Biodiversity Development Assessment Report

113 Orchard Street, Warriewood

By Ecological Consultants Australia Pty Ltd TA

Kingfisher Urban Ecology and Wetlands

October 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

Ecological Consultants Australia (ECA) has been contracted by Mr Tony McLain of Tony McLain Architects to provide a **Biodiversity Development Assessment Report** for a proposal at 113 Orchard Street, Warriewood NSW 2102 within the Northern Beaches Council Local Government Area (LGA).

Trigger for a formal BDAR under the BC Act 2016:

The proposal triggers the area clearing threshold as per the BOS entry requirements as the impact area exceeds the clearing area threshold.

Stage 1: Biodiversity Assessment

- On-ground survey took place in October 2020 by Senior Ecologist Geraldene Dalby-Ball and ecologist Luke Johnson.
- Data was gathered across three BAM plots located in each vegetation zone at the site.
- 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

Stage 2: Impact Assessment

- The impact calculations were made based on there being direct impacts to vegetation from the proposed development. The impact area has been calculated as 0.5ha.
- The vegetation was assessed as *PCT1841 Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region* in the BAM-C. This finding was concluded following desktop investigations and field assessments.
- Tree removal would be the greatest impact from this development. See Arborist report (V. Beecher 2019) for details. 30 trees are proposed for removal as they are currently in proposed development areas including horse arenas. The trees that would be removed were not observed to be bearing hollows suitable for tree roosting microbat species. This indicates a low potential for the life cycles of local populations to be put at risk from a breeding perspective however the site may be used primarily for foraging resources.
- The proposed actions would be expected to have a lesser impact upon cave dwelling species. Trees do not comprise breeding habitat for these species and would not impact their life cycles.
- No threatened species were recorded during the site surveys.

Stage 3: Improving Biodiversity values

- Fauna refuge zone
- Delineation of work areas
- Vegetation clearing control measures

- Weed Management and removal
- Native seed collection
- Preservation of habitat
- Nest boxes
- Native species landscaping

See recommendations section for a detailed explanation as to how these recommendations improve biodiversity values.

Conclusions and Recommendations

- The grand total to offset both ecosystem credits and species credits generated by this development is $62,487.41 (including GST), assuming payment will be made into the Biodiversity Conservation Fund. Several recommendations have been proposed to reduce the impact on the remaining vegetation during and post construction.
- Measures including but not limited to; nest boxes, native species landscaping, delineation of works zones, weed removal, tree protection and fauna refuge zones should all be used to mitigate any impacts associated with the proposal and increase habitat opportunities in the area.

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Stage 1: Biodiversity Assessment

1 Introduction

Ecological Consultants Australia (ECA) has been contracted by Mr Tony McLain of Tony McLain Architects to provide a **Biodiversity Development Assessment Report** for a proposal at 113 Orchard Street, Warriewood NSW 2102 within the Northern Beaches Council Local Government Area (LGA).

1.1 Site information and general description

The Subject Site (the "Site") is the area of direct and likely indirect impacts. This area has been assessed in the Biodiversity Assessment Method Calculator (BAM-C) from which offset credits have been generated.

Table 1 - Site Administrative Information

Category	Details
Title Reference (Lot/DP)	6/-/DP749791
Area (m^2)	9813m^2
Street Address	113 Orchard Street, Warriewood NSW 2102
LGA	Northern Beaches Council
Land Zoning	RU2: Rural Landscape

Figure 1.0 Site map of the proposed development.

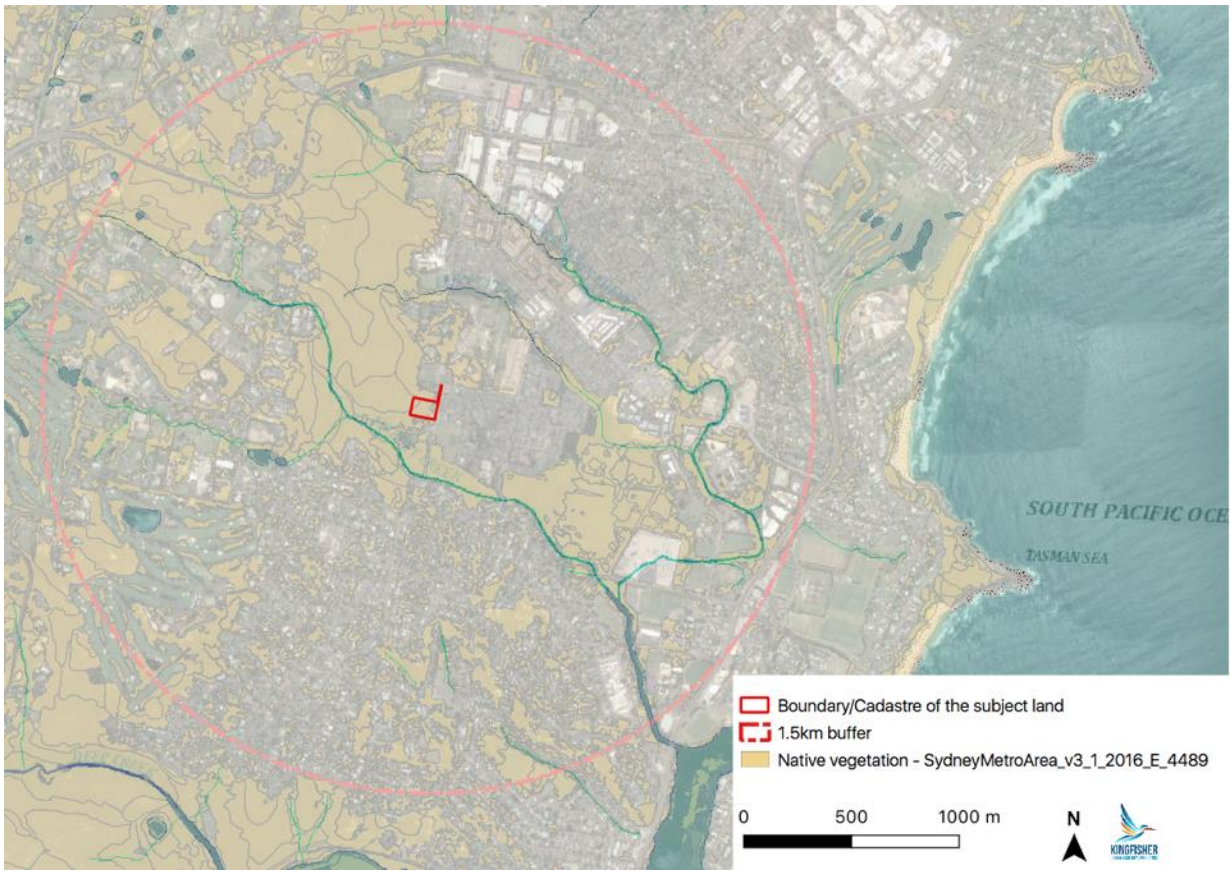


Figure 1.0a. Location map for the proposed development. ***Hydroline mapping via Water Management (General) Regulation 2018 hydro line spatial data.***

1.2 Proposed actions

The proposed actions involve horse arena, day yards, paddocks, access drive, turning and parking as well as additions to the existing dwelling. The works also involve associated earth and landscape works including gabion walls. Figure 1.1 is a plan diagram (see DA submission for higher resolution copy).

At the commencement of building works and in perpetuity, the property shall be managed as an inner protection area as outlined within PBP and the NSW RFS document 'Standards for asset protection zones' for the following minimum distances;

- North, south and east: to the boundaries.
- West: 25m from the proposed alterations and additions.

The image below (figure 1.1b) has been included to identify the recommended APZ - R Coffey (26/05/20). It is anticipated that no further tree removal or pruning will be required post development for the site to satisfy APZ standards as per PBP requirements. Rather than removing or severely pruning trees in the APZ, building modifications (gutter guards) will be installed to safeguard the house. It is expected that the tree removal and protection plan (Arborist Report, V. Beecher and O. Tebbutt) will allow the site to achieve APZ requirements. It is acknowledged that the ground and shrub vegetation layers will be continually managed in perpetuity. These factors were considered in the BAM-C when determining the future vegetation integrity score for the site.

Figure 1.1. Proposed layout. Source: Tony McLain Architect July 2019.

Figure 1.1a. Tree removal and protection plan - Arborist Report (July 2020) by V. Beecher and O. Tebbutt prepared for Tony McLain Architects.

Figure 1.1b Recommended asset protection zone - *Bushfire Risk Assessment for 113 Orchard Street, Warriewood - prepared by R Coffey (26/05/20).*

1.3 Sources of information used in the assessment

The following sources of information were used for this assessment:

- SeedMaps 2020
- SydneyMetroArea_v3.1_2016_E-VIS_4489
- BioNet DPIE (2020)
- Flora and Fauna Assessment for 113 Orchard Street, Warriewood by ECA Pty Ltd TA (updated 2020)
- Plan Showing Detail & Levels Over LOT 6 in DP749791, prepared by Axiom Surveying, dated 22.02.18.
- Proposed Horse Arena and Facilities – Site Plan, prepared by Tony McLain Architect, Drawing number DA01, rev D, dated July 2018.
- Arborist Report (July 2020) by V. Beecher and O. Tebbutt prepared for Tony McLain Architect.
- Bushfire Risk Assessment for 113 Orchard Street, Warriewood - prepared by R Coffey (26/05/20)

1.4 Legislative context and statutory requirements

1.4.1 NSW Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2000* institutes and sets out a system for environmental planning and assessment in NSW, and includes Part 4 which deals with development applications on private land.

This proposal falls under a Part 4 development and requires development consent, and associated environmental assessment.

1.4.2 NSW Biodiversity Conservation Act 2016 and associated documents

The *Biodiversity Conservation Act 2016* (BC Act 2016) is the key legislation that enables the conservation of biodiversity within the state of New South Wales. The BC Act 2016 facilitates the assessment and on-going protection of flora and fauna, including threatened species and ecological communities. The BC Act 2016 outlines assessment and offsetting requirements for activities with the potential to impact on threatened species and ecological communities in NSW, and the clearing of native vegetation which exceeds the threshold.

The BC Act also:

- Outlines the licences required under the BC Act to harm protected flora and fauna;
- Lists Threatened species and ecological communities in Schedules 1 and 2;
- Sets out monetary and imprisonment penalties for offences relating to the harming of protected flora and fauna;
- Under Part 7 (s7.4), introduces a list of activities/proposal that exceeds the biodiversity offsets scheme threshold.

The NSW *Biodiversity Conservation Regulation 2017* sets out the Biodiversity Offsets Scheme entry threshold for Part 4 developments under the EP&A Act 1979. If the development triggers as least one (1) entry threshold, the development must be assessment under The BC Act using the Biodiversity Assessment Method (BAM) (OEH 2017). See also https://www.environment.nsw.gov.au/biodiversity/entryrequirements.htm

The development triggers the Biodiversity Offsets Scheme entry threshold. The assessment type used in the BAM-C is Part 4 Developments (Small Area). Vegetation zones have annexed the appropriate areas of native vegetation which will be modified or removed. Thus, an adequate BDAR has is provided to the consent authority.

1.4.3 Commonwealth Environmental Protection and Biodiversity Conservation Act 1999

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 is not expected to significantly impact any MNES.

1.5 Biodiversity Offsets Scheme threshold

The Biodiversity Offsets Scheme applies to:

local development (assessed under Part 4 of the Environmental Planning and Assessment Act 1979) that triggers the Biodiversity Offsets Scheme threshold (see section 1.6) or is likely to significantly affect threatened species based on the test of significance in section 7.3 of the Biodiversity Conservation Act 2016.

1.5.1 BOS Area Clearing Threshold

The proposal triggers the area clearing threshold as per the BOS entry requirements as the impact area exceeds the clearing area threshold. Area clearing thresholds are determined by minimum lot size and guidelines outlined in BAM (OEH 2017) (figure 1.6).

Table 1.1. Minimum lot size and threshold which the development exceeds.

Minimum/Actual lot size	**1Ha**
Threshold for clearing, above which the BAM and offsets scheme apply	**0.5ha**
Impact area	**0.5ha**

Area clearing threshold

The area threshold varies depending on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan (LEP)), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

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

Figure 1.6 The area clearing threshold as per the BOS entry requirements.

1.5.2 Biodiversity Values Map

The proposed development area does not impact areas identified by the Biodiversity Values map published by the Chief Executive of the NSW Office of Environment and Heritage.

Figure 1.7: Biodiversity Map – Site in yellow. Source: https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

1.5.3 Assessment type

As per BAM section 3.2 and requirements specified in Appendix 2, the accredited assessor has used the Streamlined assessment module – small area development that requires consent. The site is not identified on the Biodiversity Values map and the proposed actions do not exceed the maximum area limit for application of the small area development module (Table 13 BAM). The minimum lot size is 1Ha and thus the maximum clearing area for the site to be considered small area is ≤2ha. The impact area is approximately 0.5Ha.

Appendix 2: Streamlined assessment module – small area development that requires consent

This appendix sets out a streamlined assessment module for assessing:

a) the biodiversity values of a small area development (Stage 1), and

b) the impacts of the development on biodiversity, and

c) an offset requirement for the impact.

The assessor must use the streamlined assessment module for small area development in the BAM Credit Calculator as part of the assessment of biodiversity values for developments that require consent in the NSW planning system.

The streamlined assessment module for small area developments must only be used according to the area clearing threshold shown in Table 13.

The streamlined assessment module for small area developments cannot be used to assess the biodiversity values of land that is located within an area shaded on the biodiversity values map.

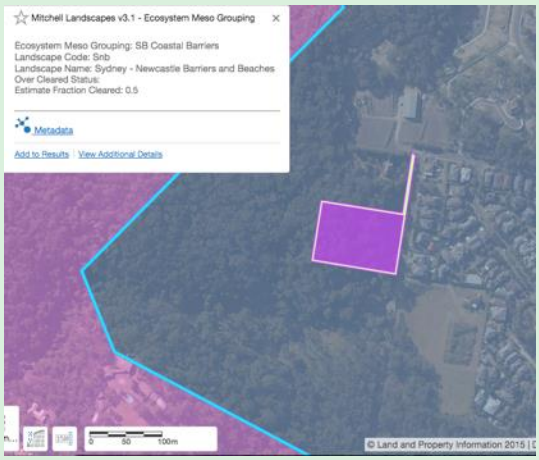
Table 13: Area limits for application of small area development threshold on land not shaded on the biodiversity values map

Minimum lot size associated with the property	Maximum area limit for application of the small area development module
Less than 1ha	≤1ha
Less than 40ha but not less than 1ha	≤2ha
Less than 1000ha but not less than 40ha	≤5ha
1000ha or more	≤10ha

Figure 1.8. Small area threshold requirements.

2 Landscape features and site context

Table 2 - Site Biodiversity Information

Category	Details
Interim Biogeographic Regionalisation for Australia (IBRA)	Sydney Basin
IBRA Sub Region	Cumberland
NSW Landscape 	SB Coastal Barriers Landscape Code: Snb Landscape Name: Sydney - Newcastle Barriers and Beaches Over Cleared Status: Estimate Fraction Cleared: 0.5
% Native vegetation cover	30% in the 1500m radius circle See Figure 1.
Landscape features	
Rivers and streams	No rivers or streams on site. Mullet creek is located approximately 200m SW of the site. See figure 1.0a for Hydroline mapping via Water Management (General) Regulation 2018 hydro line spatial data.
Wetlands	N/A
Connectivity features	The site is being used by fauna as a habitat corridor as it is directly linked to the Escarpment Bushland reserves of Epworth Park, Warriewood Escarpment, Warriewood Wetlands and Irrawong Reserve.
Areas of geological significance and soil hazard features	No
Areas of Outstanding Biodiversity Value identified under the BC Act	No

3 Native vegetation

3.1 Desktop and Survey results – Plant Community Types (PCTs)

A review of the most up-to-date vegetation mapping, SydneyMetroArea_v3.1_2016_E-VIS-4489 DPIE (2020), identified two plant community types (PCT) within site. The PCT is identified as; *Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion* (PCT1250) and *Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region* (PCT1841).

Table 3 – Table of vegetation community synonyms as per NSW and Commonwealth legislation.

NSW PCT Code	NSW PCT Name	BC Act 2016	EPBC Act 1999
1250	Sydney Peppermint - Smooth-barked Apple - Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	Coastal sandstone gully forest	Coastal sandstone gully forest
1841	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	Coastal enriched sandstone moist forest	Coastal enriched sandstone moist forest

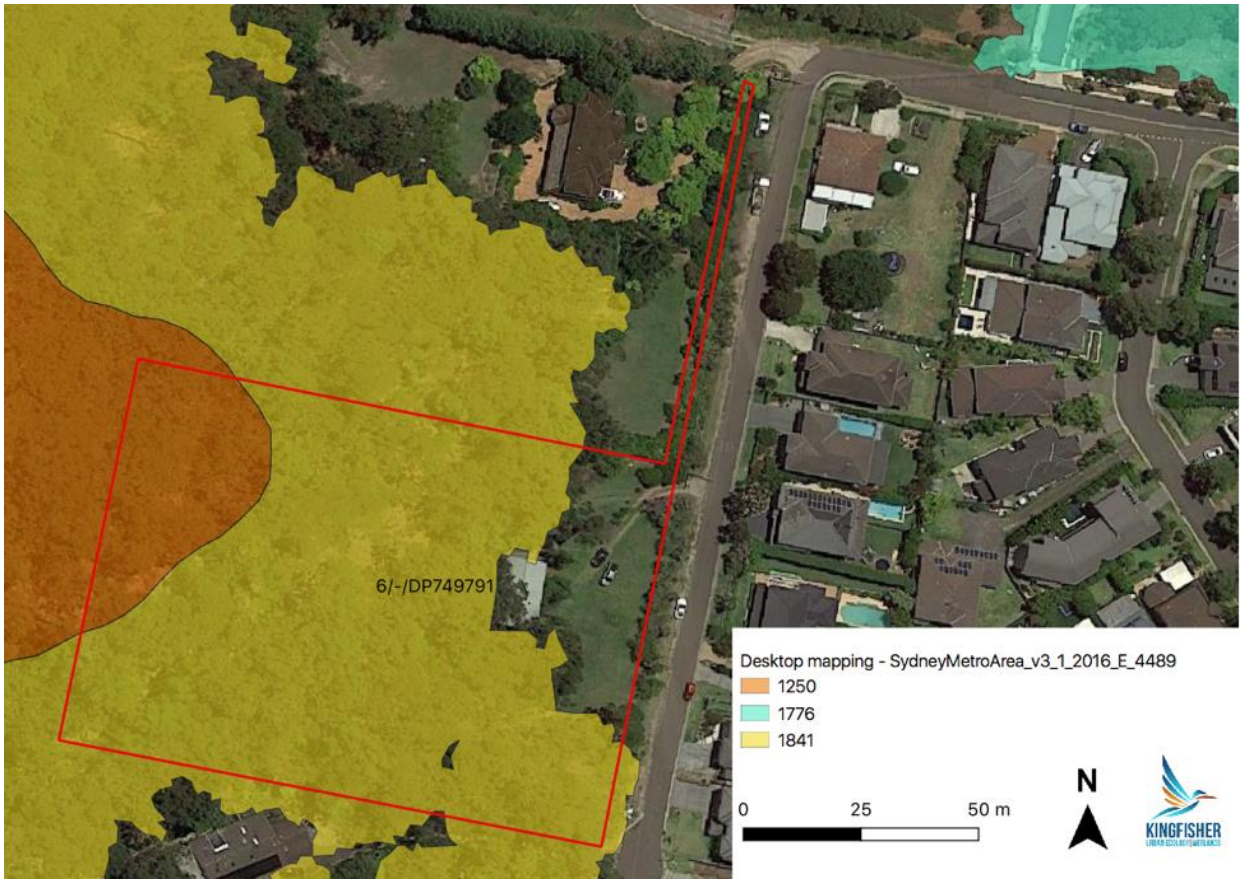


Figure 2.2. Subject site via desktop mapping - PCT1841 dominant PCT.

3.2 BAM Field Survey

The field survey assisted in verifying the distribution and quality of vegetation at the site. The vegetation was assessed as *PCT1841 Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region* in the BAM-C. This finding was concluded following desktop investigations and field assessments.

The eastern portion of the site, adjacent to Orchard Street, is modified and disturbed. This was evident in the desktop analysis and later confirmed via the field survey. The bushland is in moderate - good condition elsewhere. This is evident in the vegetation integrity score (52). Figure 2.2 highlights the vegetation zones on site following the BAM survey.

Figure 2.2. Vegetation zones and PCT mapping post BAM survey.

Stratification and plot dimensions

Plots were as per the BAM Method with 20x20 plots (400m^2) for assessing structure and composition with a center line extending 50m to great a 20 x 50 plot (1000m^2) to assess function. See Biodiversity Assessment Method Operational Manual – Stage 1 (OEH 2018) page 26-28 for methods used.

https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-operational-manual-stage-1-180276.pdf

3.3 Site Photos

Included are photos of the BAM plot and the general condition of vegetation at the site.

Plate 1. BAM Plot – indicative of the impact area – plot used in BAM-C.

Plate 2. Western portion of the site beyond APZ influence.

Plate 3. A second plot was conducted outside of the impact area.

Plate 4. Canopy coverage at the site (standing in APZ).

4 Threatened Species

4.1 Flora and Flora Field Survey

No threatened flora or fauna species were identified during 2020 field surveys.

4.1.1 Opportunistic Flora and Fauna survey methods

During opportunistic surveys, notes and photos were taken of the vegetation types and flora and fauna present onsite were recorded. Surveys were general and opportunistic in nature and were performed by traversing the site.

4.1.2 Diurnal Bird Surveys

Diurnal bird surveys occurred during mid-afternoon. Opportunistic observations of birds were made during vegetation surveys. Several species which are known to nest in hollows were predicted at the site and a dedicated effort was made to traverse the impact area to understand if hollows are present and if they are suitable for predicted bird species.

The site survey for birds primarily focused on their breeding habitat requirements such as hollows, waterways onsite, nests that are present and other features which BAM identified bird species may use for breeding purposes. It was concluded that the impact area hosts potential foraging habitat for all birds species listed in the BAM calculator. Therefore, all bird species identified in the BAM calculator were retained in the assessment for foraging purposes.

However, it is unlikely that threatened avifauna would use the impact area for breeding purposes, due to lack of optimal breeding habitat (suitable hollows, suitable waterways). Justification for species exclusion in the BAM-C can be found in appendix I. Searches and call playback was conducted for forest owls however no individuals were recorded on site.

4.1.3 Microbats

The impact area hosts marginal foraging habitat for threatened microbat species which are identified in the BAM calculator for the site. All microbat species have been retained in the BAM calculator for foraging purposes. The site survey for microbats primarily focused on their breeding habitat requirements such as caves, outcrops, hollows and other features which microbat species may use for breeding purposes.

It has been concluded that while microbat species may use the site for foraging purposes they are unlikely to use the site for breeding purposes due to lack of optimal breeding opportunities within the impact area. Therefore, impact assessment on microbat breeding habitat has been excluded from the BAM assessment.

4.1.4 Mammal Surveys

Mammal surveys occurred during the mid-afternoon. The proposed development is not expected to significantly impact upon breeding or foraging purposes for any mammal species identified in the BAM Calculator as there are no optional habitat features within the development area.

4.1.5 Amphibian Surveys

Amphibian surveys occurred during the mid-afternoon. Opportunistic observations of amphibians were made during vegetation surveys. Any potential habitat features were investigated however no threatened

amphibian species identified in the BAM calculator were identified onsite. Habitat requirements for all threatened amphibian species identified in the BAM calculator are marginal within the impact area.

4.1.6 Reptile and Snail surveys

Reptile and Snail surveys were undertaken by thorough investigation of potential habitat including:

- Leaf litter
- Bark litter
- Stick piles
- Native ground cover vegetation
- Rocks
- Rubbish

4.2 Threatened Flora - Desktop

A total of 19 threatened flora species have been recorded within 10km of the study site according to BioNet records. These species are currently listed as vulnerable or endangered under state and/or commonwealth legislation (see Table 4). The vulnerable and endangered species to focus on-site searches for can be seen in Table 4 below highlighted in bold. This is based on likelihood of occurrence.

Table 4. Threatened flora observed in previous ecological surveys within a 10km radius of the study site. NSW DPIE Bionet 2020.

Family	Scientific Name	Common Name	NSW status	Comm. status	Records
Rutaceae	*Asterolasia elegans*		E1	E	1
Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V,3		5
Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E1		13
Ericaceae	*Epacris purpurascens* var. *purpurascens*		V		3
Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	22
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	4
Orchidaceae	*Genoplesium baueri*	Bauer's Midge Orchid	E1,P,2	E	2
Grammitidaceae	*Grammitis stenophylla*	Narrow-leaf Finger Fern	E1,3		2
Proteaceae	*Grevillea caleyi*	Caley's Grevillea	E4A,3	CE	457

Family	Scientific Name	Common Name	NSW status	Comm. status	Records
Myrtaceae	*Kunzea rupestris*		V	V	1
Malvaceae	*Lasiopetalum joyceae*		V	V	1
Orchidaceae	*Microtis angusii*	Angus's Onion Orchid	E1,P,2	E	82
Proteaceae	*Persoonia hirsuta*	Hairy Geebung	E1,P,3	E	6
Thymelaeaceae	*Pimelea curviflora* var. *curviflora*		V	V	11
Lamiaceae	*Prostanthera densa*	Villous Mint-bush	V	V	1
Lamiaceae	*Prostanthera marifolia*	Seaforth Mintbush	E4A,3	CE	1
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	E4A		22
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E1	V	18
Elaeocarpaceae	*Tetratheca glandulosa*		V		91

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

4.3 Threatened Fauna - Desktop

A total of 55 threatened fauna species have been recorded within 10km of the study site according to BioNet records. These species are currently listed as vulnerable or endangered under state and/or commonwealth legislation (see Table 5). The vulnerable and endangered species to focus on-site searches for can be seen in Table 5 below highlighted in bold. This is based on likelihood of occurrence.

Table 5. Threatened fauna observed in previous ecological surveys within a 10km radius of the study site. NSW DPIE Bionet 2020.

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Amphibia	Heleioporus australiacus	Giant Burrowing Frog	V,P	V	50
Amphibia	Litoria aurea	Green and Golden Bell Frog	E1,P	V	4
Amphibia	Pseudophryne australis	Red-crowned Toadlet	V,P		81

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Aves	Anthochaera phrygia	Regent Honeyeater	E4A,P	CE	39
Aves	Ardenna carneipes	Flesh-footed Shearwater	V,P	J,K	1
Aves	Artamus cyanopterus cyanopterus	Dusky Woodswallow	V,P		2
Aves	Botaurus poiciloptilus	Australasian Bittern	E1,P	E	3
Aves	Burhinus grallarius	Bush Stone-curlew	E1,P		10
Aves	Callocephalon fimbriatum	Gang-gang Cockatoo	V,P,3		3
Aves	Calyptorhynchus lathami	Glossy Black-Cockatoo	V,P,2		109
Aves	Daphoenositta chrysoptera	Varied Sittella	V,P		4
Aves	Diomedea exulans	Wandering Albatross	E1,P	E	2
Aves	Glossopsitta pusilla	Little Lorikeet	V,P		14
Aves	Haematopus fuliginosus	Sooty Oystercatcher	V,P		7
Aves	Haliaeetus leucogaster	White-bellied Sea-Eagle	V,P		44
Aves	Hieraaetus morphnoides	Little Eagle	V,P		9
Aves	Hirundapus caudacutus	White-throated Needletail	P	V,C,J,K	13
Aves	Ixobrychus flavicollis	Black Bittern	V,P		25
Aves	Lathamus discolor	Swift Parrot	E1,P,3	CE	17
Aves	Lophoictinia isura	Square-tailed Kite	V,P,3		3
Aves	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V,P		1
Aves	Ninox connivens	Barking Owl	V,P,3		36

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Aves	Ninox strenua	Powerful Owl	V,P,3		294
Aves	Pandion cristatus	Eastern Osprey	V,P,3		29
Aves	Petroica boodang	Scarlet Robin	V,P		2
Aves	Ptilinopus magnificus	Wompoo Fruit-Dove	V,P		2
Aves	Ptilinopus regina	Rose-crowned Fruit-Dove	V,P		2
Aves	Ptilinopus superbus	Superb Fruit-Dove	V,P		4
Aves	Rostratula australis	Australian Painted Snipe	E1,P	E	3
Aves	Thalassarche cauta	Shy Albatross	V,P	V	3
Aves	Thalassarche chrysostoma	Grey-headed Albatross	P	E	1
Aves	Thalassarche melanophris	Black-browed Albatross	V,P	V	2
Aves	Tyto novaehollandiae	Masked Owl	V,P,3		6
Aves	Tyto tenebricosa	Sooty Owl	V,P,3		2
Aves	Xenus cinereus	Terek Sandpiper	V,P	C,J,K	2
Mammalia	Cercartetus nanus	Eastern Pygmy-possum	V,P		376
Mammalia	Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V	17
Mammalia	Dasyurus maculatus	Spotted-tailed Quoll	V,P	E	17
Mammalia	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P		3
Mammalia	Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1,P	E	32
Mammalia	Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V,P		22

Class	Scientific Name	Common Name	NSW Status	Comth. Status	No. of records
Mammalia	Miniopterus australis	Little Bent-winged Bat	V,P		57
Mammalia	Miniopterus orianae oceanensis	Large Bent-winged Bat	V,P		132
Mammalia	Myotis macropus	Southern Myotis	V,P		58
Mammalia	Petaurus norfolcensis	Squirrel Glider	V,P		7
Mammalia	Phascolarctos cinereus	Koala	V,P	V	37
Mammalia	Phascolarctos cinereus	Koala in the Pittwater Local Government Area	E2,V,P	V	33
Mammalia	Pseudomys novaehollandiae	New Holland Mouse	P	V	1
Mammalia	Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V	151
Mammalia	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V,P		1
Mammalia	Scoteanax rueppellii	Greater Broad-nosed Bat	V,P		8
Mammalia	Vespadelus troughtoni	Eastern Cave Bat	V,P		1
Reptilia	Caretta caretta	Loggerhead Turtle	E1,P	E	4
Reptilia	Chelonia mydas	Green Turtle	V,P	V	5
Reptilia	Varanus rosenbergi	Rosenberg's Goanna	V,P		97

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

Likelihood of occurrence

See Appendix I for a 'Rationale for Likelihood of Occurrence', which outlines why species have been retained or omitted from BAM calculations. Reasons for inclusion or removal are based on species habitat preferences, site investigations, species survey, Bionet records and expert opinion. During the survey, none of the above threatened species were observed on-site. Marginal foraging habitat for several species is present onsite. Thus, all predicted species were retained in the BAM-C and several candidate species generated species credit species due to the impact on foraging habitat.

Stage 2: Impact Assessment

5 BAM Calculator

5.1 Vegetation Zones and Integrity Scores

The vegetation zone in the BAM-C assesses the entire impact area for the site, inclusive of areas in which native vegetation is proposed for removal and/or modification as a result of direct and indirect impacts from the proposal. The vegetation zone in the BAM-C contains two future management zones; Development footprint and APZ.

- **Development footprint** - The future vegetation integrity score (F-VI) for the development area has been reduced to zero. This score accurately reflects the predicted future condition of the vegetation (nil) in the development areas associated with the dwelling, stables, paths, roads and paddocks.
- **APZ** - F-VI for the APZ management zone has been adjusted to reflect future management. Species composition in the APZ is expected to remain similar to the condition existing. Structural attributes of the APZ will be modified and F-VI scores adjusted to reflect this. Ground and shrub covers will be managed as per PBP requirements with canopy cover expected to remain in situ. See Bushfire Report for details on APZ management.

The current site plans are superimposed onto satellite imagery using GIS software – see figure 3. This process allowed ecologist to accurately determine impact areas and the associated future management zones.

Figure 3. Current site plans superimposed onto satellite imagery using GIS software. Depicts the two future management zones within the encompassing vegetation zone (impact area).

Table 6. Table of current and future vegetation integrity scores for the site.

PCT	Management Zone	Area (Ha)	Current vegetation Integrity Score	Future vegetation Integrity Score
1841	APZ	0.25	52	33.2
1841	Development footprint	0.25	52	0
Vegetation zone (impact area) = 0.5Ha				

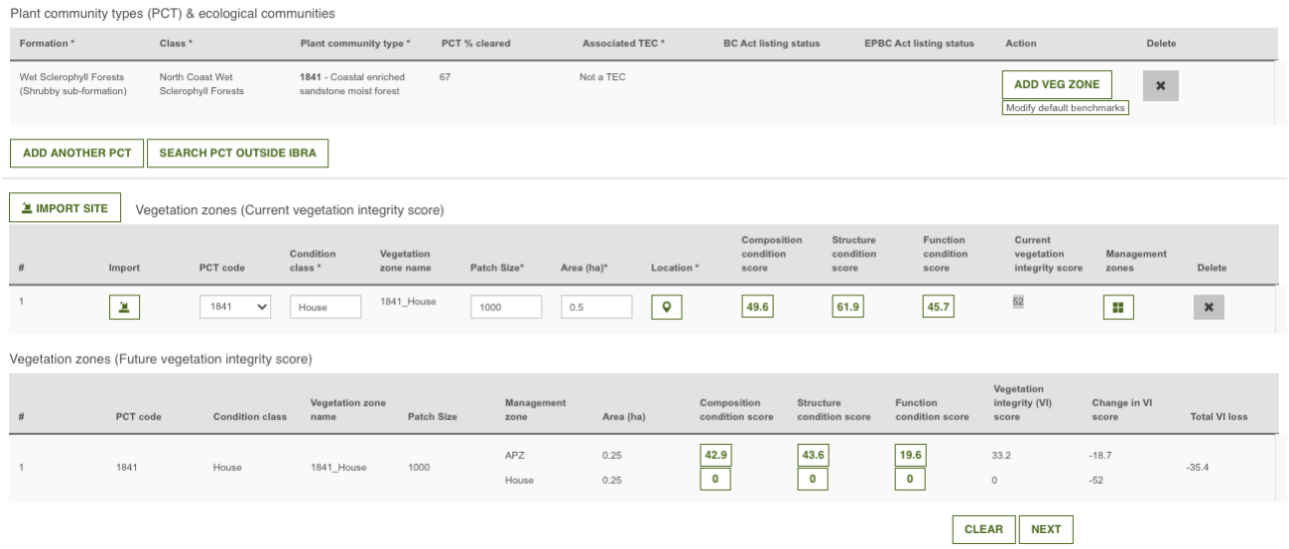


Figure 3.1. Screenshot of the BAM Calculator.

5.2 Species and Ecosystem Credits

The grand total to offset both ecosystem credits and species credits generated by this development is $62,487.41 (including GST), assuming payment will be made into the Biodiversity Conservation Fund. A credit is a unit used to measure the impact of a development. Credits have a price and are traded by the Biodiversity Conservation Trust (BCT) under the Biodiversity Conservation Scheme (BOS). A credit may be created due to a number of factors including but not limited to, amount of vegetation removed, critical habitat removed and alteration of the landscape.

5.2.1 Ecosystem Credit Species derived from BAM

The development and associated works generated eight (8) ecosystem credits for the site, with a total value of $47,477.23.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Pittwater	**1841** - Coastal enriched sandstone moist forest	No	North Coast Wet Sclerophyll Forests >=50% and <70%	20.69%	$173.07	1.9833	$5,395.14	8	$43,161.12
								Subtotal (excl. GST)	**$43,161.12**
								GST	**$4,316.11**
								Total ecosystem credits (incl. GST)	**$47,477.23**

Figure 5.1. Ecosystem credit summary from the BAM calculator.

5.2.2 Species Credit Species derived from BAM

The development and associated works generated fourteen (14) species credits for the Large-eared pied bat (*Chalinolobus dwyeri*). In total, the cost to offset the species credits generated will be $15,010.18 (including GST), assuming payment will be made into the Biodiversity Conservation Fund.

Species credits for threatened species

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10157	***Chalinolobus dwyeri*** (Large-eared Pied Bat)	Vulnerable	$741.31	20.6900%	$80.00	14	$13,645.62
						Subtotal (excl. GST)	**$13,645.62**
						GST	**$1,364.56**
						Total species credits (incl. GST)	**$15,010.18**
Calculated as on: **27/10/2020 15:06:24**						**Grand total**	**$62,487.41**

Figure 4.2. Species credit summary from the BAM calculator.

Appendix I lists the species credit species predicted by the BAM Calculator and details whether the species have been further assessed based on site suitability (I.e. Habitat constraints and/or habitat degradation within the development site). Under Section 6.4.1.13 of the BAM, further species credit species can be excluded from further assessment if an assessment of habitat constraints and microhabitats determines that the habitat within the development site is substantially degraded such that the species credit species is unlikely to occur. See section "6.1.2 BAM Candidate Species for Further Assessment".

6 Direct Impacts

6.1.1 Vegetation disturbance and Loss

Tree removal as per the Arborist report is up to 30 trees within the development footprint, to be removed or impacted by the proposed activities, see figure 5. The flowering Eucalypts (and invertebrates attracted) are foraging resources for the threatened Grey Headed Flying Fox, threated species of microbats and nectivorous birds. Breeding habitat is not expected to be impacted although foraging habitat will be modified.

Figure 5. Tree removal and protection plan - Arborist Report (July 2020) by V. Beecher and O. Tebbutt prepared for Tony McLain Architects

7 Indirect Impacts

7.1.1 Weed growth and invasion

Weed species are present and must be properly managed so they do not spread.

At the direct works zone weeds are to be managed by stopping seed spread on machinery, tools, equipment and worker clothes (e.g. boots). Additionally, after weed removal around the perimeter area of the construction, there must be continuous maintenance of the site otherwise it may result in increased weed growth, exacerbated by the high abundance of weeds present pre-works.

Weeds will colonize and pioneer on any cleared grounds so must be managed throughout the duration of the project as well as on-going post woks

7.1.2 Introduction of pathogens

The introduction of pathogens may occur into the site, and surrounding remnant bushland, 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 for Bushland Hygiene Protocols for Phytophora.

7.1.3 Soil disturbance and erosion

The removal of vegetation and trees can result in soil disturbance. The soil appears to be sodic thus erosion can occur at a faster rate. Soil compaction could occur from machinery use. It is recommended that soil compaction in non-built upon areas is to be avoided and not to occur within the trees to be retained Replacement of woody debris and a covering of organic matter over the cleared site will prevent erosion and thus is highly recommended.

7.1.4 Water Quality

There are no streams present onsite however the proposed actions may result in transport of sediment from the work zones because of increased storm water runoff to areas downstream. Which may impact water quality, riparian vegetation and aquatic fauna. Recommendations to maintain and improve water quality on site have been listed in section 10 below.

7.1.5 Livestock

Hard-hoofed animals, such as cattle, horses and sheep can accelerate habitat degradation, trample native vegetation and compact the soil, which prevents seedling growth and encourages soil erosion. These factors have been considered as indirect impacts associated with the proposal. Keeping of livestock may not significantly affect the native vegetation on site although it may increase the likelihood of other indirect impacts (soil erosion, weed invasion, decrease in water quality).

8 Serious and Irreversible Impact Assessment (SAII)

The following section provides details which address section 10.2 of the Biodiversity Assessment Method (BAM) and thus has referenced the guiding document *Guidance to assist a decision-maker to determine a serious and irreversible impact* in order to satisfy BAM requirements.

The document *Guidance to assist a decision-maker to determine a serious and irreversible impact* outlines the steps taken determine serious and irreversible impacts in section 3.2. The steps are as follows;

1. Step one: Identify relevant entities at risk of a SAII
2. Step two: Evaluate the extinction risk of the entity to be impacted
3. Step three: Detail measures taken to avoid, minimise and mitigate impacts on the entity
4. Step four: Evaluate a serious and irreversible impact
5. Step five decision making

8.1.1 Step one - Identify relevant entities at risk of a SAII

Following 3.2.1 in *Guidance to assist a decision-maker to determine a serious and irreversible impact;*

> *The Biodiversity Assessment Report (BAR) will identify species or ecological communities at risk of a SAII that are likely to be affected by the proposal. These entities are identified in the BAM Calculator (BAM-C). The front page of the credit report provided by the BAM-C will also identify all the entities that are considered to be at risk of a SAII and are impacted on by the proposal.*

The BAM-C Credit report can be found in appendix IV. The following section identifies SAII entities recognised by the BAM Calculator as being at risk of a serious and irreversible impact. Description of the principles for the Listed entities are available in the *Guidance to assist a decision-maker to determine a serious and irreversible impact.* The list of SAII entities identified by the document was accessed via;

https://www.environment.nsw.gov.au/topics/animals-and plants/biodiversity/biodiversity-offsets-scheme/serious-and-irreversible-impacts

Table 7. All SAII entity recognised by the BAM Calculator for the site.

Scientific Name	Common Name	Principles			
		1	2	3	4
Chalinolobus dwyeri	Large eared pied bat				**X**

8.1.2 Step two - Evaluate the extinction risk of the entity to be impacted

- **Large eared pied bat (*Chalinolobus dwyeri)***

Habitat removal for the Large eared pied bat (*Chalinolobus dwyeri)* is a serious concern as the species is unlikely to respond to management (Principle 4). Maternity or breeding habitat is not present for the species within the impact area or the site. Breeding habitat such as caves, outcrops, suitable hollows and other features which microbat species may use for breeding purposes for were not identified within the impact area.

The impact area hosts marginal foraging habitat for microbats in the form of canopy cover and insect abundance. These trees are expected to be removed, resulting in a further loss of marginal foraging habitat.

Foraging habitat will be lost, however it is expected that the trees are not significantly contributing towards the long-term survival of the species. The site may be used occasionally or opportunistically. It is expected that the local population of Large eared pied bat (*Chalinolobus dwyeri)* will not be significantly affected by the proposed development as they are highly mobile and may only use the site occasionally.

8.1.3 Step three - Detail measures taken to avoid, minimise and mitigate impacts on the entity

- **Large eared pied bat (*Chalinolobus dwyeri)***

It has been established that maternity or breeding habitat is not present within the impact area for the Large eared pied bat (Chalinolobus dwyeri). The impact area hosts marginal foraging habitat for the species in the form of canopy cover and insect abundance. To avoid additional disturbance on potential foraging habitat, only vegetation which requires removal because of proximity to the proposed building or the need to conform the bushfire protection requirements will be removed or modified.

Two microbat nest boxes are recommended for installation within the site bounadaries. This will increase the potential for microbats to roost in the area post development. Native species landscaping across the site is also recommended to increase potential habitat area for the Large eared pied bat (Chalinolobus dwyeri).

8.1.4 Step four - Evaluate a serious and irreversible impact

- **Large eared pied bat (*Chalinolobus dwyeri)***

Maternity or breeding habitat is not present within the impact area. The impact area hosts marginal foraging habitat for microbats in the form of canopy cover and insect abundance. Foraging habitat will lost, however it is expected that the trees are not significantly contributing towards the long-term survival of the species. The site may be used occasionally or opportunistically. It is expected that the proposal will not cause a disruption to the lifecycle to the Large eared pied bat (Chalinolobus dwyeri). Therefore, the species will not be placed at risk of a serious or irreversible impact.

Stage 3: Improving Biodiversity Values

9 Avoid and minimise impacts

The development will not significantly impact features outlined in table 8 below. The proposed actions will not affect water quality as there will be erosion and silt management controls on site to prevent runoff. Below is a table showing the potential impact the development would have on features that threatened species or communities can be dependent on.

Table 8. Expected impact on potential habitat onsite.

Feature	Present	Description of feature characteristics and location	Potential Impact	Threatened species or community using or dependent on feature	Section of the BAR where prescribed impact is addressed.
Karst, caves, crevices, cliffs or other geologically significant feature	No	N/A	N/A	N/A	N/A
Rocks	Yes	Scattered throughout	Negligible	N/A	N/A
Human made structure	Yes	House within the development site	Negligible	N/A	N/A
Non-native vegetation	Yes	Scattered throughout	Negligible	N/A	N/A

10 Recommendations

10.1.1 Native species landscaping

All landscaped areas should be planted with locally native species. This will provide greater foraging and nesting habitat for native species and will deliver greater biodiversity gain outcomes. These species should be selected in consultation with an ecologist for the greatest ecological outcome.

10.1.2 Weed management

Low impact bushland regeneration methods should be utilised to meet weed control performance criteria in all areas of remnant native vegetation, to prevent unnecessary impacts to native vegetation and disturbance to soil. Low impact bush regeneration methods include the manual removal of herbaceous weeds and their propagules by hand and with hand tools. All bush regeneration activities requiring the use of chemicals must be performed in accordance with the NSW *Pesticides Act 1999.* Herbicides must not be applied whilst exotic plants are setting seeds.

10.1.3 Delineation of work areas

During construction, impacts to the site and adjacent vegetation should be minimised by the delineation of works zones. Access to the site would be best restricted to the development footprint only. An environmental exclusion zone is proposed for vegetation outside work areas.

10.1.4 Vegetation clearing control measures

An ecologist should be present onsite during vegetation clearing to ensure no fauna are harmed as a result of clearing.

10.1.5 Tree Protection

Tree protection will be consistent with the Arborist report. Main trees to be managed are trees within close proximity to building works NB: see final tree survey for details and tree numbers.

10.1.6 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 III for further details. For key weed photo guide see Appendix VIII.

10.1.7 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.

10.1.8 Nest boxes

Installation of a 4 nest boxes designed for microbats should be added to the site to increase roosting opportunities in the area.

Image from: nestboxes.com.au

10.1.9 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.

11 Conclusion

The grand total to offset both ecosystem credits and species credits generated by this development is $62,487.41 (including GST), assuming payment will be made into the Biodiversity Conservation Fund. Several recommendations have been proposed to reduce the impact on the remaining vegetation during and post construction.

12 Appendices

12.1 Appendix I – Rationale for Likelihood of Occurrence

Rationale for Likelihood of Occurrence all Species Credit Species (candidate species) predicted by the BAM Calculator (BAM-C) and details whether the species have been retained or omitted from the calculator.

Where a species has a specific habitat constraint, which is not present within the subject land, or if the species is a vagrant within the IBRA subregion, the species is considered unlikely to occur and no further assessment is required. Additionally. in accordance with section 6.4.1.17 of the BAM, a candidate species credit species can be considered unlikely to occur within the subject land (or specific vegetation zones) where habitat is substantially degraded such that the species is unlikely to utilise area. As discussed in Sections 2 and 3, much of the vegetation within the subject land and 1,500 m buffer has been previously cleared, fragmented and is subject to ongoing disturbance.

A predicted candidate species credit species that is not considered to have suitable habitat on the subject land (or specific vegetation zones) in accordance with section 6.4.1.17 of the BAM does not require further assessment on the subject land (or specific vegetation zones). The reasons for determining that a predicted species credit species is unlikely to have suitable habitat on the subject land (or specific vegetation zones) has been included below for each Candidate Species for the BDAR.

Table 6. Potential Species Credit Species generated by the BAM-C, all the following species were candidate threatened species for the site. All BAM-C predicated species were retained.

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
Flora				
Camarophyllopsis kearneyi		Known only from its type locality in Lane Cove Bushland Park in the Lane Cove local government area in the Sydney metropolitan region. Its occurrence appears to be limited to the Lane Cove Bushland Park. Surveys in potentially	No	It is unlikely that the species would occur on site due to lack of optimal habitat characteristics. The site is not in or adjacent to Lane Cove Bushland Park – which is the only known population In the Sydney Basin.

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
		suitable habitats elsewhere in the Sydney Basin Bioregion have failed to find *Camarophyllopsis kearneyi*. Does not produce basidiomes (above-ground fruiting structures) all year, but may be present only as non-reproductive hyphal structures below ground.		The species has not been recorded on site during 2020 surveys, nor has it been recorded in previous surveys on the subject site. No Bionet recordings within 10km radius. Species is not present and is unlikely to be present on the subject land. No further assessment is required.
Grevillea shiressii		Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils. Flowers mainly late winter to Spring (July-December), with seed released at maturity in October. Flowers are bird pollinated and seeds are dispersed by ants. A fire sensitive obligate seeder that is highly susceptible to local extinction due to frequent fire, however, fire is likely to be relatively infrequent in the habitat of *G. shiressii*. Seed germination does occur in the absence of fire, however some physical disturbance is likely to promote seed germination.	No	Species automatically unselcted as candidate species as development site not within the Central Coast LGA – which is a geographic limitation for the species in BAM-C.

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
Hygrocybe anomala var. *ianthinomarginata*		Occurs in gallery warm temperate forests dominated by Lilly Pilly (*Acmena smithii*), Grey Myrtle (*Backhousia myrtifolia*), Cheese Tree (*Glochidion ferdinandi*) and Sweet Pittosporum (*Pittosporum undulatum*). Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates include soil, humus, or moss. Does not produce above ground fruiting bodies (fungus) all year round. Fruiting bodies begin appearing mid May to mid July sometimes to August.	No	It is unlikely that the species would occur on site due to lack of optimal habitat characteristics. The site is not in or adjacent to Lane Cove Bushland Park – which is the only known population In the Sydney Basin. The species has not been recorded on site during 2020 surveys, nor has it been recorded in previous surveys on the subject site. No Bionet recordings within 10km radius. Species is not present and is unlikely to be present on the subject land. No further assessment is required.
Rhodamnia rubescens	Scrub Turpentine	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	No	The site presents poor habitat for the species. Site not considered optimal habitat for the species. Due to current and historical land use (bushland management) may decrease likelihood of occurrence within in impact area. No records of the species on site from this survey or previous vegetation surveys on site. Species is not present and is unlikely to

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
				be present on the subject land. No further assessment is required.
Rhodomyrtus psidioides	Native Guava	Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	No	The site presents poor habitat for the species. Site not considered optimal habitat for the species. Due to current and historical land use (bushland management) may decrease likelihood of occurrence within in impact area. No records of the species on site from this survey or previous vegetation surveys on site. Species is not present and is unlikely to be present on the subject land. No further assessment is required.

Scientific Name	Common Name	Habitat/ Geographic Constraints	Retained in BAM Calculator	Reason for Inclusion or Removal
Fauna				
Chalinolobus dwyeri	Large-eared Pied Bat	Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin	Yes	Marginal foraging habitat for the species is present on site as there are several eucalyptus sp. The species is highly mobile and it is expected that the site may be used

		(*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.		occasionally or opportunistically for foraging purposes. The are no areas of optimal breeding habitat on site as the species breeds in caves or on cliff overhnags. Species retained as a candidate species in the BAM-C due to marginal foraging habitat opportunities. Species assumed present. No further assessment is required.
Lathamus discolor	Swift Parrot	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.	Yes - (retained as a predicted species for foraging purposes). No - (excluded as a candidate species for breeding purposes).	Marginal foraging habitat for the species is present on site due to canopy coverage. Therefore, the species has been retained as a predicted species for foraging purposes on site. There are no optimal breeding opportunities within site boundaries due to lack of surrounding optimal foraging habitat. It is known that the species breeds only in Tasmania with excludes the species from breeding on site. Additionally, species not recorded during site surveys and limited recordings on Bionet within 10 Km radius of the site. Therefore, limited nesting availability for the species within the impact area and thus breeding excluded from BAM calculator.

				No further assessment or consideration is required.
Miniopterus australis	Little Bent-winged Bat	Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows 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 Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats (*M. schreibersii*) and appears to depend on the large colony to provide the high temperatures needed to rear its young.	Yes - (retained as a predicted species for foraging purposes). No - (excluded as a candidate species for breeding purposes).	The site presents marginal habitat for the species in the form of foraging opportunities. Expected that the species uses the site for foraging for insects. The species is a cave dwelling species and therefore would not be expected to roost within impact areas. The site is not within the known five nursery sites /maternity colonies in Australia. Therefore species retained as potentially occurring for foraging purposed but breeding within the site is unlikely due to lack of structure (caves, cliff overhangs, rocky outcrops).Optimal habitat sites on Bionet including Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave", observation type code "E nest-roost" with numbers of individuals >500 not recorded within 10km of the site. Site would not be considered optimal breeding habitat for the species. No further assessment is required.
Miniopterus orianae oceanensis	Large Bent-winged Bat	Primarily roosts in caves but will utilise mine shafts, storm-water tunnels, buildings	Yes - (retained as a predicted species for	The site presents marginal habitat for the species in the form of foraging

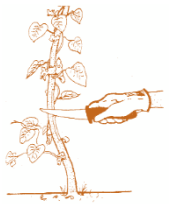
		and other man-made structures. Forms colonies within a maternity cave and disperse within a 300km range. Forage in forested areas in the tree canopy.	foraging purposes). No - (excluded as a candidate species for breeding purposes).	opportunities. Expected that the species uses the site for foraging for insects. The species is a cave dwelling species and therefore would not be expected to roost within impact areas. The site is not within the known five nursery sites /maternity colonies in Australia. Therefore species retained as potentially occurring for foraging purposed but breeding within the site is unlikely due to lack of structure (caves, cliff overhangs, rocky outcrops).Optimal habitat sites on Bionet including Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave", observation type code "E nest-roost" with numbers of individuals >500 not recorded within 10km of the site. Site would not be considered optimal breeding habitat for the species. No further assessment is required.
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	Yes - (retained as a predicted species for foraging purposes). No - (excluded as a candidate	Marginal foraging habitat for the species is present on site as there are several foraging tree species. A low likelihood of occurrence due to the vegetation not being within or located near Box-Ironbark woodland. The species has

		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.	species for breeding purposes).	been retained as a predicted species for foraging purposes onsite. There is no optimal breeding opportunities within site boundaries to the marginal foraging characteristic onsite. Mistletoes did not present at a density of greater than five mistletoes per hectare, which is a key habitat constraint. Further diminishing the likelihood that the species would use the site for breeding purposes. Therefore, limited nesting availability for the species within the impact area and thus breeding excluded from BAM calculator. No further assessment or consideration is required.

12.2 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.

12.3 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.

Contact Hornsby Bushcare if you require any refills or replacements of your Phytophthora Kits on 9484 3677 or bushcare@hornsby.nsw.gov.au

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.

12.4 Appendix IV– BAM –C; Reports and Data

12.4.1 Payment Report.

12.4.2 Credit Summary Report.

12.4.3 Predicted species report.

12.4.4 Candidate species report

12.4.5 Biodiversity Credit Report (Like for Like)

12.5 Appendix V – Species Polygon

Figure 8. The species polygon below is appropriate for all four species credit species generated in this BDAR.

12.6 Appendix V – Requirements of a BDAR Checklist

Appendix 12: Requirements for a Biodiversity Development Assessment Report – streamlined assessment modules

Table 28: Minimum information requirements for the Biodiversity Development Assessment Report – streamlined assessment modules

Report section	Information	Maps & data	BAM reference
Introduction	Introduction to the biodiversity assessment including: • identification of development/ footprint, including the operational footprint • general description of development • sources of information used in the assessment, including reports and spatial data (optional).	• Site Map (as described in Section 4.2) • Location Map (as described in Section 4.2) • Digital shape files for all maps and spatial data	
Landscape features	Identification of landscape features at the development site including: • IBRA bioregions and subregions • any landscape feature • site context components, including percent native vegetation cover in the buffer area.	• IBRA bioregions and subregions (as described in Paragraphs 4.2.1.3–4.2.1.4)	Sections 4.2 and 4.3, Appendix 3
Native vegetation	Identify the PCTs within the development site, including: • vegetation class • vegetation type • area (ha) for each PCT • information used to identify a PCT being field assessment or best available native vegetation map (as outlined in Paragraph 5.2.1.12) • Identify each TEC and area (as outlined in Paragraphs 5.2.1.14–5.2.1.15) • patch size (development site and biodiversity stewardship site) • table showing the vegetation integrity score for each vegetation zone.	• Map of PCTs within the development /biodiversity stewardship site • Map of EECs • Table of plot data for each attribute • Patch size of intact native vegetation (as described in Subsection 5.3.2) • Table of current vegetation integrity scores for each vegetation zone	Chapter 5

Report section	Information	Maps & data	BAM reference
Threatened species	Identify ecosystem credit species associated with PCTs on both the development site and biodiversity stewardship site as outlined in Section 6.2, including: • list of species derived • justification for exclusion of any ecosystem credit species predicted above. Where required, identify species credit species on both the development site and the biodiversity stewardship site as outlined in Sections 6.3 to 6.5, including: • list of candidate species assessed • justification for inclusions and exclusions based on habitat features • indication of presence based on targeted survey or expert report • details of targeted survey • species polygons • biodiversity risk weighting for the species • threatened species survey. Table detailing species and habitat feature/component associated with species and its abundance on site (as described in Paragraph 6.4.1.34 Expert report if it was used in place of targeted survey.	• Table of habitats or habitat components and their sensitivity classes for each species • Species credit species polygons (as described in Paragraph 6.4.1.33)	Chapter 6
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Section 8. Assessment of direct and indirect impacts unable to be avoided at the development site in accordance with Sections 9.1 and 9.2.	• Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility	Chapter 8
Impact summary	Description of the impact on PCTs/TECs Description of the impact on threatened species Table showing for each PCT/TEC for each vegetation zone at the development site: • current vegetation integrity score	• Table of PCTs requiring offset and the number of ecosystem credits required	Subsections 11.2.3 and 11.2.4

Appendix 12: Requirements for a BDAR -

Report section	Information	Maps & data	BAM reference
	• future vegetation integrity score (Equations 17 and 18 in Appendix 6) • change in vegetation integrity score (Subsection 9.1.3) • biodiversity risk weighting • BC Act listing status • number of required ecosystem credits for each PCT (Subsection 11.2.3) • name of each species assessed for species credits and the number of credits required for species (Subsection 11.2.4).	• Table of threatened species requiring offset and the number of species credits required	
Biodiversity credit report	Credit classes for ecosystem credits and species credits at the development site.	• Produced by the BAM Credit Calculator	Section 11.3

13 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 Hastings

ECOLOGIST

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.

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.**