Flora and Fauna Assessment 67 Marine Parade Avalon Beach

By Ecological Consultants Australia Pty Ltd TA

Kingfisher Urban Ecology and Wetlands

February 2020

About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia at Studio 1/33 Avalon Parade, Avalon. The author of the report is Geraldene Dalby-Ball with qualifications BSc. majoring in Ecology and Botany with over 20 years' experience in this field, and Jack Hastings with qualifications B EnvSc.

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

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Signed: Geraldene Dalby-Ball – Director of Ecological Consultants Australia 

Executive Summary

Introduction

- This Flora and Fauna was prepared for Matthew Root of Keith Root Building Services for the proposed development at 67 Marine Parade Avalon Beach NSW 2107.
- The proposed actions involve the modification of the existing dwelling. This will include the construction of a room on pylons that will be east of the existing building.
- Recommendations have been provided to reduce the likelihood of impact on Flora and Fauna and mitigate loss if the proposal is approved.

Methods

- On-ground survey took place on the 17th December 2019 by Senior Ecologist Geraldene Dalby-Ball.
- Flora and fauna observations were recorded on-site using binoculars and physical examination. Notes, photos and samples of flora species were taken to assess ecological health and value of the site.
- Bionet searches were performed for flora, fauna and endangered populations to identify if there were previous records of threatened species occurring within the local area using a 10km radius around the site.

Results

- The footprint of the proposed dwelling is located east of the current dwelling with an approximate impact area of 132m^2.
- The proposal does not trigger the Biodiversity Offset Scheme (BOS).
- Weeds of National Significance (WoNS) are present onsite. Weeds to remove as a priority are: Asparagus fern (*Asparagus aethiopicus*) and Bitou bush (*Chrysanthemoides monilifera*).
- The Endangered Ecological Community (EEC) of *Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions* is assumed present at the site and therefore a 'test of significance was conducted (appendix VI).
- No threatened flora or fauna species were found on-site during on site searches.

Conclusions and Recommendations

- Weed removal and native landscaping could enhance the habitat connectivity of the site.
- The overall health of the EEC onsite is marginal and the approximate impact area is 3 m x 3.5m. It is expected that the development will not place the EEC at risk of extinction.
- Delineation of works areas.
- Although not crucial, Installation of a single nest box designed for micro bats should be added to the site.

Mitigation Measures

Before works:

- Removal of weed species to prevent spread of seed.
- Effective site management to ensure sediment doesn't leave the site.

During works:

- Care must be given to preserve native species being retained.
- Protect the retained sandstone outcrops for habitat
- Bush hygiene protocols should be followed to prevent the spread of pathogens including *Phytophthora*.

After completion of works:

- Landscaping works will be conducted, native species recommended.
- Management of the sites interface with the EEC.

Legislation: Various pieces of legislation apply to this location and the proposed works are in keeping with the objective of the Acts. Key acts are listed below.

- *Cwlth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).*
- *Environmental Planning and Assessment Act 1979 (EP&A Act).*
- *Biodiversity Conservation Act 2016 (BC Act).*
- *National Parks & Wildlife Act 1974 (NP&W Act).*
- *Biosecurity Act (superseding the Noxious Weed Act 1993) (NW Act).*

Table of Contents

1 Introduction

Kingfisher Urban Ecology & Wetlands (Kingfisher) has been contracted by Matthew Root of Keith Root Building Services to provide a "Flora and Fauna Assessment" to assess potential direct and indirect impacts on any threatened species, populations and communities as per section 5A of the Environmental Planning & Assessment Act 1979. The 'test of significance' has been undertaken in accordance with the NSW Department of Planning, Industry and Environment (DPIE) 'threatened species test of significance'. The test of significance is set out in s. 7.3 of the Biodiversity Conservation Act 2016 (BC Act).

1.1 Site Location

The study area is 67 Marine Parade, Avalon Beach NSW 2107, Australia (see Figure 1).

Figure 1. Location of the site. Source: Six Maps, 2019.

1.2 Ecology of the site

An existing building currently occupies the site to the west. The remaining 60% of the site to the east is vegetated with a mix of native and exotic species.

1.3 Catchment Context

There are no creeks or waterways onsite. The site falls within the Careel Creek catchment. Careel Creek flows north from Avalon into Pittwater (figure 1.1).

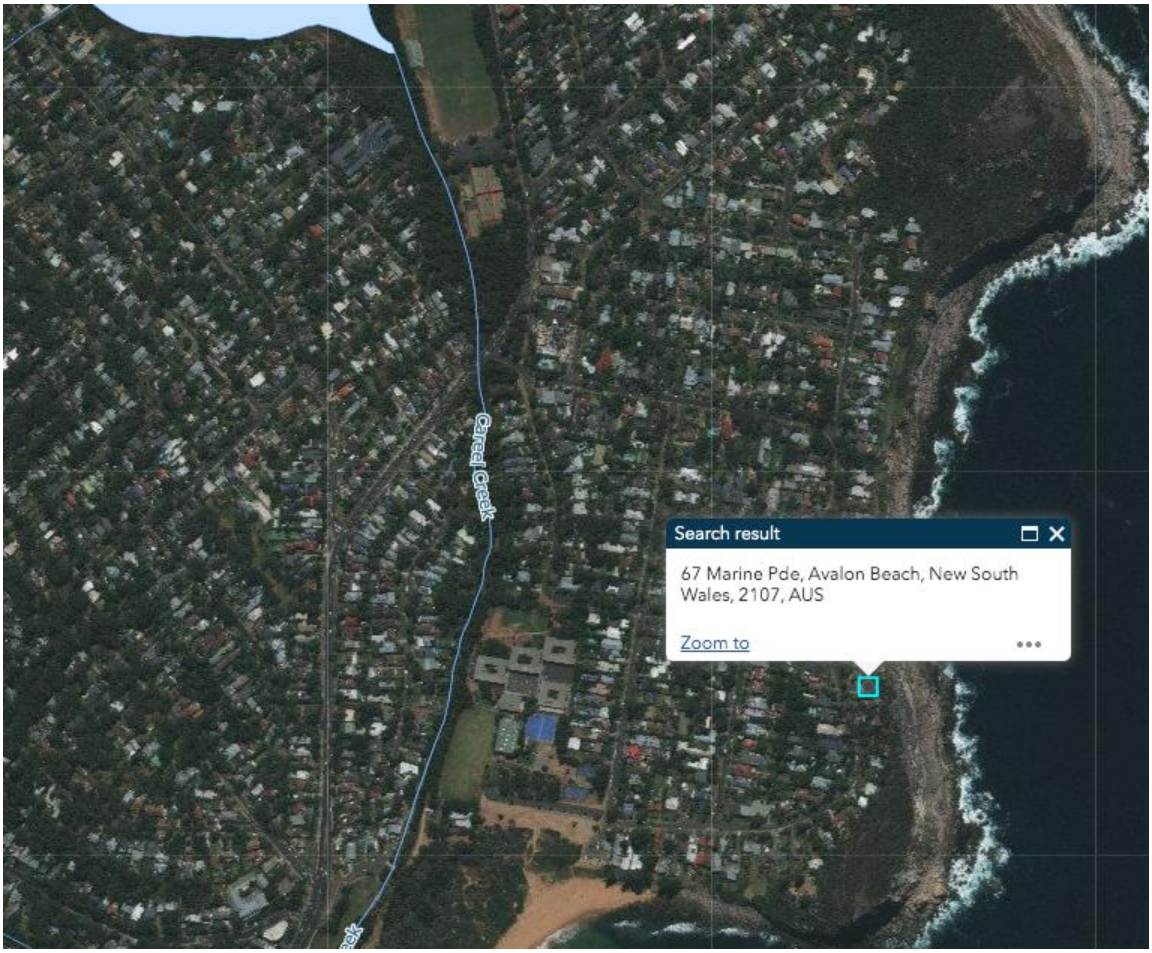


Figure 1.1. The site within the Careel Creek catchment. Careel Creek flows north from Avalon into Pittwater. (Source: Hydro line spatial data, DPIE 2020).

1.4 Geology and Soil Landscapes

NSW soil mapping service (eSPADE) has identified the soil landscape at the site as Watagan. Watagan forms part of the Narrabeen soils group. Identified as comprising of mostly interbedded laminite and shale with quartz to lithic quartz sandstone.

Sandstone is prominent throughout the site and will be retained. There was no evidence of aboriginal heritage as most sandstone were floaters that were angled, not flat.

1.5 Vegetation

The site hosts several weed species two of which are Weeds of National Significance (WoNS) (section 4.2.3). The native vegetation onsite is in poor condition as a result of weed invasion. The Endangered Ecological Community (EEC) of *Themeda grassland on seacliffs and coastal headlands* is assumed present onsite and a test of significance has been conducted (appendix VI).

2 Proposed Actions

The proposed actions involve the modification of the existing dwelling. This will include the construction of a room on pylons that will be east of the existing building (figure 1.2). The proposed development will reach the black fence shown in figure 1.3 below. Sandstone onsite will be retained with the proposed development being on peers above it.

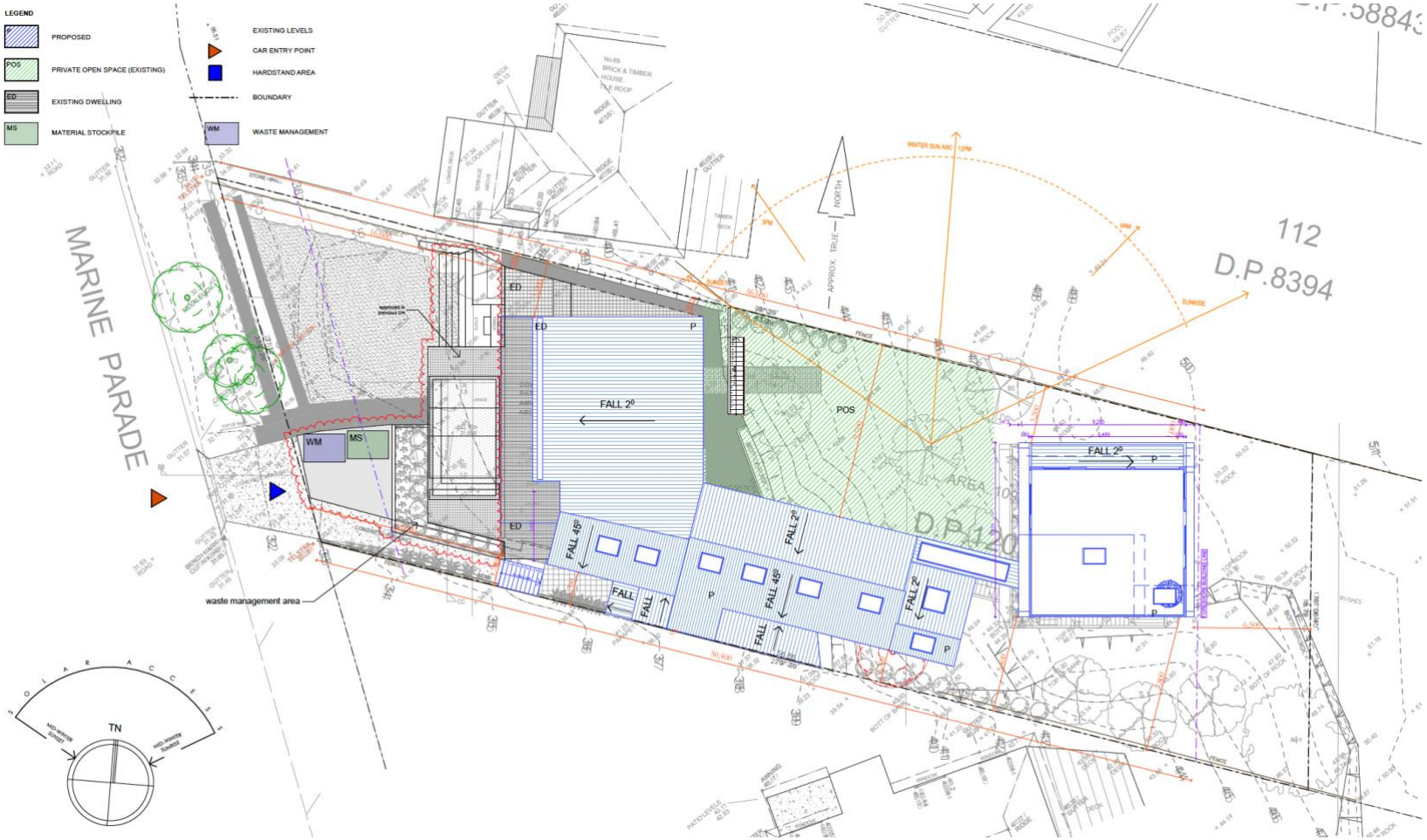


Figure 1.2. The proposed development (*Source –sketchArc -7/2/20)*

2.1 Photos from the site

Figure 1.3. *Themeda australis* in the rear (eastern) portion of the site. Photo looking west towards the development area, beyond the black fence.

Figure 1.4. Sandstone onsite show no signs of indigenous heritage, all angled or floating.

Figure 1.5. Tree being supported by rope.

2.2 Legislation and policy

The implications for the proposal were assessed in relation to key biodiversity legislation and policy including:

- *Cwlth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is applicable 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 Environment and Heritage.

Matters of national environmental significance identified in the Act are:

- world heritage properties;
- national heritage places;
- Ramsar wetlands;
- nationally threatened species and communities;
- migratory species protected under international agreements;
- the Commonwealth marine environment; and
- nuclear actions.

The Commonwealth Government has published Significant Impact Guidelines (DE 2013) to assist in the determination of whether an action is likely to have a significant impact on a matter of NES. The proposal does not impact on a 'matter of National Environmental Significance' and therefore is compliant with the EPBC Act.

- *Environmental Planning and Assessment Act 1979 (EP&A Act).*

The EPA Act requires that the assessing body, in this case local government, consider the impact of the development on the surroundings – with respect to this ecology report the impacts on the environment are assessed. The proposal indicates no significant impact on threatened species, populations or communities.

- *Biodiversity Conservation Act 2016 (BC Act).*

Recently replacing the Threatened Species Conservation Act this includes the test of significance for impacts on threated species, communities. The test of significance have been conducted and the proposal was found to not have a significant impact on the current ecology of the site. The proposed development is complaint with the BC Act.

- *National Parks & Wildlife Act 1974 (NP&W Act).*

The proposed development is complaint with the NP&W Act.

- *Biosecurity Act (superseding the Noxious Weed Act 1993) (NW Act).*

The Biosecurity Act replaced the Noxious Weeds Act and the objectives of this Act are to manage, and eradicate and Weeds that cause a high level of environmental, economic or social harm. With the removal of and management of weeds the sites work with be complaint with the objectives of this Act.

2.1.1 Biodiversity Offsets Scheme Threshold

The Biodiversity Offsets Scheme (BOS) is a test used to determine when it is necessary to engage an accredited assessor to apply the Biodiversity Assessment Method (the BAM) and thus evaluate the impacts of a proposal.

It has been concluded that the development does not trigger the BOS area clearing threshold nor is the site located on the BV map. The area clearing threshold trigger is based on the minimum lot size associated with the property (<1Ha) and the thresholds for clearing which triggers BOS (0.25Ha or more). The building footprint will not remove more than 0.25Ha of native vegetation therefore the development does not trigger the BOS.

Area clearing threshold

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
1 ha to less than 40 ha	0.5 ha or more
40 ha to less than 1000 ha	1 ha or more
1000 ha or more	2 ha or more

Minimum lot size associated with site is <1Ha and the development will not clear >0.25Ha of vegetation.

Thus, the BOS area clearing threshold does not apply.

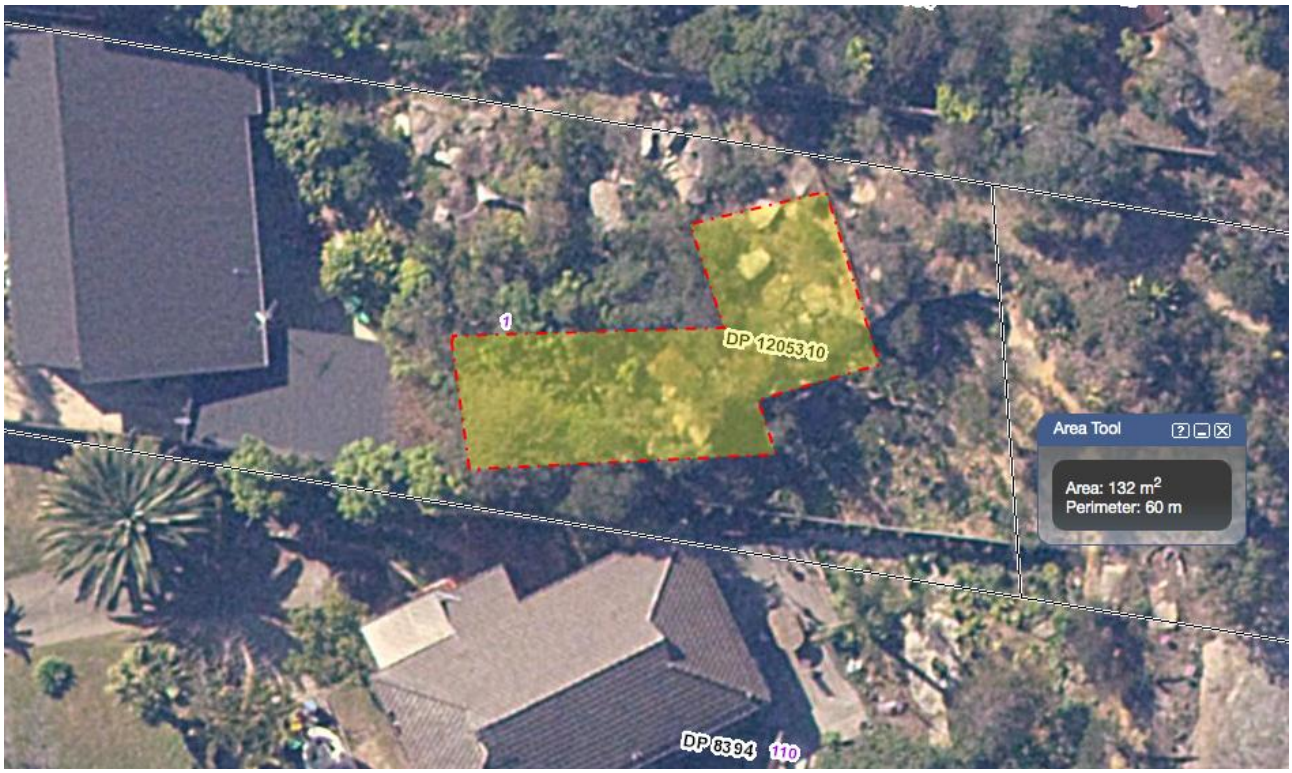
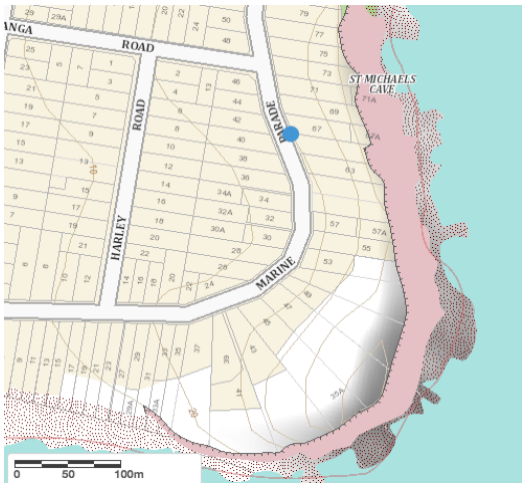


Figure 2.0. Building impact area of approximately 132m^2.

Biodiversity Values Map threshold

The Biodiversity Values (BV) Map identifies land of high biodiversity value, as defined by clause 7.3(3) of the Biodiversity Conservation Regulation 2017. The Biodiversity Offsets Scheme applies to clearing of native vegetation and other biodiversity impacts prescribed by clause 6.1 of the Biodiversity Regulation 2017 on land identified on the map.

 **Figure 2.2. The site (blue dot) located on the BV map**	The site (blue dot) is not located on high biodiversity value land as identified on the Biodiversity Values Map. Therefore, the development does not trigger the BOS as per the Biodiversity Values Map threshold.

2.3 Scope of Flora and Fauna

To provide a flora and fauna assessment for assessing the potential direct and indirect impacts of any threatened species, populations and communities on the site. This includes applying the threatened species test of significance' which is set out in s. 7.3 of the Biodiversity Conservation Act 2016 (BC Act). The assessment will also include other ecological impacts and providing recommendations for mitigating these.

The objectives of this Flora and Fauna Impact Assessment are to:

- Identify any native vegetation communities, significant species or significant habitat features present within the study area.
- Identify any known or potential habitat for threatened species.
- Review the implications of relevant biodiversity legislation and policy.
- Identify potential impacts on significant ecological communities, species or habitats from the proposed development and provide recommendations to assist with the mitigation of those potential impacts during the construction and operation stages.
- Targeted searches for significant species are based on the authors' knowledge of the site.

Works included a site survey/assessment, review of project design and any additional reports and review of available literature to produce site specific ecological and environmental effects report.

2.4 Limitations of the Study

Limitations of the study may arise where certain cryptic species of plants may occur as soil-stored seed or as subterranean vegetative structures. Some species are identifiable above-ground only after particular environmental circumstances related to factors such as periodic fire frequency, intensity or seasonality, soil moisture regime, biological life-cycle patterns as in the case of small plants such as species of orchids etc. No specific invertebrate surveys were conducted.

Surveys at one time of the year cannot be expected to detect the presence of all species occurring, or likely to occur, in the study area. This is because some species may (a) occur seasonally, (b) utilise different areas periodically (as a component of a more extensive home range), or (c) become dormant during specific periods of the year. Rather, the survey provides the opportunity to sample the area, search specifically for species likely to be encountered within the available time frame and assess the suitability of habitat for particular species.

Considering the site and habitat availability Kingfisher are confident that this survey is representative of the likely species and vegetation community and that future studies at other times would not change the conclusions in this report.

3 Methods

3.1 Site Inspections

Senior Ecologist Geraldene Dalby-Ball assessed the site on the 17th December 2019. Weather was fine and sunny during time of visit. During site visits, notes and photos were taken of the important vegetation types, flora and fauna present. Due to the small area of proposed impacts, detailed or systematic surveys were not performed. Surveys were general and opportunistic in nature and were performed by traversing the site. Surveys included one diurnal bird and fauna survey, a single vegetation survey and a general habitat survey in which fauna habitat resources were identified.

3.2 Previous studies

Bionet, previous studies and the author's knowledge of the local area, were used to determine the possible occurrence of endangered ecological communities and threatened plant species on-site. The Bionet records accessed cover a 10km^2 area extending from the site and include recordings from 1993 to the present day.

Records from the following databases were collated and reviewed:

- Atlas of NSW Wildlife (Bionet). New South Wales, Department of Planning, Industry and Environment (DPIE).
- NSW Threatened Species Information (DPIE).
- The Native Vegetation of the Sydney Metropolitan Area - Version 3.1 (OEH, 2016) VIS_ID 4489.
- PlantNET (The Royal Botanic Gardens and Domain Trust 2014).
- Protected Matters Search Tool of the Australian Government Department of the Environment (DoE) for matters protected by the Cwlth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

4 Flora

The purpose of the flora work was an investigation to determine the flora composition of the site, particularly vulnerable and endangered species. It also included an assessment of the flora as habitat. Furthermore, an

assessment of potential impact of the development with a determination of native ground and shrub was conducted.

4.1 Threatened flora

BioNet records within 10km of the study site had 9 species currently listed as vulnerable or endangered under state and/or commonwealth legislation. The vulnerable and endangered species to focus on-site searches for can be seen in **Table 2** below. This is based on likelihood of occurrence.

Table 2. Threatened flora recorded within a 10km radius since 1993. Source: NSW OEH Bionet 2019.

Family	Scientific Name	Common Name	NSW status	Comm. status	Records
Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E1		2
Myrtaceae	*^^Callistemon linearifolius*	Netted Bottle Brush	V,3		2
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	3
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	E4A		4
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E1	V	14
Orchidaceae	*^Genoplesium baueri*	Bauer's Midge Orchid	E1,P,2	E	3
Proteaceae	*^^Persoonia hirsuta*	Hairy Geebung	E1,P,3	E	3
Rutaceae	*Asterolasia elegans*		E1	E	1
Rutaceae	*Boronia umbellata*	Orara Boronia	V,P	V	1

Note: E = Endangered, V = Vulnerable, P = Protected.

Search criteria: Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Plants in selected area [North: -33.58 West: 151.29 East: 151.39 South: -33.68] returned a total of 33 records of 9 species. Report generated on 14/01/2020 5:00 PM.

4.2 Flora Findings from Site Investigations

4.2.1 Threatened plant species findings

No threatened plant species were found during site assessments.

4.2.2 Observed Flora

During the site visit a variety of native flora was observed. In total 14 native species were recorded onsite.

Table 3. Flora observed during the ecological assessment.

Scientific Name	Common Name
Themeda triandra	Kangaroo grass
Kunzea capitata	Kunzea
Dianella caerulea	Blue Flax-lily
Dodonaea triquetra	Hop Bush
Angophora hispida	Dwarf Apple
Angophora floribunda	Rough-barked Apple
Lomandra longifolia	Spiny-headed Mat-rush
Banksia serrata	Old Man Banksia
Allocasuarina littoralis	Coastal Sheoak
Westringia fruticosa	Coastal Rosemary
Pittosporum undulatum	Australian Cheesewood
Glochidion ferdinandi	Cheese Tree
Callistemon citrinus	Crimson Bottlebrush
Hardenbergia violacea	Native Lilac

N/A: None of these are listed at a State or Federal level as endangered species.

4.2.3 Notable weeds

Several weed species were recorded onsite, some of which are Weeds of National Significance (WoNS) as listed by the Department of the Environment and Energy.

Table 3.1 Weeds within the subject site.

Scientific Name	Common Name	WoNs
Lonicera japonica	Honeysuckle	No
Phoenix spp.	Phoenix palms	No

Scientific Name	Common Name	WoNs
Bambusoideae	Bamboo	No
Asparagus aethiopicus	**Asparagus fern**	**Yes**
Chrysanthemoides monilifera	**Bitou bush**	**Yes**
Conyza bonariensis	*Conyza*	No
Ehrharta erecta	Panic Veldt Grass	No

4.2.4 Endangered Ecological Community

No individual species onsite are listed as threatened under state or federal legislation. The Endangered Ecological Community (EEC) of *Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions* is assumed present at the site. Therefore a 'test of significance was conducted to determine the impact of the development on the community (see appendix VI).

4.2.5 Summary Test of significance for *Themeda grassland on seacliffs and coastal headlands.*

The overall health of the vegetation community onsite is marginal and the approximate impact area is 3 m x 3.5m. Vegetation onsite is not significantly contributing to EEC habitat connectivity across the landscape or upholding critical habitat features. There is a high abundance of weeds onsite as the area has previously been disturbed. It is expected that the development will not place the EEC at risk of extinction.

4.2.6 Tree Removal

Two trees (*Banksia integrifolia* and *Angophora hispid*a) are proposed for removal as they are within the building footprint. They are not providing significant habitat opportunities (breeding or foraging) for native fauna which may be present in the area. See figure 3 below for their location. Native species landscaping is set to offset impacts of vegetation removal.

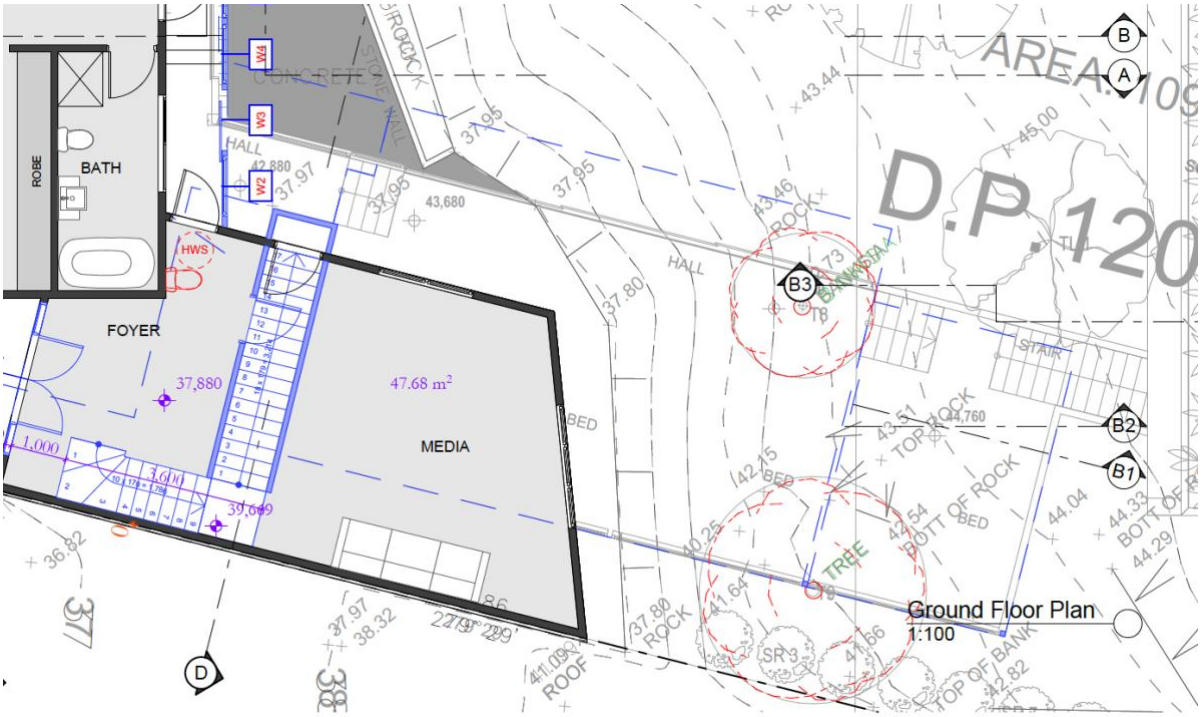


Figure 3. The two trees (*Banksia integrifolia and Angophora hispida*) within the building footprint proposed for removal.

5 Fauna

5.1 Threatened fauna

BioNet records within 10km of the study site had 52 fauna species currently listed as vulnerable or endangered under state and/or commonwealth legislation. The vulnerable and endangered species to focus on-site searches for can be seen in **Table 4** below. This is based on likelihood of occurrence.

Table 4. Threatened fauna observed in previous ecological surveys within a 10km radius since 1993. Source: NSW OEH Bionet 2019.

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Amphibia	*Pseudophryne australis*	Red-crowned Toadlet	V,P		6
Reptilia	*Caretta caretta*	Loggerhead Turtle	E1,P	E	4
Reptilia	*Chelonia mydas*	Green Turtle	V,P	V	5
Reptilia	*Eretmochelys imbricata*	Hawksbill Turtle	P	V	2
Reptilia	*Varanus rosenbergi*	Rosenberg's Goanna	V,P		1
Aves	*Ptilinopus regina*	Rose-crowned Fruit-Dove	V,P		1
Aves	*Ptilinopus superbus*	Superb Fruit-Dove	V,P		2
Aves	*Diomedea exulans*	Wandering Albatross	E1,P	E,J	3
Aves	*Diomedea gibsoni*	Gibson's Albatross	V,P	V	1
Aves	*Thalassarche cauta*	Shy Albatross	V,P	V	3
Aves	*Thalassarche melanophris*	Black-browed Albatross	V,P	V	1
Aves	*Ardenna carneipes*	Flesh-footed Shearwater	V,P	J,K	1
Aves	*Macronectes giganteus*	Southern Giant Petrel	E1,P	E	1
Aves	*Ixobrychus flavicollis*	Black Bittern	V,P		1
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V,P	C	34
Aves	*^^Lophoictinia isura*	Square-tailed Kite	V,P,3		1
Aves	*^^Pandion cristatus*	Eastern Osprey	V,P,3		3
Aves	*Burhinus grallarius*	Bush Stone-curlew	E1,P		48
Aves	*Haematopus fuliginosus*	Sooty Oystercatcher	V,P		4
Aves	*Numenius madagascariensis*	Eastern Curlew	P	CE,C,J,K	8
Aves	*^^Callocephalon fimbriatum*	Gang-gang Cockatoo	V,P,3		1
Aves	*^Calyptorhynchus lathami*	Glossy Black-Cockatoo	V,P,2		11
Aves	*Glossopsitta pusilla*	Little Lorikeet	V,P		3

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Aves	^^*Lathamus discolor*	Swift Parrot	E1,P,3	CE	1
Aves	^^*Ninox connivens*	Barking Owl	V,P,3		9
Aves	^^*Ninox strenua*	Powerful Owl	V,P,3		178
Aves	^^*Tyto novaehollandiae*	Masked Owl	V,P,3		2
Aves	^*Dasyornis brachypterus*	Eastern Bristlebird	E1,P,2	E	1
Aves	*Anthochaera phrygia*	Regent Honeyeater	E4A,P	CE	1
Aves	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		1
Aves	*Petroica boodang*	Scarlet Robin	V,P		1
Mammalia	*Dasyurus maculatus*	Spotted-tailed Quoll	V,P	E	2
Mammalia	*Isoodon obesulus obesulus*	Southern Brown Bandicoot (eastern)	E1,P	E	1
Mammalia	*Phascolarctos cinereus*	Koala	V,P	V	70
Mammalia	*Phascolarctos cinereus*	Koala in the Pittwater Local Government Area	E2,V,P	V	70
Mammalia	*Cercartetus nanus*	Eastern Pygmy-possum	V,P		5
Mammalia	*Petaurus norfolcensis*	Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	E2,V,P		1
Mammalia	*Petaurus norfolcensis*	Squirrel Glider	V,P		1
Mammalia	*Petauroides volans*	Greater Glider	P	V	1
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	V,P	V	90
Mammalia	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V,P		3
Mammalia	*Chalinolobus dwyeri*	Large-eared Pied Bat	V,P	V	2
Mammalia	*Myotis macropus*	Southern Myotis	V,P		4
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		2
Mammalia	*Dugong dugon*	Dugong	E1,P		1
Mammalia	*Arctocephalus forsteri*	New Zealand Fur-seal	V,P		1
Mammalia	*Arctocephalus pusillus doriferus*	Australian Fur-seal	V,P		2
Mammalia	*Eubalaena australis*	Southern Right Whale	E1,P	E	2
Mammalia	*Megaptera novaeangliae*	Humpback Whale	V,P	V	15
Mammalia	*Physeter macrocephalus*	Sperm Whale	V,P		1

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Mammalia	*Miniopterus australis*	Little Bent-winged Bat	V,P		8
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V		16

Note: E = Endangered, V = Vulnerable, P = Protected. Species in bold have been identified as having appropriate habitat present on-site.

Public Report of all Valid Records of Threatened (listed on TSC Act 1995) or Commonwealth listed Animals in selected area [North: -33.58 West: 151.29 East: 151.39 South: -33.68] returned a total of 637 records of 52 species. Report generated on 14/01/2020 5:02 PM.

Likelihood of occurrence

The habitat suitability is a broad categorisation used by Kingfisher to indicate the potential for a species to occur within the study area. It is based on expert opinion and implies the relative value of a study area for a particular species. See Appendix I for rational lists of what threatened fauna species may occur on site due to habitat preferences and whether the site offers these habitat features.

During the survey, none of the above threatened species were observed on-site. However, marginal foraging habitat for the Microbats, Spotted Tail Quoll and Bush-stone Curlew may be present as they have all been recorded within 2km of the site.

5.1 Endangered populations

Two endangered populations have been recorded to occur within 10km of the site. Table 5 outlines these populations. It is unlikely that either of these populations would occur at the site due to habitat requirements and site accessibility. See Appendix I for rationale.

Table 5. Endangered Populations in the LGA. Source NSW OEH Bionet 2019.

Endangered Population	Scientific Name	NSW Status	Comth. Status	No. of records
Koala in the Pittwater Local Government Area	*Phascolarctos cinereus*	E2,V,P	V	70
Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	*Petaurus norfolcensis*	E2,V,P		1

5.2 Fauna findings from site assessment

Table 6 provides a list of vertebrate fauna recorded during the site visit.

Table 6. Fauna recorded within the site.

Class	Scientific Name	Common Name	NSW Status	Comth. Status
Reptilia	*Eulamprus quoyii*	Eastern Water-skink	P	
Reptilia	*Lampropholis sp.*	unidentified grass skink	P	
Aves	*Lopholaimus antarcticus*	Topknot Pigeon	P	
Aves	*Dacelo novaeguineae*	Laughing Kookaburra	P	
Aves	*Manorina melanocephala*	Noisy Miner	P	
Aves	*Cracticus tibicen*	Australian Magpie	P	

Note - None of these species are listed as threatened under wither State or Federal legislation.

5.2.1 Fauna habitat

A number of potential habitat features were identified onsite during the site assessment.

Habitat and fauna signs present on-site. Photos are outside of impacts area, looking west downslope.

Possible invertebrate and reptile habitat

Possible invertebrate and reptile habitat

Plate 1. Habitat features of the site, primarily for reptiles.

Flowering Eucalypts and Mangroves

The site contains *Angophora sp* which could potentially be providing foraging resources for the threatened Grey Headed Flying Fox and microbats. It is unlikely that either species is reliant on the site due it is small area and lack of nesting features.

Rocks

The site holds sandstone rocks providing habitat for a number of invertebrates and reptiles.

5.3 Habitat Corridors

Study of aerial imagery of the site and the surrounding landscape and land use suggest that it is unlikely that the site is being used by fauna as a habitat corridor other than by highly mobile and aerial species (see Figure 4). The vegetation surrounding the site is highly urbanised.

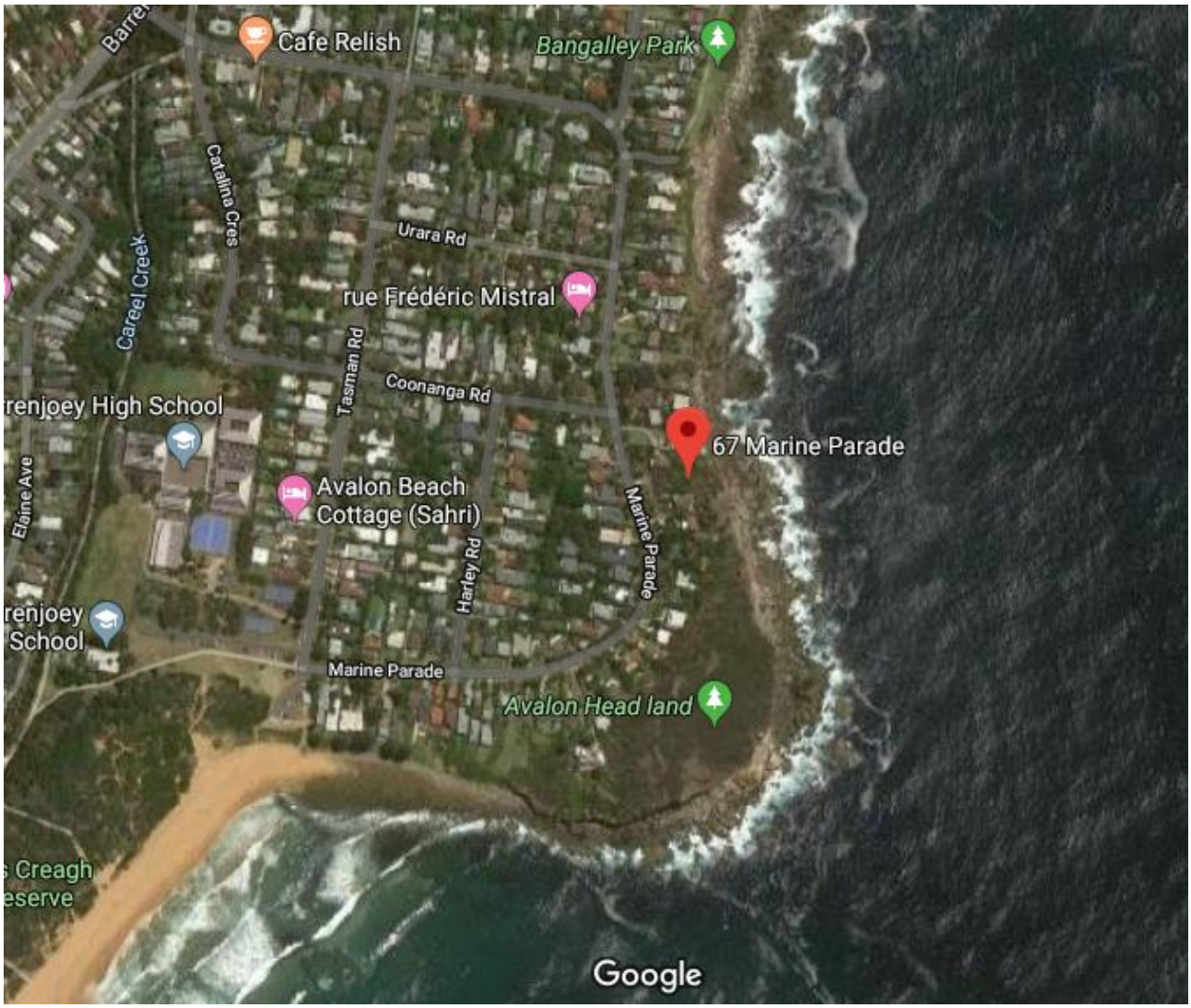


Figure 4. Habitat Corridor Connectivity in the wider area. Source: Google Maps 2019.

6 Bushfire

The Bushfire Assessment Report for the property, by Building Code and Hazard Solution PTY LTD, (2019) has concluded that the following;

The bushfire hazard was identified as being located within neighbouring private allotments to the south of the proposed works. The vegetation posing a hazard was determined to be Scrub.

The proposed alterations and additions were found to be located >30 metres from the hazard interface. The Asset Protection Zone includes land within the subject property and land “equivalent to an Asset Protection Zone” within neighbouring private allotments. All grounds within the subject property not built

upon will be maintained as an Asset Protection Zone (Inner Protection Area). as detailed in the NSW Rural Fire Service's document 'Standards for Asset Protection Zones' and Appendix 2 of Planning for Bush Fire Protection 2006.

7 Impacts

7.1 Direct Impacts

7.1.1 Vegetation disturbance

Two Trees will be removed as they fall within the development footprint. These trees are not of habitat significance for species in the area. The proposed building will be erected on pylons above the ground therefore vegetation will experience increase shading.

7.2 Indirect Impacts

The proposed actions may result in a range of indirect impacts affecting species or communities.

7.2.1 Weed growth and invasion

Weed species may arise within the direct works zone through soil disturbance or by being brought in as seed on work machinery, tools, equipment and worker clothes (e.g. boots). Soil disturbance combined with the elevated nutrients and increased light exposure may result in increased weed growth, aggravated by the high abundance of weeds present pre-works.

7.2.2 Introduction of pathogens

The introduction of pathogens may occur into the site, via machinery, tools, equipment and worker clothing (e.g. boots). Diseases to watch out for include Phytophthora (also known as Root Rot – type of water mold) and Myrtle Rust (*Puccinia psidii* – type of fungus). See Appendix III for methods to control selected pathogens.

7.2.3 Construction Noise

The proposed actions may result in a large amount of construction noise which may result in minor disturbance to sensitive fauna in the local canopy and adjacent bushland nearby. Construction disturbance may also result in fewer aerial fauna species frequenting the site for the duration of works.

8 Recommendations

8.1 Mitigation Measures

8.1.1 Delineation of work areas

During construction, impacts on the site and adjacent vegetation should be minimized by the delineation of works zones. Access to the site would be best restricted to small passageways avoiding native vegetation to prevent soil disturbance in general and damage to native vegetation. Access will be restricted to disturbed open areas.

8.1.2 Tree Protection

Tree protection will be consistent with industry standards, an ecologist or arborist can provide direction on tree protection. Main trees to be managed are trees within proximity to building works.

8.1.3 Weed management, bush regeneration and planting

Weed management and native species landscaping is recommended to increase the habitat value of the site.

8.1.4 Erosion and runoff

Where required, sediment controls will be put in place. These will include, but not be limited to sediment fences, jute matting and crushed sandstone. Sediment controls will be reviewed during site inspections and/or after significant rainfall (more than 10mm in 24hrs resulting in site runoff).

8.1.5 Weed Removal Techniques

Weed removal proposed for the site will consist of hand removal techniques, manual/mechanical removal using bush regenerator tools and winter thermal (flame) weeding. This approach will reduce the amount of herbicide used and reduce the amount of off-target damage through spot on application.

Woody perennial weeds less than 2 metres in height will require cut and paint or scrape and paint bush regenerator techniques based on the germinating/epicormic behaviour of the plant (especially plants that tend to coppice or sucker).

It is recommended that seed heads are removed prior to commencement of primary works. This would be best performed carefully by hand with secateurs with the aim of avoiding the spread flowers or seeds into planting zones. See Appendix II for further details.

8.1.6 Native Seed Collection

Any native trees or shrubs being removed for the construction works should be checked for seeds during removal works. If seeds are present, they should be collected and used off-site, location to be determined with council.

8.1.7 Nest boxes

Although it is not critical, installation of a single nest box designed for microbats should be added to the site to replace potential loss of roosting habitat.

Image from: nestboxes.com.au

8.1.8 Pathogen prevention

To prevent the introduction of pathogens, Bushland Hygiene Protocols outlined in Appendix V should be followed. The site is considered to be an area which may promote the spread of Phytophthora (a group of fungus-like diseases affecting plants) due to its moist soil and proximity to water. It is recommended that Bushland Hygiene Protocols be followed closely.

Phytophthora infected vegetation. (Image by Rasbak, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported, 2.5 Generic, 2.0 Generic and 1.0 Generic license.)

Myrtle Rust generally infects new leaf growth. (Image by John Tann, licensed under the Creative Commons Attribution 2.0 Generic license.)

8.2 Appendix I – Threatened Species Habitat Preferences

Rationale for Likelihood of Occurrence

Flora - following are considerations of species likelihood of being on-site or impacted by proposed activities.

Scientific Name	Common Name	Habitat Requirements	Site Suitability
Chamaesyce psammogeton	Sand Spurge	Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (Spinifex sericeus) and Prickly Couch (Zoysia macrantha). Flowering recorded in spring and summer. Sand Spurge seeds float, so some dispersal between beaches may occur. Longevity of the species is approximately 5 – 30 years with a primary juvenile period of less than 1 year. Plant growth occurs in spring and summer.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence
^^Callistemon linearifolius	Netted Bottle Brush	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.
Eucalyptus nicholii	Narrow-leaved Black Peppermint	Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.
Syzygium paniculatum	Magenta Lilly Pilly	On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast species occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.

Scientific Name	Common Name	Habitat Requirements	Site Suitability
^^Persoonia hirsuta	Hairy Geebung	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone from near sea level to 600m altitude. It is usually present as isolated individuals or very small populations	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.
Rhodamnia rubescens	Scrub Turpentine	Occurs in coastal districts north from Batemans Bay in New South Wales. Populations of R. rubescens typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.
Asterolasia elegans		Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Found in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.
^Genoplesium baueri	Bauer's Midge Orchid	Grows in dry sclerophyll forest and moss gardens over sandstone. A terrestrial orchid 6-15 cm high, fleshy, brittle, yellowish-green or reddish. Inflorescence sparse, 1-3 cm long, 1-6-flowered. Flowers approximately 15 mm across, green and red or wholly reddish. Dorsal sepal approximately 3.5 mm long, 4 mm wide; lateral sepals linear to lanceolate, 9-10 mm long, approximately 1.5 mm wide, widely divergent. Petals approximately 3 mm long, 1.5 mm wide, striped. Labellum approximately 4 mm long, approximately 2.5 mm wide, margins incurved; callus raised, of 2 linear, curved lobes extending about halfway to the labellum apex.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.

Scientific Name	Common Name	Habitat Requirements	Site Suitability
Boronia umbellata	Orara Boronia	This Boronia grows as an understorey shrub in and around gullies in wet open forest. It appears to regenerate well after disturbance, but it is not known whether prolonged or repeated disturbance affects long-term persistence. Orara Boronia is an open shrub, 1 – 2 m tall, with upright branches. The fragrant, paired leaves are divided into one or two pairs of leaflets with a longer terminal leaflet. Dense hairs cover the underside of the leaves, branchlets and new shoots. Clusters of dark pink, four-petalled flowers, 7 - 10 mm long, are held at the base of the leaves, and are produced in spring and early summer. The fruit is smooth and has four lobes.	No flora bearing the key identifying features of this species was seen within the site. No potential habitat within the site boundaries. No further assessment required. Low likelihood of occurrence.

Fauna

Scientific Name	Common Name	Habitat Preferences	Site Suitability
Pseudophryne australis	Red-crowned Toadlet	Occurs in open forests on Hawkesbury and Narrabeen Sandstones. Inhabits ephemeral drainage lines below sandstone ridges. Requires shelter in the form of rocks, dense vegetation and thick leaf litter.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
Varanus rosenbergi	Rosenberg's Goanna	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
Ptilinopus regina	Rose-crowned Fruit-Dove	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. They are shy pigeons, not easy to see amongst the foliage, and are more often heard than seen. They feed entirely on fruit from vines, shrubs, large trees and palms.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
Ptilinopus superbus	Superb Fruit-Dove	The species is found in rainforests, rainforest margins, mangroves, wooded stream-margins, and even isolated figs, lilly pillies and pittosporums. The Superb Fruit-Dove may migrate to New Guinea in winter, but little is known of its movements, or the reasons for its sometimes southerly flights as far as Tasmania. Feeds almost exclusively on fruit, mainly in large trees.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence

Scientific Name	Common Name	Habitat Preferences	Site Suitability
Ardenna carneipes	Flesh-footed Shearwater	Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand.	Marine species. Low potential for the species to occur within the site due to low habitat quality of the site.
Macronectes giganteus	Southern Giant Petrel	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	Marine species. Low potential for the species to occur within the site due to low habitat quality of the site.
Ixobrychus flavicollis	Black Bittern	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	Occurs along the coastline and occasionally larger waterways. Birds are normally seen, perched high in a tree, or soaring over waterways and adjacent land. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
^^Lophoictinia isura	Square-tailed Kite	Inhabits dry woodlands and open forests, particularly along timbered watercourses. Specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence
^^Pandion cristatus	Eastern Osprey	Inhabits coastal areas, especially the mouths of large rivers, lagoons and lakes. Feeds on fish over clear, open water. Breed from July to September	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	consideration is required. Low likelihood of occurrence.
Burhinus grallarius	Bush Stone-curlew	Inhabits open forests and grassy woodlands. Fallen branches and logs are key habitat features that provides camouflage for the bird as well as areas for foraging. It is found in all states, except for Tasmania. Feeds at night on insects and small vertebrates including frogs, lizards, snakes and mice.	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use as critical habitat. No further assessment or consideration is required. Moderate likelihood of occurrence as Bionet Recording <1km away.
Haematopus fuliginosus	Sooty Oystercatcher	Inhabits rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Numenius madagascariensis	Eastern Curlew	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The Eastern Curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
^^Callocephalon fimbriatum	Gang-gang Cockatoo	In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. Favours old growth forest and woodland attributes for	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	
^Calyptorhynchus lathami	Glossy Black-Cockatoo	Lives in coastal woodlands and drier forest areas, open inland woodlands or timbered watercourses where casuarinas (or sheoaks), its main food trees, are common. Glossy black-cockatoos occasionally eat seeds from eucalypts, angophoras, acacias and hakeas, as well as eating insect larvae.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Glossopsitta pusilla	Little Lorikeet	Prefers open Eucalypt forest and woodlands. Primarily feeds within the canopy of Eucalyptus, Angophora and Melaleuca trees. Prefers riparian areas but may visit isolated trees in open or cleared land.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
^^Lathamus discolor	Swift Parrot	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany Eucalyptus robusta, Spotted Gum Corymbia maculata, Red Bloodwood C. gummifera, Mugga Ironbark E. sideroxylon, and White Box E. albens. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis. Return to home foraging sites on a cyclic basis depending on food availability.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
^^Ninox connivens	Barking Owl	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can	Low potential for the species to occur within the site due to low habitat quality of the

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Preferentially hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows decreases these prey populations the owl becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits.	site. No further assessment or consideration is required. Low likelihood of occurrence.
^^*Ninox strenua*	Powerful Owl	The species requires large tracts of forest or woodland, however fragmented landscapes can contribute to their range. Breeds in forests and woodlands but may forage in open areas. Mainly preys upon medium sized arboreal mammals. Requires tree hollows for breeding.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
^^*Tyto novaehollandiae*	Masked Owl	The species prefers dry eucalypt forests and woodlands and hunts along the edges and forests and roadsides. Mainly preys upon arboreal and ground mammals, primarily rats. Requires tree hollows in moist gullies for breeding.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
^*Dasyornis brachypterus*	Eastern Bristlebird	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.

Scientific Name	Common Name	Habitat Preferences	Site Suitability
Anthochaera phrygia	Regent Honeyeater	The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. This species has been seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Migratory bird primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. Feeds on invertebrates, mainly insects.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Petroica boodang	Scarlet Robin	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	Species found in heath or open forest with a heathy understorey on sandy or friable soils. hey feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogenous (underground-fruiting) fungi.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Dasyurus maculatus	Spotted-tailed Quoll	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		logs, small caves, rock outcrops and rocky-cliff faces as den sites. Mostly nocturnal animal feeding on medium-sized (500g-5kg) mammals.	as critical habitat. No further assessment or consideration is required. Moderate likelihood of occurrence as Bionet Recording <1km away.
Phascolarctos cinereus	Koala	Inhabit eucalypt woodlands and forests. Feeds on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	The site presents low quality and low potential for the species to occur within the site. No further assessment or consideration is required. Bionet recordings within 2km. However no feed trees and site inaccessible for the species.
Phascolarctos cinereus	Koala in the Pittwater Local Government Area	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	No kola has been seen within the site. Low potential for the species to occur within the site. No further assessment or consideration is required Bionet recordings within 2km. However no feed trees and site inaccessible for the species.
Cercartetus nanus	Eastern Pygmy-possum	Found in rainforests communities to sclerophyll (including Box-Ironbark) forests, woodland and heath. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes, soft fruits are eaten when flowers are unavailable and insects.	The site presents low quality and low potential for the species to occur within the site. No further assessment or consideration is required.
Petaurus norfolcensis	Squirrel Glider	Inhabits mature or old growth Blackbutt-Bloodwood forests with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Requires abundant tree hollows for refuge and nest sites.	The site presents low quality and low potential for the species to occur within the

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	site. No further assessment or consideration is required.
Petaurus norfolcensis	Squirrel Glider on Barrenjoey Peninsula, north of Bushrangers Hill	The availability of a year-round supply of carbohydrates (nectar, sap, gum, and honeydew) appears to be an important habitat feature. In NSW, this corresponds to a high diversity of tree and shrub species, including a high nectar producing species and one or more winter flowering species. In Pittwater, important food sources are likely to be the winter flowering Coast Banksia (*Banksia integrifolia*) and Spotted Gum (*Corymbia maculata*) and the summer flowering Old Man Banksia (*B. serrata*) and Grey Ironbark (*Eucalyptus paniculata*). Other likely food sources include *Angophora costata, Banksia spinulosa, Corymbia gummifera, Eucalyptus botryoides, E. punctata, E. robusta, Melaleuca quinquernervia*, mistletoes and *Xanthorrhoea* species. This animal will gouge and lick incisions on the trunks and main branches of *Eucalyptus, Corymbia* and *Angophora* trees to feed on sap and on *Acacia* trees and shrubs to feed on gum, especially when nectar is in short supply.	No sightings nor markings were present on the trunks of foraging trees. No further assessment or consideration is required
Petauroides volans	Greater Glider	The greater glider chooses habitat based on several factors, the dominant factor being the presence of specific species of eucalypt. Distribution levels are higher in regions of montane forest containing manna gum (E. viminalis) and mountain gum (E. dalrympleana, E. obliqua). Furthermore, the presence of E. cypellocarpa appears to improve the quality of habitat for the greater glider in forests dominated by E. obliqua.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Pteropus poliocephalus	Grey-headed Flying-fox	Occurs within tall sclerophyll forests and woodlands, heath, swamp subtropical and temperate rainforests, and urban areas. Occurs within 20km of a significant food source. May be found close to gullies and water within vegetation with a dense canopy.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or

Scientific Name	Common Name	Habitat Preferences	Site Suitability
			consideration is required. Low likelihood of occurrence.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane. Freetail-bats are also known as mastiff-bats, having hairless faces with wrinkled lips and triangular ears. They weigh up to 10 grams.	Low potential for the species to occur within the site due to low habitat quality of the site. No further assessment or consideration is required. Low likelihood of occurrence.
Chalinolobus dwyeri	Large-eared Pied Bat	Roosts in caves, cliff crevices, mine shafts and in old nests of the Fairy Martin. Typically inhabits low to mid elevation well-timbered dry open forests and woodlands in close proximity to suitable nesting. Prefers areas containing gullies.	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use as critical habitat. No further assessment or consideration is required. Moderate likelihood of occurrence as Bionet Recording <1km away.
Myotis macropus	Southern Myotis	Roosts in groups of 10-15 in areas close to water. Will utilise caves, mine shafts, tree hollows, storm water drains, buildings, bridges and dense foliage. Forages over water bodies catching insects and small fish.	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use as critical habitat. No further assessment or consideration is required.
Scoteanax rueppellii	Greater Broad-nosed Bat	Roosts in tree hollows but may be found in buildings. Primarily found in gullies and river systems that drain the Great Dividing Range. Occurs in a range of habitats including woodlands to moist or dry eucalypt forest, rainforest with greatest preference for tall wet forests. Forages along creeks and river corridors.	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use as critical habitat. No further assessment or consideration is required.
Miniopterus australis	Little Bentwing-bat	Roosts in tree hollows, caves, tunnels, mine shafts, stormwater drains, culverts, bridges and buildings. Forages for insects in the tree canopy in	Marginal potential for the species to occur within the site. However poor habitat

Scientific Name	Common Name	Habitat Preferences	Site Suitability
		densely vegetated areas. Prefers moist eucalyptus forests, rainforests, vine thickets, wet and dry sclerophyll forests, Melaleuca swamps, dense coastal forests and banksia scrub. Prefers well-timbered areas.	quality of the site would not see species use as critical habitat. No further assessment or consideration is required. Moderate likelihood of occurrence as Bionet Recording <1km away.
Miniopterus orianae oceanensis	Large Bent-winged Bat	Primarily roosts in caves but will utilise mine shafts, storm-water tunnels, buildings and other man-made structures. Forms colonies within a maternity cave and disperse within a 300km range. Forage in forested areas in the tree canopy.	Marginal potential for the species to occur within the site. However poor habitat quality of the site would not see species use as critical habitat. No further assessment or consideration is required. Moderate likelihood of occurrence as Bionet Recording <1km away.

Note: Species in **bold** have been assumed as having appropriate habitat present on-site.

8.3 Appendix II– Key Weed Removal Methods

Physical removal

Technique	Method	Equipment
Hand Removal 	Seedlings and smaller weed species where appropriate will be pulled out by hand, without risk of injury to workers. The size that this can occur varies throughout the treatment area. Generally, it ranges from post seed to approximately 300mm in height. Rolling and raking is suitable for larger infestations of Wandering Jew. The weed can be raked and stems and plants parts rolled. The clump of weed material can then be bagged and removed from site.	Tools: Gloves, Rakes, Knife and Weed Bags
Crowning 	Plants that possess rhizomes or bulbs might not respond to various removal techniques and may need to be treated with crowning. A knife, mattock or trowel is to be driven into the soil surrounding the bulb or rhizome at an angle of approximately 45 degrees with surrounding soil, so as to cut any roots that may be running off. This is to occur in 360 degrees around the bulb/rhizome. The rhizome or bulb is to be bagged and removed from the site and disposed of at an appropriate waste recycling facility Soil disturbance is to be kept to a minimum when using this technique.	Tools: Knife, mattock, trowel, impervious gloves, and all other required P.P.E.
Cut and Paint Stems 	Weed species deemed unsuitable for hand removal shall be cut. Those that have persistent of vigorous growth will be cut and painted with Roundup® Biactive Herbicide or equivalent. Juvenile and smaller weed species will be cut with secateurs at base of plant, and herbicide applied via applicator bottle. Stem to be cut horizontally as close to the ground as possible, using secateurs, loppers or a pruning saw. Horizontal cuts to be made on top of stem to prevent the herbicide running off the stump. Apply herbicide to the cut stem immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Herbicide is not to reach sediment or surrounding non-targeting plants.	Tools: loppers, secateurs, pruning saw, herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide and all other required P.P.E.

Technique	Method	Equipment
Scrape and Painting 	More resilient weed species, where other techniques are less reliable are to be scraped with a knife or chisel and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current herbicide license. Weed species will be scraped with a knife or chisel up the length of the trunk, and herbicide applied via applicator bottle. Scrape the trunk from as close to the ground as possible to approximately ¾ of the plants height. Where trunk diameters exceed approximately 5 cm a second scrape shall be made on the other side of the trunk. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants. Follow up treatment may be required. If plants resprout, scrape and paint the shoots using the same method after sufficient regrowth has occurred.	Tools: knife, chisel, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.
Cut with a Chainsaw and Paint 	Larger size weed species, too large for cutting with hand tools, shall be cut with a chainsaw and painted with undiluted Roundup® Biactive Herbicide. Works to be carried out by a contractor with a current chainsaw and herbicide license. Larger weed species will be cut with a chainsaw at base of plant, and herbicide applied via applicator bottle. Cut the stem horizontally as close to the ground as possible, using the chainsaw. Remove upper branches to reduce bulk of plant. If cutting at the base is impractical, cut higher to get rid of the bulk of the weed, then cut again at the base and apply herbicide. Make cuts horizontal to prevent the herbicide running off the stump. Apply undiluted herbicide to the cut trunk immediately, within 10-20 seconds, before the plant cells close and the translocation of the herbicide is limited. Ensure there is no runoff of poison. All care must be taken by the contractor not to spill herbicide into water, onto sediment, or surrounding non-targeting plants. Follow up treatment will be required. If plants resprout, cut and paint the shoots using the same method.	Tools: chainsaw, ear muffs, protective clothing, safety glasses herbicide applicator/sprayer, impervious gloves, Roundup® Biactive Herbicide, and all other required P.P.E.

Technique	Method	Equipment
Spot Spraying	Spot spraying involves spraying non-seeding annuals and grasses, and for regrowth of weeds once an area has been cleared or brushcut. Works to be carried out by a contractor with a current herbicide license. Herbicide will be mixed up according to the manufacturer's directions for the particular weed species being targeted. Mixed herbicide shall be applied to the targeted weed species with a backpack sprayer. All care must be taken by the contractor not to spill herbicide onto sediment or surrounding non-targeting plants.	Tools: protective clothing, safety glasses, herbicide sprayer, impervious gloves, Herbicide, and all other required P.P.E.

Flame Weeding

Thermal (flame) weeding is a method where high temperatures are applied to weeds, causing the plant to die. Thermal weeding is particularly useful in situations where conservation or health considerations are high and weed density is low such as waterways where herbicide use is not permitted.
While flame weeding is not suited to most streetscapes due to the fire hazard nor can it be used on materials such as soft fall and similar playground equipment it is noted that 'flame' weeding in waterways allows weed management in areas where herbicides are not permitted.
Also for native vegetation areas thermal weeding, with a flame weeder, has been shown to stimulate germination of native plants while killing the seeds of annual weeds such as Devils Pitchfork, *Bidens pilosa*. Flame weeding is also effective in killing persistent weeds like
Mother of Millions.
Best results are obtained when follow up weed control is undertaken 4-6 weeks after treatment. In addition, weed control should be conducted periodically after that for example to control weeds over a period of a year it is likely that between 3-5 applications will be necessary, depending on rainfall and the extent of the weed seed bank. This method is most effective on young annual weeds and least effective on older perennial weeds. In some cases, control of perennial weeds will be ineffective however this depends on the species present and its age.

Images provided by Dragonfly Environmental

Flame weeding should be undertaken outside of the fire seasons. Flame weeding allows for the mimicking of a burn in areas where a control burn could not be undertaken. See native plants regenerating after flame weeding.

8.4 Appendix III– Bushland Hygiene Protocols for Phytophthora (Hornsby Council Recommendations)

- Always assume that the area you are about to work in is free of the disease and therefore needs to be protected against infection.
- And, always assume that the activity you are about to undertake has the potential to introduce the disease.
- Arrive at site with clean shoes, i.e.: no dirt encrusted on them.
- If you arrive with shoes that are encrusted with dirt, they will have to be completely soaked in metho or disinfectant and allow a few minutes to completely soak in. NEVER scrape untreated dirt off your shoes onto the ground.
- Before you move onto the site spray the bottom of your shoes with 70 % metho. Bleach solution (1% strength) or household/commercial disinfectant (as per label) are also suitable.
- Check all tools and equipment that comes in contact with soil are clean before entering the area (they should have been cleaned on site at the end of the previous work session). If there is any dirt on them, spray them with 70% metho.
- Clean all tools at the end of each work session while still on site ensuring this is done away from drainage lines and adjacent work areas. Knock or brush off encrusted dirt and completely spray with 70 % metho. Replace in storage/transport containers.
- Preferably compost all weed material on site.
- Never drag vegetation with exposed roots and soil through bushland.
- When removing weeds from site, remove as much soil as possible from them in the immediate work area and carefully place vegetative material into plastic bags.
- Try not to get the bag itself dirty; don't put it on/in a muddy area.
- Always work from the lower part of a slope to the upper part.
- Always work in areas known to be free of the pathogen before working in infected areas.
- Minimise activities wherever possible when the soil is very wet.
- Vehicles should not be driven off track or into reserves (unless vehicle decontamination is carried out before and after entering a single work site)
- Only accredited supplies of plants/mulch to be used.

Kit should contain: 1 bucket, 1 scrubbing brush, 1 spray bottle (metho 70% solution), 1 bottle tap water, 1 bottle methylated spirits.

Facts about Phytophthora

Phytophthora cinnamomi (Phytophthora) is a microscopic, soil borne, water-mould that has been implicated in the death of remnant trees and other plants in Australian bushland. Phytophthora is not native to Australia. It is believed to have been introduced sometime after European settlement. Phytophthora is a national problem and is listed as a key threatening process under the Commonwealth's Environmental Protection and Biodiversity Conservation Act 1999.

Symptoms including Dieback

"Dieback" simply means dying or dead plants. There are many causes of dieback; Phytophthora is just one of them. Often dieback is the result of a combination of factors such as; changed drainage patterns and nutrient loads (e.g.: increased stormwater run-off) or changed soil conditions (e.g.: dumped fill or excavation of/near root zone). Plants that are stressed are more vulnerable to Phytophthora.

Initial symptoms of Phytophthora include; wilting, yellowing and retention of dried foliage, loss of canopy and dieback. Infected roots blacken and rot and are therefore unable to take-up water and nutrients. Severely infected plants will eventually die. Symptoms can be more obvious in summer when plants may be stressed by drought. If you suspect that Phytophthora is on your site, please contact the Bushcare team to collect a soil sample to be lab tested. This is usually done in the warmer months where conditions are optimum for the disease.

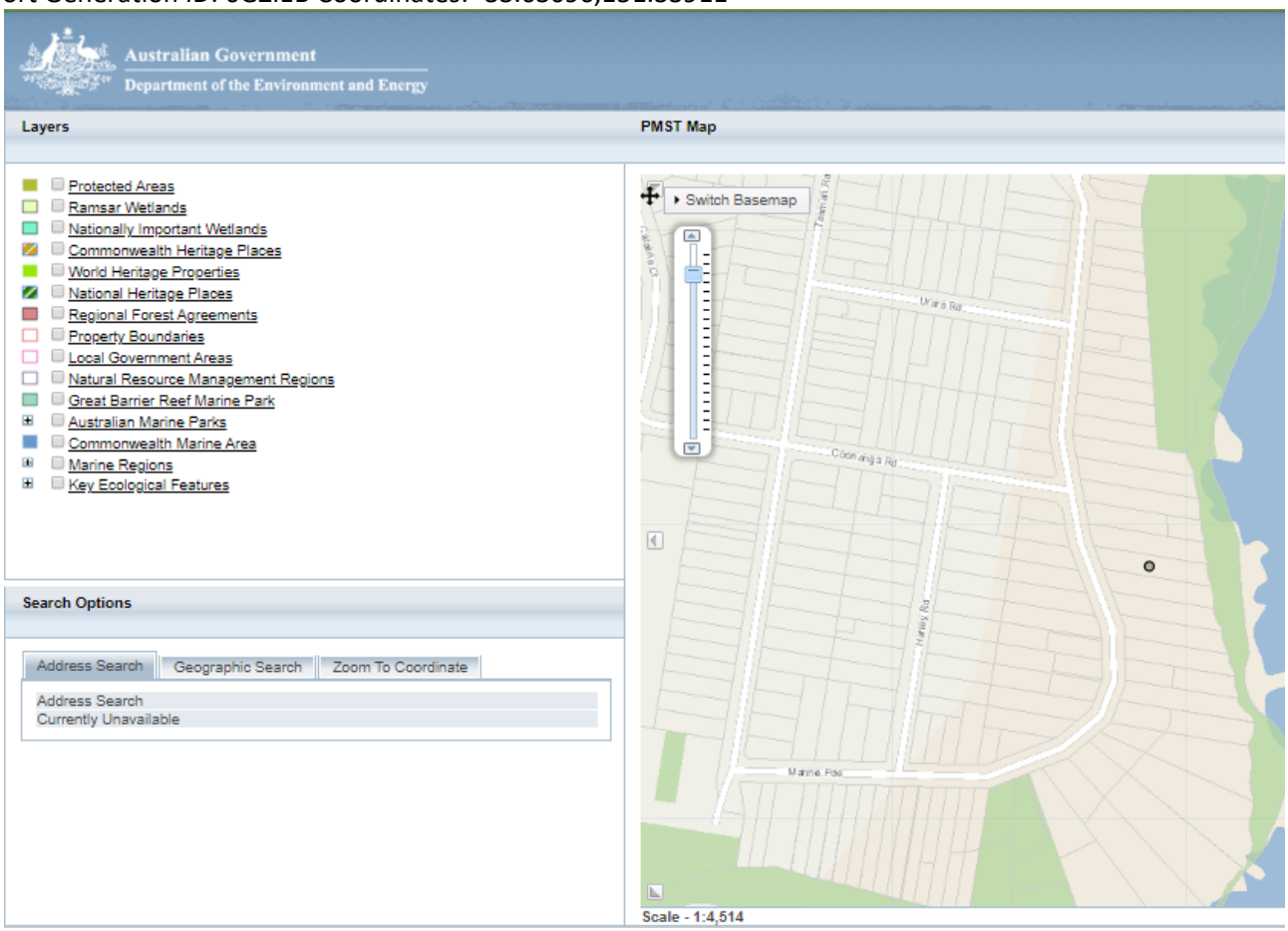
Infection

There is no way of visually telling if Phytophthora is present in the soil as its structures and spores are microscopic (invisible to the naked eye). Phytophthora requires moist soil conditions and warm temperatures for infection, growth and reproduction. Spores travel through moist soil and attach to plant roots. Once Phytophthora has infected a host plant it can grow inside plant root tissue independent of external soil moisture conditions. After infection, Phytophthora grows through the root destroying the tissue which is then unable to absorb water and nutrients.

8.5 Appendix IV– MNES Search

A Protected Matters Search was conducted.

Report Generation ID: 6GZIEB Coordinates: -33.63096,151.33911



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental si
relate to, the area you nominated. Further information is available in the de
accessed by scrolling or following the links below. If you are proposing to u
significant impact on one or more matters of national environmental signific
Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	68
Listed Migratory Species:	58

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
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community may 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 likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog [64733]	Vulnerable	Species or species habitat may occur within area
Mammals		
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
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), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat likely 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

8.6 Appendix VI – Test of Significance

A 5- Part Test for The Endangered Ecological Community (EEC) of *Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.* The test is used to determine whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

(1) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

N/A, not a threatened species.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

The overall health of the vegetation community onsite is marginal and the approximate impact area is 3 m x 3.5m This small piece of the EEC is in poor condition and it is expected that the development will not place the EEC at risk of extinction. Primarily because the community onsite is already missing key structural and functional attributes.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The vegetation onsite will be modified although it is not a pristine example of the EEC. There is a high abundance of weeds onsite including WoNs; Asparagus fern and Bitou bush. Vegetation onsite is structural and functionally poor. It has previously been modified such that is it has not retained original ecological features. It is expected that the development will not place the local occurrence of the EEC at risk of extinction.

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

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

Habitat will be modified as a result of this development, however only within a patch of 3x3.5m. The building will be erected on pylons above the site thus modifying the potential habitat area for the community. The site has previously been modified causing the community to lose many of its natural features.

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

The potential habitat area for *Themeda grassland on seacliffs and coastal headlands* is highly fragmented across the coastline of Sydney. This development will not significantly increase fragmentation of the EEC due to a small area of impact. The community onsite does not support critical habitat requirements for other species which may utilize the community.

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

The vegetation community onsite is not significantly contributing to habitat connectivity across the landscape or upholding critical habitat features. The impact area on the EEC (3x3.5m) has previously been modified which has caused the community to lose many important structural and functional features. It is expected that the *Themeda grassland on seacliffs and coastal headlands* vegetation community outside of the development footprint will not be effected by the loss of vegetation within site boundaries.

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

The development does not affect an area of outstanding biodiversity value, as per the Biodiversity Values (BV) Map (DPIE 2020).

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

Coastal development is a KTP for this EEC. However, the impact area on the EEC for this development is 3x3.5m and the community is in decline due to a number of factors, most notably invasion of Wons. Therefore the community is already altered form its original community structure and this development is expected not to significantly constitute to further increase in KTP.

Conclusion

The overall health of the vegetation community onsite is marginal and EEC vegetation onsite is not significantly contributing to habitat connectivity across the landscape or upholding critical habitat features. There is a high abundance of weeds onsite as the area has previously been disturbed. It is expected that the development will not place the EEC at risk of extinction.

Source: https://legislation.nsw.gov.au/#/view/act/2016/63/part7/div1/sec7.3

9 Expertise of authors

Geraldene Dalby-Ball
DIRECTOR

With over 20 years wetland and urban ecology experience, a great passion for what she does, and extensive technical and on-ground knowledge make Geraldene a valuable contribution to any project.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference, Sydney CMA and Hawkesbury Nepean forums. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Geraldene was a key contributor to the recent set of Guidelines commissioned by South East Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to many community and professional workshops on ecological matters particularly relating to environmental management. She is an excellent Project Manager.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013). Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Urban waterway management – assessing, designing and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.
- **Practicing member and vice president** Ecological Consultants Association of NSW

Jack is a passionate ecologist who has worked with various stakeholders across both the public and private sectors to deliver sustainable environmental outcomes. He has worked on projects with major construction contractors and has been able to deliver tailored environmental solutions on time and within budget.

As an undergraduate student, he published a study that examined the cost of revegetation across the Richmond River Catchment in NSW. This study provided Jack with a deep understanding of urban and landscape ecology and the environmental factors associated with habitat restoration.

He has advanced communication skills and can deliver professional ecological assessments. He has a thorough understanding of current NSW and Commonwealth environmental legislation. He is also competent in the practical application of flora and fauna surveying and monitoring techniques.

Jack would be a valuable addition to any ecology project as he is committed to achieving the best possible outcome for both the client and the environment.

Key Projects Include:

- Monitoring of Endangered Species, various locations
- Environmental consultant for many civil developments throughout the Sydney region
- Researching the On-farm costs of revegetation in the Richmond River Catchment
- Sustainable business transformation proposal for a retail store.

Jack Hastings

ECOLOGIST

SPECIALISATIONS

- Urban and landscape ecology – design and re-creation
- Environmental Impact Assessments (EIA)
- Review of Environmental Factors for development applications
- Flora and Fauna management plans
- Habitat tree assessment, marking and mapping
- GIS mapping
- Sound understanding and practical application of experimental design
- Grant writing and grant assessment

CAREER SUMMARY

- **Ecologist**, Ecological Consultants Australia. *2019-present*
- **Environmental Consultant,** BBN Consulting. *2018-2019*

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Environmental Science, Southern Cross University.**
- **Certificate II Agriculture.**
- **WHS General Induction of Construction Industry NSW White Card.**