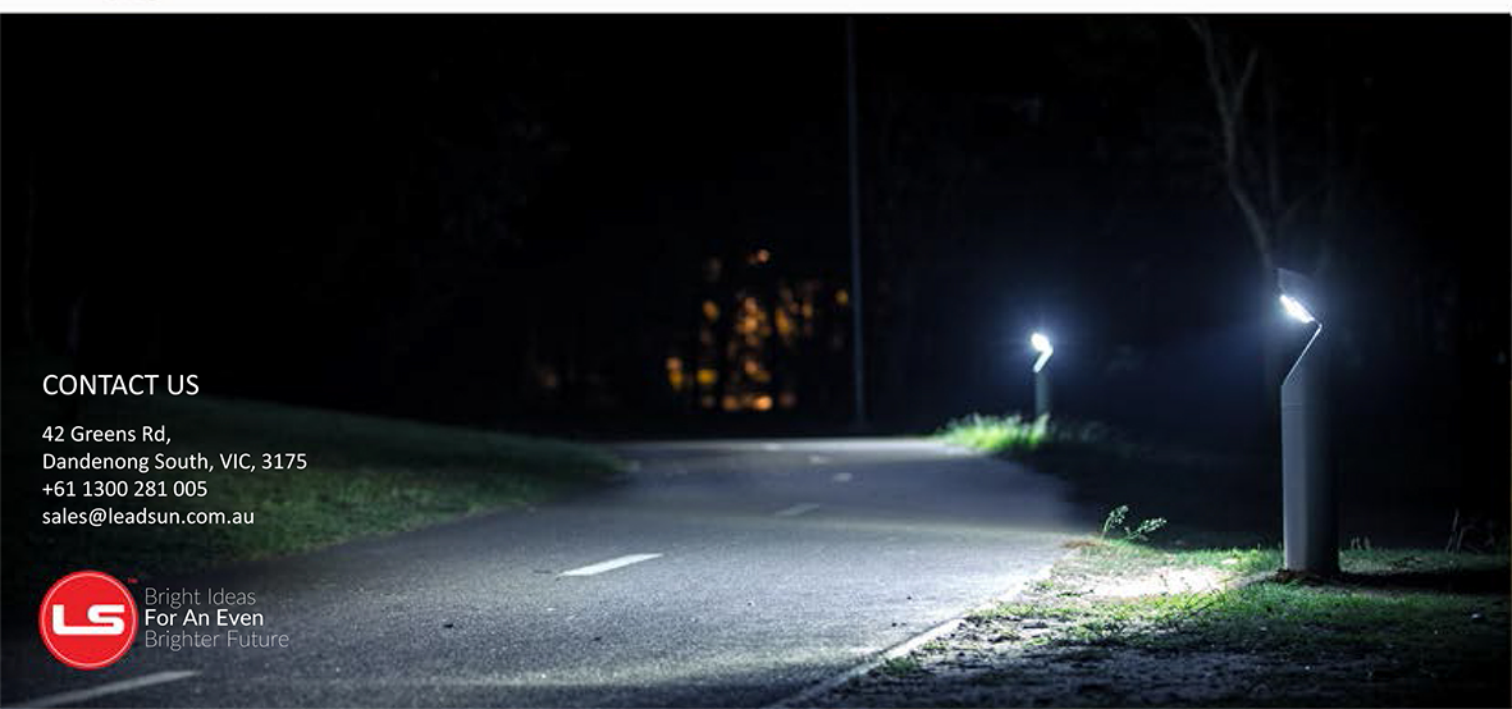
Installation

Installing the EDGE bollard is a breeze, the bollard has 3 sections that assemble together in 2 stages.

- **Footing Post:** Typically the bollard is installed within a 600mm deep concrete footing where the base section is levelled 'plumb' in readiness for the installation of the bollard post.
- **Bollard Post:** Once the base section has been installed and the concrete has cured, the bollard post 'sleeves' over the base section and is fixed together by 'theft proof' screws.
- **Bollard Head:** The final piece of assembly is connecting the incoming 24Vdc cabling directly to the internal controller.

SPECIFICATIONS:

PART NO	ED5M
LED type	'CREE' Asymmetrical distribution
Lumens	600 lumens (Scalable via programmable controller)
Material	Electroplated steel, Stainless steel
Diameter	137mm
Height	955mm
Weight	10kgs
Warranty	5 Years
IP Rating	IP67
IK Rating	IK08
Product Finish	Powder Coat, Stainless steel
Power Solutions	Off Grid 'remote' solar power utilising Leadsun's AE6 series solar engines Grid connected '24V DC' Extra Low Voltage



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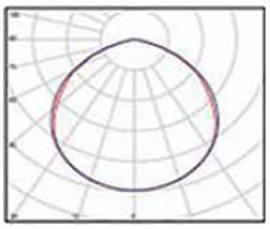
Bright Ideas
For An Even
Brighter Future

11 Appendix D: Pole Type Lighting Specifications

AE2 (Link Light) Specifications

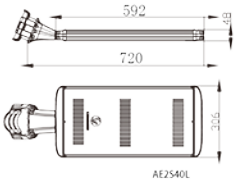
● Standard ○ Optional ／ N/A

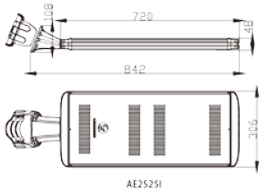
		Solar Power System			RHEA MINI LED light	
Model No		**AE2S12B6**	**AE2S25B10**	**AE2S36B16**	**LSL4-12**	**LSRM4-12**
Physical Parameters						
PV Module Power		12W	25W	36W		
Lithium Battery Capacity		5.2AH	10.4AH	16.6AH		
PIR Sensor		●	●	●		
	Bluetooth	／	／	／		
	433MH	／	／	／		
	GPRS	／	／	／		
Net Weight of Product		6.2Kg	7.6Kg	9.5Kg		
Physical Dimensions		592(L)x306(W)x48(T)mm	720(L)x306(W)x48(T)mm	1021(L)x306(W)x48(T)mm		
Light Parameters						
Light Output Factory Settings		／	／	／	4W	4W
Optical Distribution		／	／	／	Symmetrical	Symmetrical
Visual Angle		／	／	／	140' X 70'	140' X 70'
Color Temperature		／	／	／	5000K	5000K
Max. Luminous Flux		／	／	／	3600lm	3600lm
Min Working Time	Bright Mode	／	／	／	10h	6.5h
	DIM Mode (30%)	／	／	／	33h	21h
Light Photosensivity		／	／	／	30lx	30lx
Enviroment Requirement						
Charge Temperature		0'C ~ 60'C	0'C - 60'C	0'C - 60'C	／	／
Discharge Temperature		-20'C ~ 60'C	-20'C ~ 60'C	-20'C ~ 60'C	／	／
Storage Temperature		-20'C ~ 45'C	-20'C ~ 45'C	-20'C ~ 45'C	-20'C ~ 45'C	
Installation Suggest						
Recommended Installation Height		5~8m	5~8m	5~8m	3~6m	
Recommended Installation Distance		23~35m	23~35m	23~35m	25~35m	
Recommended Installation Light Pole		60~90mm	60~90mm	60~90mm	60~90mm	

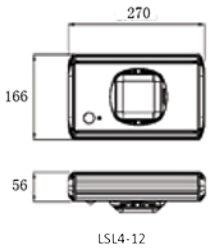


Light Distribution

Physical Dimensions







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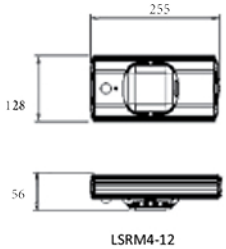

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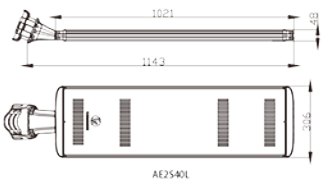

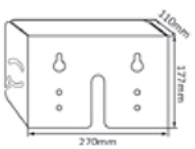

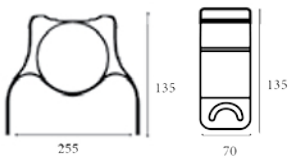

Lighthead Housing Stainless Steel
* (Anti theft light cage available)