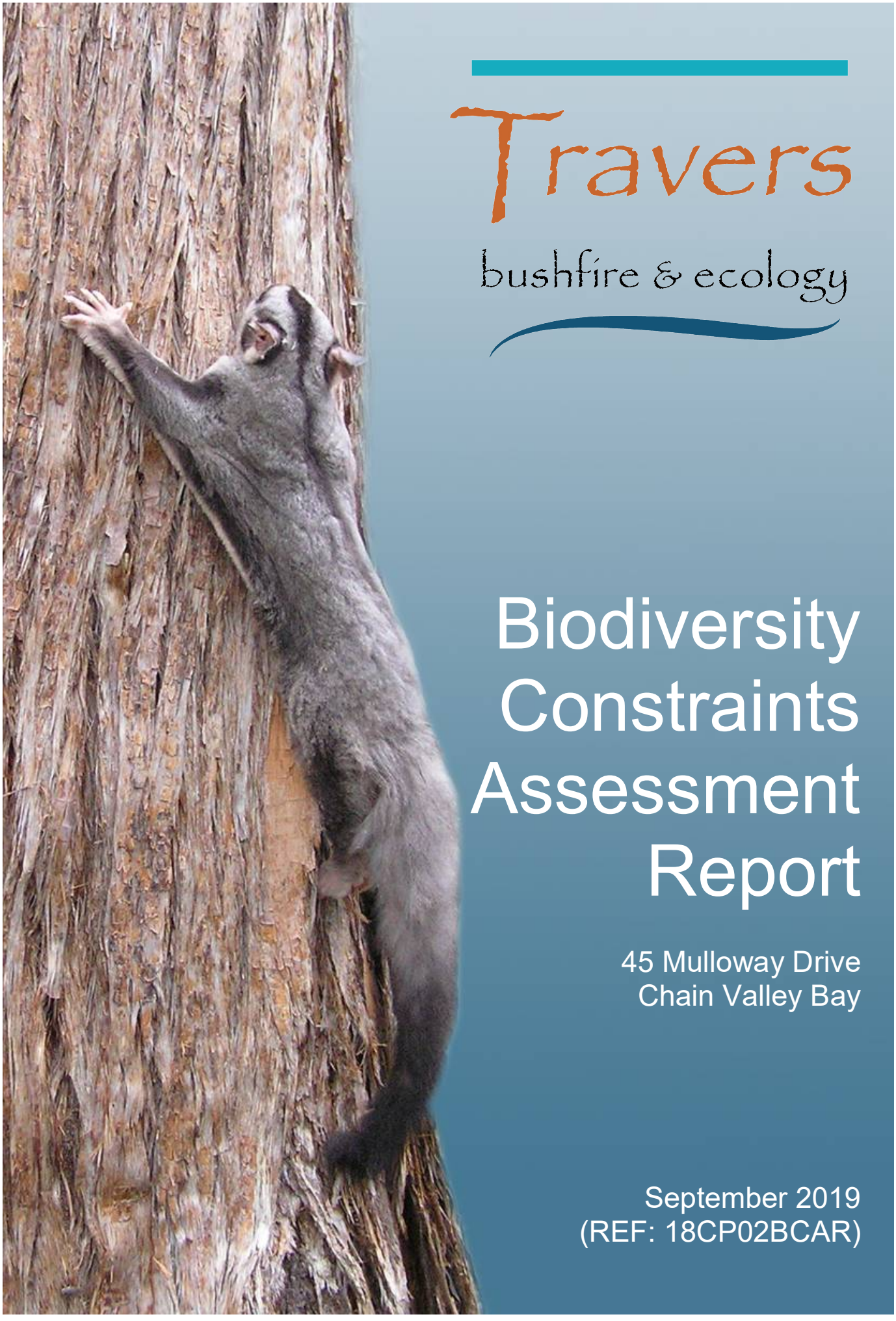

Travers

bushfire & ecology

# Biodiversity Constraints Assessment Report

45 Mulloway Drive
Chain Valley Bay

September 2019
(REF: 18CP02BCAR)

# Biodiversity Constraints Assessment Report

**45 Mulloway Drive**
**Chain Valley Bay**

| | |
|---|---|
| Report authors: | Michael Sheather-Reid B. Nat. Res. (Hons.) – Managing Director Accredited Assessor no. BAAS17085<br>George Plunkett B. Sc. (Hons.), PhD – Botanist – Accredited Assessor no. BAAS19010<br>Robert Sansom B. Sc. (Hons.) – Botanist<br>Corey Mead B. App. Sc. – Senior Fauna Ecologist<br>Bronte Talbot B. Env. Sc. Mgmt. – Ecologist |
| Plans prepared: | Sandy Cardow B. Sc.<br>Bronte Talbot B. Env. Sc. Mgmt. |
| Approved by: | Michael Sheather-Reid (Accredited Assessor no. BAAS17085) |
| Date: | 24/09/19 |
| File: | 18CP02BCAR |



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*The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.*

TBE Environmental Pty Ltd
ABN 85 624 419 870
PO Box 7138
Kariong NSW 2250

38A The Avenue
Mt Penang Parklands
Central Coast Highway
Kariong NSW 2250

t: 02 4340 5331
e: info@traversecology.com.au
www.traversecology.com.au

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# List of abbreviations

| | |
|---|---|
| APZ | asset protection zone |
| BAM | Biodiversity Assessment Method |
| BAR | Biodiversity Assessment Report |
| *BC Act* | *Biodiversity Conservation Act (2016)* |
| *BC Reg* | *Biodiversity Conservation Regulation (2017)* |
| BCAR | Biodiversity Constraints Assessment Report |
| BDAR | Biodiversity Development Assessment Report |
| BOS | Biodiversity Offset Scheme |
| BPA | bushfire protection assessment |
| BSSAR | Biodiversity Stewardship Site Assessment Report |
| CEEC | Critically endangered ecological community |
| *CM Act* | *Coastal Management Act 2016* |
| DCP | development control plan |
| DEC | NSW Department of Environment and Conservation (superseded by DECC from April 2007) |
| DECC | NSW Department of Environment and Climate Change (superseded by DECCW from October 2009) |
| DECCW | NSW Department of Environment, Climate Change and Water (superseded by OEH from April 2011) |
| DEWHA | Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC) |
| DOEE | Commonwealth Department of Environment & Energy |
| EEC | endangered ecological community |
| EPA | Environmental Protection Agency |
| *EP&A Act* | *Environmental Planning and Assessment Act (1979)* |
| *EPBC Act* | *Environment Protection and Biodiversity Conservation Act (1999)* |
| *FM Act* | *Fisheries Management Act* |
| IBRA | Interim Biogeographic Regionalisation for Australia |
| LEP | local environmental plan |
| LGA | local government area |
| *LLS Act* | *Local Land Services Act (2013*) |
| NES | national environmental significance |
| *NPW Act* | *National Parks and Wildlife Act (1974)* |
| NSW DPI | NSW Department of Industry and Investment |
| OEH | Office of Environment and Heritage |
| PCT | plant community type |
| PFC | projected foliage cover |
| RFS | NSW Rural Fire Service |
| ROTAP | rare or threatened Australian plants |
| SAII | Serious And Irreversible Impacts |
| SEPP | State Environmental Planning Policy |
| SEWPAC | Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE) |
| SIS | species impact statement |
| SULE | safe useful life expectancy |
| TEC | threatened ecological community |
| TPZ | tree preservation zone |
| *TSC Act* | *Threatened Species Conservation Act (1995) – Superseded by the Biodiversity Conservation Act (2016)* |
| VMP | vegetation management plan |

# Biodiversity Assessment

## 1.0 Background

*Travers bushfire & ecology* has been engaged to undertake a biodiversity constraints assessment within Lot 5 DP 1228880, at 45 Mulloway Drive, Chain Valley Bay within the Central Coast local government area (LGA). The extent of this entire lot is shown in Figure 1. This lot is subject to a proposed retirement village development application and will hereafter be referred to as the 'study area'.

The area containing the proposed development and APZs is hereafter referred to as the 'subject site' (see Figure 1).

The proposal shall be assessed under the *Biodiversity Conservation Act* (BC Act), 2016.

**Figure 1** – Study area (red) and subject site (yellow)

## 1.1 Proposed development

The concept proposal is shown in Figure 2 below. The layout seeks to provide an extension of the Valhalla development (by Gateway Lifestyle) which occurs on the western boundary, which is a retirement village. The concept plan will retain existing dwellings in the northern portion of the property, but will utilise the disturbed area in the central portions of the site. The vegetation near the southern boundary adjacent to Karignan Creek will be retained where possible.

Access to the site will be provided via two private access roads from the existing Valhalla development to the west and a single access directly onto Chain Valley Bay Road in the west as shown in Figure 2.

**Figure 2** – Draft Masterplan
*(Source – Mako Architecture Nov 2018 – Version 9 – November 2018)*

## 1.2 Site description

Table 1 examines the landscape features of the proposed development site in accordance with the biodiversity assessment methodology (BAM). The proposal will be a Part 4 development (general).

**Table 1** – Site features

| | |
|---|---|
| **Lot / DP** | Lot 5 DP 1228880 |
| **Address** | 45 Mulloway Road, Chain Valley Bay |
| **Local government area** | Central Coast (formerly, Wyong) |
| **Coordinates** | 367600E 6328200N (GDA94) AMG zone 56 |
| **Lot size** | 10.61ha |
| **IBRA bioregions and subregions** | Sydney Basin bioregion – Wyong subregion |
| **NSW landscape region and area (ha)** | Wyong; Gosford - Cooranbong Coastal Slopes. |
| **Zoning** | E3 |
| **Native vegetation extent in the 1,500m buffer area** | 70.3% |
| **Cleared areas** | The majority of the study area has been previously cleared for agricultural or pastoral usage. There are some existing dwellings in the study area, those in the northern portion will be retained. There are small pockets of disturbed vegetation across the property, largely along the western boundary, around the dam near the centre part of the site, and some scattered trees in the road reserve along the eastern boundary. The southern remnant of vegetation is moderate-good quality with good connectivity features and part of the Karignan Creek riparian corridor. |
| **Evidence to support differences between mapped vegetation extent and aerial imagery** | Ground-truthed vegetation closely matches aerial imagery.<br><br>Interpretation of 'native vegetation' as per the *Local Land Services Act 2013* (*LS Act*) and *Biodiversity Conservation Act 2016* (*BC Act*) definition. |
| **Connectivity features** | The southern remnant has excellent connectivity features along Karignan Creek to the west of the site. It links to extensive vegetation to the east which is partly conserved within the Lake Macquarie State Conservation Area. |
| **Patch size** | Very extensive. 2,000ha was input into the calculator. |
| **Areas of geological significance and soil hazard features** | Geology; Munmorah Conglomerate across most of the site, Quaternary Alluvium in Karignan Creek.<br>Soils: Doyalson Soil Landscape across most of the site, Wyong Soil Landscape or Tacoma Swamp Soil Landscape along Karignan Creek. |
| **Identification of method applied (i.e. linear or site-based)** | Site based assessment. |


**Figure 3** – Flora and Fauna Survey Effort and Results

## 2.0 Biodiversity Offsets Scheme (BOS)

The *BC Act* repeals the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and the animal and plant provisions of the *National Parks and Wildlife Act 1974*.

Together with the *Biodiversity Conservation Regulation 2017*, the *BC Act* establishes a new regulatory framework for assessing and offsetting biodiversity impacts on proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme (BOS). Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the new Biodiversity Assessment Method (BAM).

### 2.1 Threshold assessment

The BOS includes two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the BOS applies to the proposed clearing.

#### *2.1.1 Sensitive Biodiversity Land Map*

Sensitive Biodiversity Values Land has been mapped within the south of study area (purple areas in Figure 4) – an offset is required for any development within the mapped Biodiversity Values Land. Figure 4 shows the approximate position of the concept proposal (development area - blue) in relation to those areas (coloured purple) as having biodiversity values. Based on the current concept proposal, Biodiversity Values Land may be impacted and an offset will be required under this trigger.

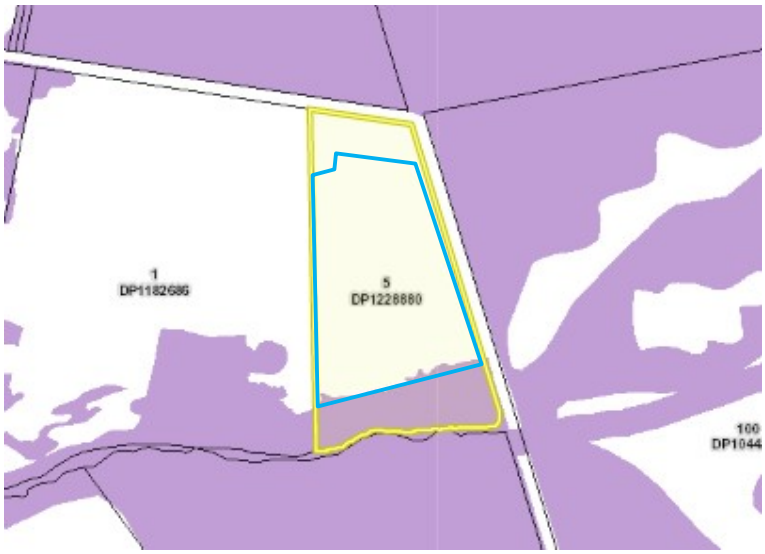



**Figure 4** – Biodiversity value land (purple) relative to the study area (yellow)
*(Source: OEH – Biodiversity Values Map – 4 July 2019)*

### *2.1.2 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).

**Table 2 – BOS entry threshold report**

| | | |
|---|---|---|
| **Date of Calculation** | 28/06/2019 11:02 AM | **BDAR Required*** |
| **Total Digitised Area** | 6.72 ha | |
| **Minimum Lot Size Method** | Lot size | |
| **Minimum Lot Size** | 10.87 ha | |
| **Area Clearing Threshold** | 0.5 ha | |
| **Area clearing trigger**<br>Area of native vegetation cleared | Unknown # | Unknown # |
| **Biodiversity values map trigger**<br>Impact on biodiversity values map(not including values added within the last 90 days)? | no | no |
| **Date of the 90 day Expiry** | N/A | |

Table 2 identifies that the BOS entry threshold report has determined the area threshold based on the actual lot size of 10.87ha, and the area clearing threshold for which the BOS applies is 0.5ha. Clearing of 'native vegetation' that exceeds 0.5ha will require a biodiversity offset to be obtained. Note that 'native vegetation' includes planted native species and remnant trees. The based on the concept proposal, the development will impact more than 0.5ha of remnant native vegetation within the study area, therefore offsetting will be required under this trigger.

Modification of the development layout to reduce the impact on native vegetation to below 0.5ha will avoid offsetting under this trigger.

## 2.2 Serious and irreversible impacts on biodiversity values

Development consent cannot be granted for non-State significant development under Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) if the consent authority is of the opinion it is likely to have serious and irreversible impacts (SAII) on biodiversity values.

The determination of SAII is to be made in accordance with principles prescribed section 6.7 of the *BC Regulation* (2017). The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales.

Candidate SAII entities/species recorded or with potential to occur include:

- Eastern Bentwing-bat (recorded)
- Little Bentwing-bat (recorded)
- Swift Parrot
- Regent Honeyeater

The ecological data profiles of each of the above listed candidate species has been reviewed to determine any habitat constraints present. There is no presence of breeding habitat (caves) for the two Bentwing-bats and the proposal will not likely remove any important winter flowering trees for the two winter migratory bird species, therefore the proposal is not considered likely to cause serious and irreversible impacts.

# 3.0 Flora

## 3.1 Survey

A field inspection was previously undertaken by Botanist, Mr Robert Sansom (B. Sc. (Hons.)) on 24 November 2018 for constraints assessment purposes over the time frame of approximately 4hrs. This field inspection was restricted to the allotment as shown in Yellow within Figure 2 and was undertaken within the study area primarily to confirm the plant community types (PCTs) and to determine the ecological and habitat value of the site.

Two (2) 20 x 20 metre flora quadrats were undertaken within the existing native or remnant vegetation of the lot to assist in the identification of any PCT present.

Random meanders throughout the subject site were also undertaken to determine the value of native or non-native vegetation and to undertake habitat assessments and threatened species searches across the whole of the site for potential flora and fauna species.

Vegetation boundaries were drawn to the approximate extent of any drip line. Opportunistic threatened flora searches were undertaken during stratified surveys.

Botanical survey was undertaken to collect data for entry into the credit calculator on 14 February 2019 over a time frame of approximately 7hrs. This included the placement of three (3) BAM plots at selected locations and included some opportunistic survey for *Cryptostylis hunteriana* (may continue flowering to February but usually early summer), *Corunastylis sp. Charmhaven* (flowers Feb-Mar) and *Acacia bynoeana.* Survey was conducted over remnant patches in the proposed development area, but very restricted in the riparian area in the southern portion of the study area.

All naturally occurring species were identified to species level where possible, and are listed in Appendix 1.

## 3.2 Vegetation communities

Within the study area native vegetation occurs as scattered remnant trees within large areas of pastoral land or as large contiguous polygons along the western and southern boundaries of the lot. There are also areas (approximately 1.4ha) of household gardens surrounding the large shed and northern and central dwellings.

The vegetation in the locality and within the whole of the study area has been mapped within *The natural vegetation of the Wyong Local Government Area, Central Coast, New South Wales* (S. A. J. Bell, 2002) as Map Unit 31 – Narrabeen Doyalson Coastal Woodland.

The Coastal Woodland vegetation within the northern parts of the site corresponds to *Scribbly Gum – Red Bloodwood – Angophora inopina heathy woodland on lowlands of the Central Coas*t (PCT 1636).

The vegetation patch in the southern parts of the site contains Riparian Forest which is commensurate with Swamp Mahogany – Flaxleaved Paperbark swamp forest on coastal lowlands of the Central Coast (PCT 1718). Our quadrat and ecological survey results support these PCT classifications.

The Coastal Woodland vegetation within the study site (PCT 1636) is listed as being associated with the *Kincumber Scribbly Gum forest in the Sydney Basin Bioregion (Part)* Threatened Ecological Community (TEC) listed under the *Biodiversity Conservation Act 2016* (BC Act). However, Kincumber Scribbly Gum Forest is restricted to a small area on the Bouddi Peninsula on the NSW Central Coast south of Kincumber. It only occurs in the

Gosford LGA. Therefore the Coastal woodland vegetation within the study area does not correspond to the Kincumber Scribbly Gum Forest TEC.

The remaining vegetation in the study area occurs as planted trees, garden beds and managed cropping and pastoral areas.

## 3.3 Description of Vegetation

There are three (3) vegetation types present within the study area as shown in Figure 3. These are:

- Coastal Woodland
- Riparian Forest , and
- Household Gardens and Lawns

*Coastal Woodland*

This vegetation community describes all non-floodplain vegetation located within the study area, and occupies approximately 1.12 ha.

*Canopy*

*Angophora costata, Eucalyptus haemastoma, Corymbia gummifera* and *Eucalyptus capitellata* are the dominant species, 14-22m tall with a highly variable projected foliage cover between 2-40%.

*Sub-canopy*

*Allocasuarina littoralis*. Vegetation height to 12m tall.

*Mid-storey*

*Acacia longifolia, Lambertia formosa, Hakea dactyloides, Banksia oblongifolia* and within moister areas, *Melaleuca sieberi*.
Vegetation 1-4m tall and where present a highly variable projected foliage cover of 1-10%. Cover is variable due to the impacts of past and ongoing land uses.

*Ground layer*

*Epacris pulchella, Gonocarpus teucrioides, Pimelea linifolia*, Lomatia silaifolia, *Bossiaea heterophylla, Platysace linearifolia, Xanthorrhoea latifolia, Patersonia sericea, Lomandra obliqua, Dianella caerulea, Lindsaea linearis,* and *Actinotus minor*.
Grasses include *Entolasia stricta, Eragrostis brownii, Themeda triandra, Panicum simile, Oplismenus aemulus, Imperata cylindrica* and *Anisopogon avenaceus*.

Classification

The Coastal Woodland corresponds to PCT 1636 – Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland on lowlands of the Central Coast. This vegetation is also associated with the Threatened Ecological Community (TEC) known as Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion (Part) as listed within the NSW *BC Act* (2016). However, Kincumber Scribbly Gum Forest is restricted to a small area on the Bouddi Peninsula on the NSW Central Coast south of Kincumber. It only occurs in the Gosford LGA. Therefore the Coastal woodland vegetation within the study area is not commensurate with the Kincumber Scribbly Gum Forest TEC.

*Photo 1 – Coastal Woodland (PCT 1636) looking north from Quadrat 2, Note predominance of native species within the ground layer.*

*Photo 2 – Coastal Woodland (PCT 1636) located in a patch to the west of the large dam. Note the largely intact native ground layer*

*<u>Riparian Forest</u>*

This vegetation community describes the floodplain vegetation in the southern portion of the study area. The vegetation is upon slightly hummocky grounds with small areas of intermittent soaks as well as mounds, thus there is a mixture of species that occur regularly in Swamp Sclerophyll vegetation as well as others that occur more regularly in drier locations but can handle the rare flood event. This vegetation community occupies approximately 2.3ha within the study area.

*Canopy*

*Eucalyptus robusta, Angophora costata, Eucalyptus capitellata* and *Melaleuca quinquenervia* are the dominant species 12-23m tall and with a projected foliage cover of 20-40%.

*Mid-storey*

*Melaleuca sieberi, Melaleuca linariifolia, Acacia longifolia, Kunzea ambigua, Allocasuarina littoralis*. Vegetation 1-12m tall and average projected foliage cover of 15-40%.

*Ground layer*

*Gahnia spp., Pteridium esculentum, Centella asiatica, Goodenia heterophylla, Pimelea linifolia, Gonocarpus teucrioides, Pultenaea palacea.*
Grasses include *Imperata cylindrica, Entolasia stricta* and *Panicum simile*.

*Classification*

The Riparian Forest (PCT 1718) vegetation community corresponds to the Endangered Ecological Community (EEC) known as *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South-east Corner Bioregions* as listed within the NSW Biodiversity Conservation Act (2016).

*Photo 3 – Riparian Forest (PCT 1718) within Quadrat 1*

<u>*Household Gardens and Lawns*</u>

This vegetation is typically found surrounding dwellings and consists of mostly exotic tree, shrub and ground layer species. There may be a few remnant native trees, however the exotic trees, shrubs and groundcovers are dominant or more numerous.

*Canopy*

Various horticultural, ornamental or exotic species including *Morus sp.* (Mulberry), *Callitris sp.*, *Jacaranda, Acer, Callistemon viminalis, Lagerstroemia sp.* (Crepe Myrtle), *Liquidambar, Acmena sp.* (Lillypilly), *Notelaea sp.* (Mock Olive), *Melia azedarach* and *Prunus sp*. were common species 6-14m tall and with a variable projected foliage cover of 3-40%. There were some remnant native trees in the north-eastern most corner of the study area.

*Mid-storey*

*Buxus sp., Frangipani sp., Schefflera sp.,* various exotic palms, and a suite of fruit trees. Vegetation 3-8m tall and average projected foliage cover of 3-35%.

*Ground layer*

Various exotic garden plants such as *Canna sp., Agapanthus sp., Hedychium gardnerianum*, *Passiflora sp*., and weeds such as *Verbena, Conyza, Plantago, Taraxacum, Trifolium* and *Solanum.*
Grasses included *Cynodon dactylon, Paspalum dilatatum, Pennisetum clandestinum* and *Poa annua*.

*Photo 4 – Household Gardens near the northern dwelling*

*Photo 5 – Household gardens and trees to the east of the central dwellin*

## 3.4 Threatened flora species

The NSW Bionet database and the Commonwealth Protected Matters Search Tool were accessed to provide an indication of the threatened flora present within a 10km radius of the study area. Table 3 lists all recorded threatened flora species within 10km and whether they have potential habitat.

**Table 3 – Threatened flora potential habitat**

| Scientific name | *BC Act* status | *EPBC Act* status | Potential to occur | Survey period (OEH) |
|---|---|---|---|---|
| *Angophora inopina* | V | V | ✓ | all months |
| *Genoplesium insigne* | E4A | CE | ✓ | Sept–Nov |
| *Tetratheca juncea* | V | V | ✓ | July–Dec |
| *Callistemon linearifolius* | V | - | low | Sept–March |
| *Cryptostylis hunteriana* | V | V | low | Nov–Jan |
| *Diuris praecox* | V | V | low | July–Sept |
| *Eucalyptus camfieldii* | V | V | low | all months |
| *Rutidosis heterogama* | V | V | unlikely | all months |

No threatened flora species were observed within the study area during the initial biodiversity constraints inspection. There is potential habitat within the study area for several threatened flora species as listed in Table 3.

The native vegetation within the study area is limited to small patches of remnant Coastal Woodland and an area of Riparian Forest. The majority of the proposed development area has been disturbed by past and ongoing disturbances such as native vegetation clearing, pastoral land uses, invasion by exotic pasture species and trampling by hooved livestock.

Therefore the disturbed parts of the study area provides limited habitat for any threatened flora species.

Additional targeted surveys for threatened flora will be required in the future depending on the proposed development. Note that some of the species are cryptic and may require adequate survey during flowering or fruiting at various times of the year, as shown in Table 3.

## 3.5 Endangered flora populations

One (1) threatened flora population is known within 10km. This population is:

- *Eucalyptus parramattensis C. Hall ssp. parramattensis* in the Wyong and Lake Macquarie local Government Areas.

No specimens of *Eucalyptus parramattensis subsp. parramattensis* were observed within the study area during the initial biodiversity constraints inspection. It is considered that the presence of this species within the study area is unlikely.

## 3.6 Threatened ecological communities

As stated previously, the Coastal Woodland (PCT 1636) has some affinity to Kincumber Scribbly Gum Forest (KSGF). However KSGF is restricted to a small area on the Bouddi Peninsula on the NSW Central Coast south of Kincumber. It only occurs in the Gosford LGA. Therefore the Coastal woodland vegetation within the study area does not correspond to the Kincumber Scribbly Gum Forest TEC.

The Riparian Forest (PCT 1718) vegetation community corresponds to the Threatened Ecological Community (TEC) known as *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South-east Corner Bioregions* as listed within the NSW Biodiversity Conservation Act (2016).

## 3.7 State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017

The *State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017* (Vegetation SEPP) was one of a suite of Land Management and Biodiversity Conservation (LMBC) reforms that commenced in New South Wales on 25 August 2017. The Vegetation SEPP (the SEPP) works together with the *Biodiversity Conservation Act 2016* and the *Local Land Services Amendment Act 2016* to create a framework for the regulation of clearing of native vegetation in NSW.

The SEPP will ensure the BOS (established under the Land Management and Biodiversity reforms) will apply to all clearing of native vegetation that exceeds the offset thresholds in urban areas and environmental conservation zones that does not require development consent.

Vegetation SEPP applies to the following local government areas: *Bayside, City of Blacktown, Burwood, Camden, City of Campbelltown, Canterbury-Bankstown, Canada Bay, Cumberland, City of Fairfield, Georges River, City of Hawkesbury, Hornsby, Hunter's Hill, Georges River, Inner West, Ku-ring-gai, Lane Cove, City of Liverpool, Mosman, Newcastle, North Sydney, Northern Beaches, City of Parramatta, City of Penrith, City of Randwick, City of Ryde, Strathfield, Sutherland Shire, City of Sydney, The Hills Shire, Waverley, City of Willoughby, Woollahra.*

As 'development consent' is required for the proposed works the Vegetation SEPP does not apply.

# 4.0 Fauna

## 4.1 Survey / Habitat assessment

Fauna diurnal survey was undertaken on the 26/6/19. Diurnal fauna survey included:

- 3x bird census points (out to a radius of 30-50m for 30 minutes),
- Opportunistic bird call and activity survey between census points,
- Mammal activity searches (scats, scratches, diggings, burrows, etc)
- Habitat tree survey within the subject site,
- Searches of significant habitat trees within the retained vegetation to the south

Significant habitat trees are defined as trees containing large hollows suitable for owls/cockatoos and/or two or more good quality medium hollows and/or several small hollows and/or a tree showing notable use by a threatened species (eg. sap feed tree, raptor nest tree, microbat roost, etc).

Weather conditions at the time of diurnal survey were 4/8 cloud, light SE wind, previous days rain, 17-19$^{o}$C between 11:00 – 16:00.

Nocturnal fauna survey was undertaken on the following day 27/6/19 and included:

- Stag-watching of habitat trees HT8 & HT12 during and following the dusk period,
- Spotlighting,
- Frog call identification,
- Ultrasonic microbat recording (x2 passive recording stations),
- Owl calling (Masked Owl)

Weather conditions at the time of nocturnal survey were 0/8 cloud, no wind, no rain (but previous week much rain), no moon, 16-14$^{o}$C between 17:00 – 19:20.

Specific survey effort locations and results are shown on Figure 3. All fauna species recorded during survey within the subject site and nearby surrounds are listed in Table A1.2 in Appendix 1.

A review of the Atlas of NSW Wildlife (OEH 2019) was undertaken prior to the site visit to determine threatened species previously recorded within 10km of the subject site.

The following notable habitat features were observed present:

- Trees containing mostly small (0-10cm) and some medium (10-30cm) hollows within the subject site,
- A patch of trees to the south containing large hollows suitable for large forest owls, most notably Masked Owl given their density, some being vertical spouts from broken trunks and the surrounding mosaic of dense and open understorey,
- Spring, summer and autumn flowering trees within the subject site,
- Winter flowering Swamp Mahogany within the natural vegetation in the southern study area,
- Seed producing *Allocasuarina* trees,
- Perenial drainage line with side soaks within the southern study area,
- Dense under-storey foliage areas within the southern study area, and
- Open water within the farm dam.

Fauna survey is limited by the following:

- Targeted Koala survey to effectively conclude on CKH under SEPP 44.
- A second night's fauna survey is considered to be required. Stag-watching of other hollows within the development landscape should also be undertaken at this time given potential use of the subject site by Squirrel Glider. Further checks on Wallum Froglet breeding activity areas in adjacent habitat is also advised at this time.

## 4.2 Hollow-bearing trees

Hollow-bearing trees within the subject site were surveyed during the fauna survey with a total of fifteen (15) trees containing hollows recorded. These trees were found to contain fifteen (15) small hollows (0-10cm in size) and four medium hollows (10-15cm in size).

Recorded hollows within the subject site are considered suitable for threatened microbats, Little Lorikeet and Squirrel Glider. Two hollow-dependent threatened microbat East-coast Freetail Bat and Large-footed Myotis were recorded during survey.

Hollow-bearing tree data for the subject site is provided in Table 3. Each of these hollows will require removal for the proposed development layout. Further stag-watching of hollows would be considered appropriate given their suitability for threatened species use to ensure that they are not of breeding value to threatened biodiversity. This is not necessarily expected based on current observations.

**Table 2** – Hollow-bearing tree data

| Tag No. | Common name | DBH (cm) | Height (m) | Spread (m) | Vigour (%) | Hollows recorded |
|---|---|---|---|---|---|---|
| HT1 | Sribbly Gum | 37 | 14 | 8 | 75 | 1x 0-5cm branch,<br>1x 0-5cm branch spout |
| HT2 | Smooth-barked Apple | 45 | 20 | 13 | 35 | 1x 5-10cm branch |
| HT3 | Smooth-barked Apple | 38 | 21 | 19 | 35 | 1x 0-5cm branch spout |
| HT4 | Sribbly Gum | 45 | 17 | 15 | 40 | 1x 10-15cm low trunk split<br>possum scratches |
| HT5 | Smooth-barked Apple | 32 | 22 | 10 | 55 | 1x 5-10cm broken trunk |
| HT6 | stag | 60 | 6 | 2 | 0 | 3x 0-5cm low cut branch spouts |
| HT7 | Sribbly Gum | 42,38 | 15 | 12 | 65 | 1x 0-5cm branch spout |
| HT8 | Stringybark | 65 | 9 | 13 | 55 | 1x 5-10cm low broken trunk |
| HT9 | Stringybark | 60 | 14 | 12 | 80 | 1x 0-5cm branch (wear) |
| HT10 | Stringybark | 43,35 | 14 | 15 | 75 | 1x 0-5cm low branch |
| HT11 | Sribbly Gum | 85 | 14 | 11 | 40 | 1x 20-30cm low open trunk |
| HT12 | Sribbly Gum | 50,60 | 18 | 19 | 85 | 1x 0-5cm trunk split,<br>1x 5-10cm branch (good) |
| HT13 | Swamp Oak | 32 | 3 | 5 | 15 | 1x 5-10cm low broken trunk |
| HT14 | Sribbly Gum | 41,34 | 15 | 8 | 75 | 1x 10-15cm trunk (good)<br>scratches around hole |
| HT15 | stag | 50 | 6 | 2 | 0 | 1x 15-20cm low open broken trunk |

Recorded significant habitat trees containing large hollows located in the natural vegetated areas in the southern study area are expected to be utilised by the recorded Masked Owl. The individual recorded during initial survey responded quickly to calls suggesting it was

close by at this time. The large hollows are also aligned in an ideal scenario to support nesting by a female within a central high quality hollow, and nearby roosting by a male in various large surrounding hollows. The cluster of large hollows were considered ideal for Masked Owl before the initial recording. Hence the attempt to call in by mouth.

Whilst over six large hollows were observed in a cluster in this southern area, one stood out above others as an ideal nesting tree based on its tree size, foliage shelter, hollow character and central proximity to the other large hollows. This tree was suspected to be a nesting tree for Masked Owl. The locations of these trees in a cluster containing large hollows were identified by GPS during initial survey (refer to Figure 3 for these locations).

Based on this, owl expert John Young was engaged and undertook a site visit between 30/8/19 to 3/9/19. Just prior to his visit, all other large hollows within 300m of the suspected nest tree were then also identified by GPS with some considered higher quality than others. Mr Young confirmed that Masked Owl is using the suspected nest tree and also confirmed another large hollow to the south-east as being used for roosting by the male. My Young's report and locations of all recorded large hollows is provided in Appendix 3.

## 4.3 Threatened fauna species

*BC Act* – A search of the *Atlas of NSW Wildlife* (OEH, 2019) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Appendix Table A2.2 and are considered for potential habitat within the subject site.

*Fisheries Management Act (FM Act)* – No habitats suitable for threatened aquatic species were observed within the subject site and as such the provisions of this act do not require any further consideration.

*EPBC Act* – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have also been listed in Appendix Table A2.2.

In accordance with Table A2.2 the following state and nationally listed threatened fauna species are considered to have suitable habitat with varying potential to occur within the subject site. The state listed species will be considered in the significance of impact test (Appendix 3):

**Table 3** – Threatened fauna species with suitable habitat present

| Common name | *BC Act* | *EPBC Act* | Potential to occur |
|---|---|---|---|
| Masked Owl | V | - | recorded |
| East-coast Freetail Bat | V | - | recorded |
| Little Bentwing-bat | V | - | recorded |
| Eastern Bentwing-bat | V | - | recorded |
| Large-footed Myotis | V | - | recorded |
| Wallum Froglet | V | - | ✓ |
| White-bellied Sea Eagle | V | - | ✓ |
| Little Lorikeet | V | - | ✓ |
| Swift Parrot | E | E | ✓ |
| Powerful Owl | V | - | ✓ |
| Varied Sittella | V | - | ✓ |
| Spotted-tailed Quoll | V | E | ✓ |

| Common name | *BC Act* | *EPBC Act* | Potential to occur |
|---|---|---|---|
| Squirrel Glider | V | - | ✓ |
| Grey-headed Flying-fox | V | V | ✓ |
| Eastern Falsistrelle | V | - | ✓ |
| Greater Broad-nosed Bat | V | - | ✓ |
| Eastern Cave Bat | V | - | ✓ |
| Square-tailed Kite | V | - | low |
| Glossy Black-Cockatoo | V | - | low |
| Regent Honeyeater | E4A | CE | low |
| Yellow-bellied Sheathtail-bat | V | - | low |
| Little Eagle | V | - | unlikely |
| Barking Owl | V | - | unlikely |
| Dusky Woodswallow | V | - | unlikely |
| Koala | V | V | unlikely |
| Eastern Pygmy Possum | V | - | unlikely |

Of the above listed and recorded threatened fauna the Masked Owl will cause most constraint to development. This is because large hollows to the south are being utilised by this species (as described in Section 4.2 above and confirmed by owl expert John Young).

In his owl expert report (Appendix 3) and following his site visit, John Young has recommended a non-development buffer of 100m be applied to an expected nest tree and also a 50m buffer from the nearest potential roost trees be applied as protection measures. These buffers are standard for forestry prescriptions by DPI. Two buffers overlap and pass marginally into the subject site area. Mr Young has drawn a line of the southernmost development edge outside of these buffers in his report. The development is therefore constrained by Masked Owl activity in this south-western corner of the study area and will need to be refined back.

Whilst Mr Young has allowed for the placement of any necessary stormwater detention pond within the buffer, he has also required a dense planting edge to provide a sound and light barrier between the road and development and the roost/nest trees. The dense planting may occur on either side of the stormwater basin.

The Masked Owl is a specialist on hunting small to moderate sized terrestrial prey items and therefore depends on a mosaic of understorey structure. It will forage along the open edges of dense understorey patches and therefore is expected to utilise the cleared edge of forest in the southern study area.

Given its low foraging nature, Masked Owls are also known to be susceptible to vehicle collisions which is of concern given that the proposed site entry road runs along the southern edge of the subdivision. Vehicle speed restrictions will need to be imposed. The current proposal provides a cleared and managed strip between the forest edge and the entry road for APZ purposes. This edge is preferable along the entirety of the forest edge to setback the road from foraging. The planting of a dense strip of vegetation to act as a noise and light barrier should therefore be in addition to the cleared strip.

All hollow trees within the subject site area itself will likely require removal based on the concept development layout. The two recorded hollow-dependent threatened microbats (and less potentially Squirrel Glider) may make use of these hollows. The two highest quality hollow-bearing trees were stag-watched during survey with no observations recorded. Whilst use is not necessarily expected, other hollows and a further night survey will be required to

ensure other hollows are not of importance. There may be scope to relocate any utilised hollow, depending on the species.

The Wallum Froglet is also known to occur and breed in locations directly across Chain Valley Bay Road. It is possible that individuals may disperse into the study area during ideal conditions, however the subject site itself is not of any likely importance for breeding, shelter or foraging for this species. The proposal will need to ensure adequate stormwater management measures are achieved within the subject site area, to prevent any water quality, quantity or erosion impacts on the adjacent natural drainage and habitat in the far southern reaches. There is some potential that the southern study area may be temporarily utilised by dispersing Wallum Froglet, given sinkholes retaining moisture present. These are not ideal or likely core breeding habitat for the local population but should nonetheless be protected from indirect impacts.

*SEPP 44 Koala Habitat Protection* – Koala feed trees Scribbly Gum (*Eucalyptus haemastoma*) and Swamp Mahogany (*Eucalyptus robusta*) make up the only eucalypt trees on site and comprise more than 15% of trees within the Coastal Woodland and Riparian Forest communities respectively. Therefore these communities comprise Potential Koala Habitat (PKH) under the definitions of SEPP 44.

Koalas have not been recorded during survey to date and are considered with an unlikely potential to occur. Further target Koala survey incorporating scat searches will be undertaken during future target owl surveys, to provide a final conclusion on if the site comprises Core Koala Habitat under the definitions of SEPP 44.

## 4.4 Protected migratory species (National)

*The EPBC Act Protected Matters Report* provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. The habitat potential of migratory species is considered in Table A2.3 (Appendix 2). The habitat potential of threatened migratory species is considered in Table A2.3 Table A2.2 (Appendix 2).

One (1) nationally protected migratory bird species the Black-faced Monarch was recorded only to a ‘possible’ level of certainty from a brief distant call within the natural open forest vegetation on adjacent land to the south-west. The proposal will not directly impact on any potential breeding or important foraging habitat for this species.

Other migratory species protected under the EPBC also do not likely contain any breeding habitat or habitat otherwise of importance within the subject site. Therefore protected migratory species will not likely offer constraint to the proposal.

## 4.5 Endangered fauna populations

There are no endangered fauna populations within the Central Coast LGA.

## 4.6 Connectivity

The natural vegetation within the study area is confined to the far southern portion. Some small patches of remnant trees occur within the remaining managed areas as well as a narrow strip of good quality natural vegetation along the western boundary. Whilst containing natural hollows and of good quality through the middle reaches, this strip does not likely provide current connectivity for gliders as the southern and north limits have large separations to natural vegetation beyond the study area.


**Figure 5** – Local connectivity

# 5.0 Watercourses and wetlands

## 5.1 Endangered wetland communities

A number of wetland communities have been listed as an 'endangered ecological community' under the NSW *BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the *Water Management Act* (*WM Act*) 2000, due to their inclusion in the definition of a 'lake' under the same act.

Impacts on wetland communities must be assessed under the *BC Act* and if present the management of wetland communities must be given due consideration in accordance with the objectives and principles of management as contained within the NSW Wetlands Policy (2010), and appropriate management as determined by NSW DPI - Office of Water in their general terms of approval (GTA's). This may include but not limited to the provision of buffers, management of stormwater runoff and maintenance of natural inflows or runoff into those wetland communities.

- Artesian springs ecological community - endangered ecological community listing
- Castlereagh swamp woodland community - endangered ecological community listing
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Kurri sand swamp woodland in the Sydney Basin Bioregion - endangered ecological community listing
- Lagunaria swamp forest on Lord Howe Island - endangered ecological community listing

- Maroota Sands swamp forest - endangered ecological community listing
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion - endangered ecological community listing
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion - endangered ecological community listing
- The shorebird community occurring on the relict tidal delta sands at Taren Point - endangered ecological community listing
- Upland wetlands of the drainage divide of the New England Tableland Bioregion - endangered ecological community listing
- Wingecarribee Swamp - endangered ecological community listing

In accordance with the *WM Act*, endangered wetland communities are through the definition of 'lakes' potentially classed as waterfront land. Referral to DPI WaterNSW may be required for determination under the *WM Act* as a controlled activity. As well as protection, a buffer may be applied to these communities as specified by DPI WaterNSW.

Swamp Sclerophyll Forest on Coastal Floodplains is present within the southern portion of the study area, which is an EEC as listed within the *BC Act*, but not within the *EPBC Act*.

- *Impact on the extent of wetland vegetation*

  The concept proposal is not likely to impact significantly on the extent of this endangered wetland community.

- *Impact on acid sulphate soils*

  The study site is not identified as containing acid sulphate soils.

- *Indirect impacts of wetlands*

  Indirect impacts may include pedestrian usage and trampling of soils, dumping of rubbish and garden waste, accidental spillages post development.

  A Vegetation Management Plan (VMP) should be prepared to protect, and mitigate impacts on, the swamp sclerophyll forest.

- *Impacts due to storm water quality or quantity*

  It is expected that an appropriate storm water management plan will be prepared to avoid these impacts on the EEC.

- *Impacts on groundwater*

  The proposal is not expected to impact on groundwater resources or groundwater dependent ecosystems

- *Proposed mitigation measures*

  1. Appropriate design of construction of any works e.g. storm water outlets.
  2. Manage access to the area.

3. Undertake pest animal and weed control.
4. Preparation of a VMP to improve and maintain sensitive ecological landscapes, sediment and erosion control measures.

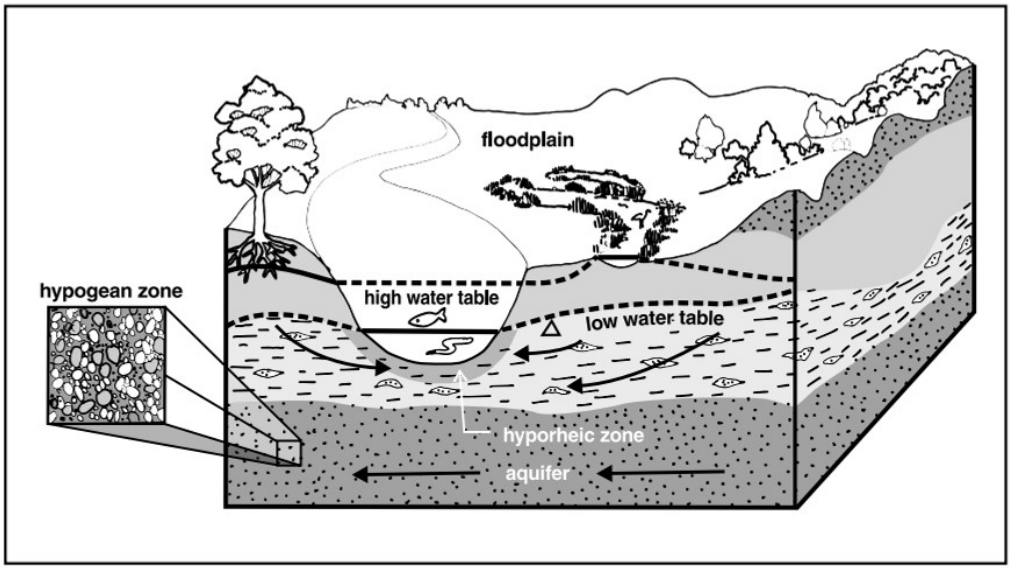
- Watercourses and waterfront lands

  There are no riparian streams or zones throughout the site with the exception of the Karignan Creek corridor which forms the southern boundary. The area of EEC – Swamp Sclerophyll Forest is classed as an endangered protected wetland and is a 'lake' as defined under the *WM Act* therefore it is deemed as 'waterfront land'.

## 5.2 Groundwater dependent ecosystems (GDEs)

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. Some examples of ecosystems which depend on groundwater are:

- wetlands;
- red gum forests, vegetation on coastal sand dunes and other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.




**Alluvial groundwater system discharging into a river**

Groundwater dependent ecosystems are therefore ecosystems which have their species composition and their natural ecological processes determined by groundwater (NSW State Groundwater Dependent Ecosystems Policy April 2002).

Swamp Sclerophyll Forest on Coastal Floodplains is considered to be a wetland community and, in the context of the landscape is likely to be a GDE. To assist in protecting this in the future, this community is recommended to be conserved and managed in accordance with a Vegetation Management Plan (VMP) should be prepared to protect, and mitigate impacts on, the swamp sclerophyll forest.

# 6.0 Conclusions

Ecological survey and biodiversity constraints assessment has been undertaken for a proposed development within Lot 5 DP 1228880, at 45 Mulloway Drive, Chain Valley Bay. Assessment has been undertaken in consideration to the *BC Act* through the relevant process outlined by the *EP&A Act*. The schedules and assessment criteria under the *EPBC Act* and the *FM Act* have also been considered for the proposal.

No threatened flora species have been observed. There is potential habitat within the study area for several threatened flora species. Seasonal targeted surveys for threatened flora will be required in the future during the appropriate survey period (see Table 3).

Five (5) threatened fauna species were recorded present during survey including Masked Owl (*Tyto novaehollandiae*), Eastern Bentwing-bat (*Miniopterus orianae oceanensis*), Little Bentwing-bat (*Miniopterus australis*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Large-footed Myotis (*Myotis macropus*). The East-coast Freetail Bat was recorded to a 'probable' level of certainty.

Vegetation present within the south of the study area is attributable to *Swamp Sclerophyll Forest on Coastal Floodplains,* which is listed within the NSW *BC Act* as an Endangered Ecological Community (EEC).

## 6.1 Constraints for matters listed under the Biodiversity Conservation Act

No threatened flora species have been observed. There is potential habitat within the study area for several threatened flora species. Seasonal targeted surveys for threatened flora will be required in the future during the appropriate survey period (see Table 3).

The southern development footprint is constrained by the breeding presence of Masked Owl. Protection buffers are required from the identified nest tree and potential roosting trees as outlined in the owl expert report by John Young provided in Appendix 3. Mapping provided in this report shows these trees and the proposed buffers within a protection area.

Hollows within the development landscape may also be utilised by recorded threatened microbats or to a lesser extent Squirrel Glider. Whilst this is not necessarily expected, further survey should be undertaken to check more hollow activity on dusk. Other survey to be undertaken at this time is outlined at the end of Section 4.1.

Vegetation present within the south of the study area is attributable to *Swamp Sclerophyll Forest on Coastal Floodplains,* which is listed within the NSW *BC Act* as an Endangered Ecological Community (EEC).

The Biodiversity Offsets Scheme (BOS) and The Regulation (2017) and Biodiversity Assessment Method (2017) came into force under the *BC Act* on the 25th of August, 2017. There are two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the BOS applies to the proposed clearing.

- Sensitive Biodiversity Values Land has been mapped within the far south of study area. Based on the current concept proposal, Biodiversity Values Land may be impacted and an offset will be required under this trigger.

- The threshold for clearing above which the BAM and offsets scheme apply is 0.5ha or more. The based on the concept proposal, the development will impact more than 0.5ha of remnant native vegetation within the study area, therefore offsetting will be required under this trigger.

Any future development proposal will need to be assessed in accordance with the Significance of Impact Test of the *BC Act* to determine if the proposal constitutes a significant impact upon threatened species, endangered populations or threatened ecological communities.

## 6.2 Recommendations

To minimise adverse ecological impacts, the following mitigation measures are proposed:

1. A non-development area (allowing for a stormwater detention basin) is required in the southwestern corner of the subject site as a protection measure for a pair of Masked Owls utilising nearby trees for breeding. A dense planting of vegetation is required along this southern cleared edge as a sound and light barrier between the proposed activity and the owls. Further to this, a minimum 10m cleared setback from the road is also required along this edge to reduce potential for vehicle collisions.

2. Avoidance of impact on native vegetation within mapped Biodiversity Values Land and native vegetation to minimise offsetting requirements.

3. Reduce the impact on native vegetation to below 0.5ha, which will avoid offsetting under this trigger.

4. Replacement landscaping should consider the use of locally occurring (endemic) native species commensurate with Scribbly Gum – Red Bloodwood – *Angophora inopina* heathy woodland including trees, shrubs and ground covers to encourage fauna within the locality.

5. Sediment and erosion control measures in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom 2004) to minimise impact of possible sedimentation to local drainage lines.

6. A Vegetation Management Plan (VMP) is to be prepared to protect, and mitigate impacts on, the swamp sclerophyll forest EEC as a conservation area and to maintain or improve connective landscape along Karignan.

7. Control and eradication of invasive ecological weeds should be undertaken to prevent further invasion by these species. Invasive species such as Bitou Bush, Blackberry and Pampas Grass were observed within the study area.

8. Target threatened species survey is recommended to:

    a. Stag-watch remaining quality hollows within the subject site to determine any roosting/breeding use by recorded hollow-dependent microbats.
    b. Further survey could also determine nearest habitat breeding opportunity for Wallum Froglet.
    c. Target cryptic threatened flora species.
    d. Target Koala survey.

# Appendix 1
# Flora and Fauna Species Lists

**Table A1.1** – Flora species recorded

| Family | Scientific name | Common name |
|---|---|---|
| **TREES** | | |
| Casuarinaceae | *Allocasuarina littoralis* | Black She-oak |
| Myrtaceae | *Angophora costata* | Smooth-barked Apple |
| Myrtaceae | *Corymbia gummifera* | Red Bloodwood |
| Myrtaceae | *Eucalyptus haemastoma* | Broad-leaved Scribbly Gum |
| Myrtaceae | *Eucalyptus robusta* | Swamp Mahogany |
| Phyllanthaceae | *Glochidion ferdinandi* var. *ferdinandi* | Cheese Tree |
| Myrtaceae | *Melaleuca decora* | - |
| Meliaceae | *Melia azedarach* | White Cedar |
| Pittosporaceae | *Pittosporum undulatum* | Sweet Pittosporum |
| **SHRUBS** | | |
| Fabaceae | *Acacia longifolia* var. *longifolia* | Sydney Golden Wattle |
| Fabaceae | *Acacia myrtifolia* | Red Stem Wattle |
| Fabaceae | *Acacia suaveolens* | Sweet Scented Wattle |
| Fabaceae | *Acacia ulicifolia* | Prickly Moses |
| Myrtaceae | *Baeckea diosmifolia* | Fringed Baekea |
| Proteaceae | *Banksia marginata* | Silver Banksia |
| Proteaceae | *Banksia oblongifolia* | Fern-leaf Banksia |
| Fabaceae | *Bossiaea heterophylla* | Variable Bossiaea |
| Asteraceae | *Chrysanthemoides monilifera* subsp. *rotundata** | Bitou Bush |
| Fabaceae | *Dillwynia retorta* | Eggs and Bacon |
| Epacridaceae | *Epacris pulchella* | Wallum Heath |
| Fabaceae | *Gompholobium glabratum* | Dainty Wedge-pea |
| Proteaceae | *Grevillea sericea* | Pink Spider Flower |
| Proteaceae | *Hakea dactyloides* | Broad-leaved Hakea |
| Proteaceae | *Isopogon anethifolius* | Round-leaved Drumsticks |
| Myrtaceae | *Kunzea ambigua* | Tick Bush |
| Proteaceae | *Lambertia formosa* | Mountain Devil |
| Myrtaceae | *Leptospermum trinervium* | Slender Tea-tree |
| Myrtaceae | *Melaleuca sieberi* | - |
| Fabaceae | *Mirbelia speciosa* | - |
| Proteaceae | *Persoonia levis* | Broad-leaved Geebung |
| Proteaceae | *Petrophile pulchella* | Conesticks |
| Apiaceae | *Platysace linearifolia* | Narrow-leafed Platysace |
| Fabaceae | *Pultenaea daphnoides* | Large-leaf Bush Pea |
| Fabaceae | *Pultenaea linophylla* | - |
| Fabaceae | *Pultenaea villosa* | Hairy Bush-pea |
| Rosaceae | *Rubus fruticosus* sp. agg.* | Blackberry complex |
| **GROUNDCOVERS** | | |
| Asteraceae | *Actinotus minor* | Lesser Flannel Flower |
| Adiantaceae | *Adiantum aethiopicum* | Common Maidenhair |
| Poaceae | *Anthoxanthum avenaceus* | Oat Speargrass |
| Poaceae | *Austrostipa pubescens* | Tall Speargrass |
| Poaceae | *Axonopus fissifolius** | Narrow-leaved Carpet Grass |
| Asteraceae | *Bidens pilosa** | Cobbler's Pegs |

| Family | Scientific name | Common name |
|---|---|---|
| Poaceae | *Briza subaristata** | - |
| Anthericaceae | *Caesia parviflora* var. *parviflora* | Pale Grass Lily |
| Apiaceae | *Centella asiatica* | Swamp Pennywort |
| Asteraceae | *Conyza sumatrensis** | Tall Fleabane |
| Asteraceae | *Coreopsis lanceolata** | Coreopsis |
| Poaceae | *Cortaderia selloana** | Pampas Grass |
| Orchidaceae | *Cryptostylis subulata* | Large Tongue Orchid |
| Poaceae | *Cynodon dactylon* | Common Couch |
| Cyperaceae | *Cyperus eragrostis** | Umbrella Sedge |
| Phormiaceae | *Dianella caerulea* var. *caerulea* | Flax Lily |
| Poaceae | *Dichelachne micrantha* | Short-hair Plume Grass |
| Poaceae | *Echinopogon caespitosus* var. *caespitosus* | Tufted Hedgehog Grass |
| Restionaceae | *Empodisma minus* | - |
| Poaceae | *Entolasia stricta* | Wiry Panic |
| Poaceae | *Eragrostis brownii* | Brown's Lovegrass |
| Cyperaceae | *Gahnia clarkei* | Tall Saw-sedge |
| Asteraceae | *Gamochaeta* sp.* | Cudweed |
| Haloragaceae | *Gonocarpus micranthus* subsp. *micranthus* | Creeping Raspwort |
| Haloragaceae | *Gonocarpus tetragynus* | Poverty Raspwort |
| Haloragaceae | *Gonocarpus teucrioides* | Raspwort |
| Goodeniaceae | *Goodenia heterophylla* subsp. *heterophylla* | Variable Leaved Goodenia |
| Haemodoraceae | *Haemodorum planifolium* | Bloodroot |
| Apiaceae | *Hydrocotyle bonariensis** | Kurnell Curse / Pennywort |
| Apiaceae | *Hydrocotyle peduncularis* | Pennywort |
| Poaceae | *Hyparrhenia hirta** | Coolatai Grass |
| Clusiaceae | *Hypericum* sp.* | |
| Asteraceae | *Hypochaeris radicata** | Flatweed |
| Poaceae | *Imperata cylindrica* | Blady Grass |
| Cyperaceae | *Lepidosperma laterale* | Variable Sword-sedge |
| Restionaceae | *Lepyrodia scariosa* | Scale Rush |
| Lindsaeaceae | *Lindsaea linearis* | Screw Fern |
| Lomandraceae | *Lomandra cylindrica* | - |
| Lomandraceae | *Lomandra glauca* | Pale Mat-rush |
| Lomandraceae | *Lomandra longifolia* | Spiky-headed Mat-rush |
| Lomandraceae | *Lomandra multiflora subsp. multiflora* | Many-flowered Mat-rush |
| Lomandraceae | *Lomandra obliqua* | Twisted Mat-rush |
| Poaceae | *Microlaena stipoides* | Weeping Grass |
| Myrtaceae | *Micromyrtus spp.* | |
| Poaceae | *Panicum simile* | Two Colour Panic |
| Poaceae | *Paspalidium distans* | - |
| Poaceae | *Paspalum urvillei** | Vasey Grass |
| Iridaceae | *Patersonia sericea* | Wild Iris |
| Poaceae | *Cenchrus clandestinum** | Kikuyu, Kikuyu Grass |
| Thymelaeaceae | *Pimelea linifolia* subsp. *linifolia* | Slender Rice Flower |
| Plantaginaceae | *Plantago lanceolata** | Ribwort |
| Lobeliaceae | *Pratia purpurascens* | Whiteroot |
| Dennstaedtiaceae | *Pteridium esculentum* | Bracken |
| Ranunculaceae | *Ranunculus spp.* | |

| Family | Scientific name | Common name |
|---|---|---|
| Rubiaceae | *Richardia* sp.* | |
| Goodeniaceae | *Scaevola ramosissima* | Purple Fan Flower |
| Selaginallaceae | *Selaginella uliginosa* | Swamp Selaginella |
| Poaceae | *Setaria parviflora** | Slender Pigeon Grass |
| Malvaceae | *Sida rhombifolia** | Paddy's Lucerne |
| Solanaceae | *Solanum nigrum** | Black Nightshade, Black-berry Nightshade |
| Poaceae | *Sporobolus elongatus* | Slender Rat's Tail Grass |
| Stackhousiae | *Stackhousia nuda* | - |
| Poaceae | *Stenotaphrum secundatum** | Buffalo Grass |
| Stylidiaceae | *Stylidium lineare* | Narrow-leaved Trigger Plant |
| Asteraceae | *Taraxacum officinale** | Dandelion |
| Poaceae | *Themeda triandra* | Kangaroo Grass |
| Anthericaceae | *Thysanotus tuberosus* | Fringed Lily |
| Apiaceae | *Trachymene incisa* subsp. *incisa* | Native Parsnip |
| Verbenaceae | *Verbena bonariensis** | Purpletop |
| Menyanthaceae | *Villarsia exaltata* | Yellow Marsh Flower |
| Campanulaceae | *Wahlenbergia communis* | Tufted Bluebell |
| Xanthorrhoaceae | *Xanthorrhoea media* | Forest Grass Tree |
| **VINES** | | |
| Lauraceae | *Cassytha glabella* | Slender Devil's Twine |
| Fabaceae | *Glycine clandestina* | Twining Glycine |
| Fabaceae | *Hardenbergia violacea* | False Sarsparilla |
| Dilleniaceae | *Hibbertia dentata* | Twining Guinea Flower |
| * denotes exotic species<br>TS denotes threatened species | | |

It should be noted that not all garden, cultivar or landscape species have been identified as part of this assessment.

**Table A1.2** – Fauna species recorded

| Common name | Scientific name | Method observed |
|---|---|---|
| **Birds** | | **June 2019** |
| Australasian Grebe | *Tachybaptus novaehollandiae* | O |
| Australian Hobby | *Falco longipennis* | O |
| Australian Magpie | *Cracticus tibicen* | O W |
| Australian Raven | *Corvus coronoides* | O W |
| Australian Wood Duck | *Chenonetta jubata* | O |
| Black-faced Monarch | *Monarcha melanopsis* | W[PO] |
| Brown Thornbill | *Acanthiza pusilla* | O W |
| Crested Pigeon | *Ocyphaps lophotes* | O |
| Eastern Rosella | *Platycercus eximius* | O W |
| Eastern Spinebill | *Acanthorhynchus tenuirostris* | W |
| Eastern Yellow Robin | *Eopsaltria australis* | W |
| Galah | *Eolophus roseicapillus* | O W |
| Grey Fantail | *Rhipidura albiscapa* | O W |
| Laughing Kookaburra | *Dacelo novaeguineae* | O W |
| Lewin's Honeyeater | *Meliphaga lewinii* | W |
| Magpie-lark | *Grallina cyanoleuca* | O W |
| Masked Owl [TS] | *Tyto novaehollandiae* | O W |
| Musk Lorikeet | *Glossopsitta concinna* | W |
| Noisy Miner | *Manorina melanocephala* | O W |
| Pied Butcherbird | *Cracticus nigrogularis* | O W |
| Rainbow Lorikeet | *Trichoglossus haematodus* | O W |
| Satin Bowerbird | *Ptilonorhynchus violaceus* | W |
| Scaly-breasted Lorikeet | *Trichoglossus chlorolepidotus* | W |
| Spotted Pardalote | *Pardalotus punctatus* | W |
| Striated Thornbill | *Acanthiza lineata* | O W |
| Superb Fairy-wren | *Malurus cyaneus* | O W |
| Welcome Swallow | *Hirundo neoxena* | O |
| White-throated Treecreeper | *Cormobates leucophaea* | W |
| Yellow-faced Honeyeater | *Caligavis chrysops* | W |
| Yellow-tailed Black-Cockatoo | *Calyptorhynchus funereus* | W |
| **Mammals** | | |
| Common Brushtail Possum | *Trichosurus vulpecula* | F |
| Common Ringtail Possum | *Pseudocheirus peregrinus* | O |
| East-coast Freetail Bat [TS] | *Micronomus norfolkensis* | U[PR] |
| Eastern Bentwing-bat [TS] | *Miniopterus orianae oceanensis* | U |
| Eastern Freetail-bat | *Mormopterus ridei* | U |
| Gould's Wattled Bat | *Chalinolobus gouldii* | U |
| Horse * | *Equus caballus* | O |
| Large Forest Bat | *Vespadelus darlingtoni* | U[PR] |
| Large-footed Myotis[TS] | *Myotis macropus* | U |
| Long-eared Bat | *Nyctophilus sp.* | U[PR] |
| Little Bentwing-bat [TS] | *Miniopterus australis* | U |
| Little Forest Bat | *Vespadelus vulturnus* | U[PR] |
| Rabbit * | *Oryctolagus cuniculus* | O |
| Sheep | *Ovis aries* | O |
| Swamp Wallaby | *Wallabia bicolor* | O |

| Common name | Scientific name | Method observed |
|---|---|---|
| **Amphibians** | | |
| Common Eastern Froglet | *Crinia signifera* | W |
| Jervis Bay Tree Frog | *Litoria jervisiensis* | W |
| Striped Marsh Frog | *Limnodynastes peronii* | W |

Note:
* indicates introduced species
TS indicates threatened species
MS indicates Migratory species

All species listed are identified to a high level of certainty unless otherwise noted as:

PR indicates species identified to a 'probable' level of certainty – more likely than not
PO indicates species identified to a 'possible' level of certainty – low-moderate level of confidence

| | | | |
|---|---|---|---|
| E - Nest/roost | H - Hair/feathers/skin | P - Scat | W - Heard call |
| F - Tracks/scratchings | K - Dead | Q - Camera | X - In scat |
| FB - Burrow | O - Observed | T - Trapped/netted | Y - Bone/teeth/shell |
| G - Crushed cones | OW - Obs & heard call | U - Anabat/ultrasound | Z - In raptor/owl pellet |

# Appendix 2
# Threatened Flora and Fauna Species Habitat Assessment

**Table A2.1** – Threatened flora species habitat assessment

| ***Scientific name*** DATABASE SOURCE1 | ***BC Act*** | ***EPBC Act*** | **Growth form and habitat requirements** ***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| *Acacia bynoeana* OEH EPBC | E1 | V | Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. *Distribution limits N-Newcastle S-Berrima.* | x | ✓ | x | 2011 | x | x |
| *Angophora inopina* OEH EPBC | V | V | Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. *Distribution limits N-Wyee S-Gorokan with a disjunct population near Karuah.* | x | ✓ | 700m ENE | ✓ | ✓ | ✓ |
| *Caladenia tessellata* OEH EPBC | E1 | V | Terrestrial orchid. Clay-loam or sandy soils. LHCCREMS guidelines suggest the species grows in Map Unit 34 – Coastal Sand Wallum Woodland - Heath. Flowers in September – November. *Distribution limits N-Swansea S-south of Eden.* | x | marginal | 5km E | 1998 | x | x |
| *Callistemon linearifolius* OEH | V | - | Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. *Distribution limits N-Nelson Bay S-Georges River.* | x | ✓ | 4km E | 2018 | low | ✓ |
| *Chamaesyce psammogeton* OEH | E1 | - | Prostrate herb. Coastal dunes. *Distribution limits N-Tweed Heads S-Jervis Bay.* | x | x | - | - | x | x |
| *Corybas downlingii* OEH | E1 | - | An orchid that forms clonal colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m. *Known from 4 localities including Port Stephens (2 localities), Bulahdelah and Freemans Waterhole.* | x | x | - | - | x | x |

| ***Scientific name*** DATABASE SOURCE1 | ***BC Act*** | ***EPBC Act*** | **Growth form and habitat requirements** ***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| *Corunastylis sp.* Charmhaven OEH EPBC | CE | CE | Terrestrial orchid currently only known from the Wyong Shire of NSW in the Gorokan/Charmhaven area. It occurs within low woodland to heathland with a shrubby understorey and ground layer. Dominants include *Allocasuarina littoralis, Leptospermum juniperinum, Melaleuca nodosa, Callistemon linearis* and *Schoenus brevifolius.* Flowers likely in Feb-Mar. | x | low | x | 2017 | x | x |
| *Cryptostylis hunteriana* OEH EPBC | V | V | Saprophytic orchid. Grows in swamp heath on sandy soils. *Distribution limits N-Gibraltar Range S-south of Eden.* | x | ✓ | 3km N | 2018 | low | ✓ |
| *Cynanchum elegans* EPBC | E1 | E | Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. *Distribution limits N-Gloucester S-Wollongong.* | x | x | - | - | x | x |
| *Diuris praecox* OEH EPBC | V | V | Terrestrial orchid. Grows in sclerophyll forest near the coast. *Distribution limits N-Nelson Bay S-Ourimbah.* | x | moderate | 1km N & E | 2017 | low | ✓ |
| *Eucalyptus camfieldii* OEH EPBC | V | V | Stringybark to 10m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. *Distribution limits N-Norah Head S-Royal NP.* | x | moderate | 4km E | 2007 | low | ✓ |
| *Eucalyptus parramattensis* subsp. *decadens* OEH EPBC | V | V | Red gum to 15m high. Grows in dry open forest on sandy to clay soils often in lowly elevated moist sites. *Distribution limits N-Port Macquarie S-Kurri Kurri.* | x | x | - | - | x | x |

| ***Scientific name*** DATABASE SOURCE1 | ***BC Act*** | ***EPBC Act*** | **Growth form and habitat requirements** ***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| *Genoplesium insigne* OEH EPBC | E4A | CE | Terrestrial orchid. Found in *Themeda* patches among shrubs and sedges in heathland and forest. *Known from 3 localities in Wyong-Charmhaven area.* Occurs in vegetation dominated by Scribbly Gum, Red Bloodwood, Smooth-barked Apple and Black She-oak at Charmhaven. Flowers Sept-Oct. | x | ✓ | 500m E | 2018 | ✓ | ✓ |
| *Grevillea parviflora* subsp. *parviflora* OEH EPBC | V | V | Open to erect shrub to 1m. Grows in woodland on light clayey soils. *Distribution limits N-Cessnock S-Appin.* | x | moderate | x | 2018 | x | x |
| *Melaleuca biconvexa* OEH EPBC | V | V | Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. *Distribution limits N-Port Macquarie S-Jervis Bay.* | x | x | - | - | x | x |
| *Persoonia hirsuta* EPBC | E1 | E | Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. *Distribution limits N-Glen Davis S-Hill Top.* | x | x | - | - | x | x |
| *Pterostylis gibbosa* EPBC | E1 | E | Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks. | x | x | - | - | x | x |
| *Pultenaea maritima* OEH | V | - | Prostrate mat forming hairy stemmed shrub. 3.5-5mm long 1.8-2.8mm wide leaves. Pea flowers are 6.5-10mm long and are a buttery yellow in colour. Flowers August to March with fruit appearing January to March. Occurs along the coast from Newcastle to QLD. Occurs in grasslands, shrublands and heath on exposed coastal headlands and adjoining low coastal heath. Found on clay, sandy loam or clay loam over sandstone at altitude 5-30m. | x | x | - | - | x | x |

| ***Scientific name*** DATABASE SOURCE1 | ***BC Act*** | ***EPBC Act*** | **Growth form and habitat requirements** ***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| *Rhodamnia rubescens* *OEH* | E4A | - | Shrub to small tree to 25m tall. Widespread in warmer rainforest and on rainforest margins on range of volcanically derived and sedimentary soils. Mainly coastal areas; north from Batemans Bay. Flowers late winter to spring. | x | x | - | - | x | x |
| *Rhodomyrtus psidioides* OEH | E4A | - | Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. Distribution N – Maryborough Qld, S – Broken Bay NSW. | x | x | - | - | x | x |
| *Rutidosis heterogama* OEH EPBC | V | V | Erect herb to 30cm. Grows mostly in heath, often along roadsides. *Distribution limits N-Maclean S-Hunter Valley.* | x | moderate | 4km SE | 2015 | unlikely | ✓ |
| *Syzygium paniculatum* OEH EPBC | V | V | Small tree. Subtropical and littoral rainforest on sandy soil. *Distribution limits N-Forster S-Jervis Bay.* | x | x | - | - | x | x |
| *Tetratheca glandulosa* OEH | V | - | Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. *Distribution limits N-Mangrove Mountain S-Port Jackson.* | x | x | - | - | x | x |
| *Tetratheca juncea* OEH EPBC | V | V | Prostrate shrub to 1m high. Dry sclerophyll forest and heath. *Distribution limits N-Bulahdelah S-Port Jackson.* | x | ✓ | 500m W | 2018 | ✓ | ✓ |

| ***Scientific name*** DATABASE SOURCE1 | ***BC Act*** | ***EPBC Act*** | **Growth form and habitat requirements** ***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and / or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| *Thelymitra adorata* EPBC | E4a | CE | Currently known from a few localised occurrences in the area bounded by the towns of Wyong, Warnervale and Wyongah on the New South Wales Central Coast, Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest with a diverse grassy understorey and occasional scattered shrubs. | x | x | - | - | x | x |
| *Thesium australe* EPBC | V | V | Erect herb to 0.4m high. Root parasite. Themeda grassland or woodland often damp. *Distribution limits N-Tweed Heads S-south of Eden.* | x | x | - | - | x | x |

| | |
|---|---|
| OEH | - Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* |
| EPBC | - Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search |
| TBE | - Denotes additional species considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records |
| V | - Denotes vulnerable listed species under the relevant Act |
| E or E1 | - Denotes endangered listed species under the relevant Act |
| E4A or CE | - Denotes critically endangered listed species under the relevant Act |
| NOTE: | 1. This field is not considered if no suitable habitat is present within the subject site<br>2. 'records' refer to those provided by the *Atlas of NSW Wildlife*<br>3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle |

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**Table A2.2** – Threatened fauna species habitat assessment

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Wallum Froglet<br>*Crinia tinnula*<br>OEH | V | - | Found in acidic paperbark swamps and wallum country with dense groundcover. Breeds in temporary and permanent pools and ponds of high acidity. *Distribution limit: N-Tweed Heads S-Kurnell.* | x | dispersal | ✓ | ✓ | ✓ | ✓ |
| Giant Burrowing Frog<br>*Heleioporus australiacus*<br>EPBC | V | V | Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. *Distribution limit: N-Near Singleton S-South of Eden.* | x | x | - | - | x | x |
| Green and Golden Bell Frog<br>*Litoria aurea*<br>OEH EPBC | E | V | Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. *Distribution limit: N-Byron Bay S-South of Eden.* | x | Sub-optimal | x | x | Not likely | x |
| Littlejohn's Tree Frog<br>*Litoria littlejohnii*<br>EPBC | V | V | Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. *Distribution limit: N-Hunter River S-Eden.* | x | x | - | - | x | x |
| Stephens' Banded Snake<br>*Hoplocephalus stephensii*<br>OEH | V | - | A nocturnal and partly arboreal species that inhabits open and closed forest communities sheltering under bark, in hollows and under exfoliating slabs of granite. *Distribution limit: N-Border Ranges National Park. S-Gosford.* | x | marginal | x | x | Not likely | x |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Magpie Goose<br>*Anseranas semipalmata*<br>OEH | V | - | A strongly nomadic species found in tropical through to sub-tropical wetlands, flood plains, large swamps, dams and wet grasslands with dense growths of rushes and sedges. *Distribution limit: N-Tweed Heads. S-Mulwala.* | x | marginal | x | x | Not likely | x |
| Blue-billed Duck<br>*Oxyura australis*<br>OEH | V | - | A completely aquatic species occurring mainly throughout the Murray-Darling basin in cool to warm temperate deep permanent freshwater lakes, lagoons and swamps with extensive reed-beds. *Distribution limit: N-Tenterfield. S-Albury*. | x | x | - | - | x | x |
| Freckled Duck<br>*Stictonetta naevosa*<br>OEH | V | - | Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. *Distribution limit: N- Tenterfield. S-Albury.* | x | x | - | - | x | x |
| Rose-crowned Fruit-dove<br>*Ptilinopus regina*<br>OEH | V | - | Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit. *Distribution limit: N-Tweed Heads. S-Wollongong.* | x | x | - | - | x | x |
| Superb Fruit-dove<br>*Ptilinopus superbus*<br>OEH | V | - | Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. *Distribution limit: N-Border Ranges National Park. S-Batemans Bay.* | x | x | - | - | x | x |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Black-necked Stork<br>*Ephippiorhynchus asiaticus*<br>OEH | E | - | Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution limit: N-Tweed Heads. S-Nowra.* | x | marginal | x | x | Not likely | x |
| Australasian Bittern<br>*Botaurus poiciloptilus*<br>EPBC | E | E | Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. *Distribution limit: N-North of Lismore. S- Eden.* | x | x | - | - | x | x |
| Black Bittern<br>*Ixobrychus flavicollis*<br>OEH | V | - | Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | marginal | x | x | Not likely | x |
| White-bellied Sea Eagle<br>(*Haliaeetus leucogaster*)<br>OEH | V | - | Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. *Sedentary; dispersive. N-Tweed Heads. S-South of Eden.* | x | Sub-optimal | ✓ | ✓ | ✓ | ✓ |
| Little Eagle<br>*Hieraaetus morphnoides*<br>OEH | V | - | Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. *Distribution limit - N-Tweed Heads. S-South of Eden.* | x | marginal | x | x | unlikely | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Square-tailed Kite<br>*Lophoictinia isura*<br>OEH | V | - | Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. *Distribution limit: N-Goondiwindi. S-South of Eden.* | x | ✓ | x | ✓ | low | ✓ |
| Eastern Osprey<br>*Pandion cristatus*<br>OEH | V | - | Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | x | - | - | x | x |
| Black Falcon<br>*Falco subniger*<br>OEH | V | - | Inhabits plains, grasslands, foothills, timbered watercourses, wetland environs, crops; occasionally over towns and cities. *N-Tweed Heads. S-South of Eden* | x | x | - | - | x | x |
| Bush Stone-curlew<br>*Burhinus grallarius*<br>OEH | E | - | Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. *Distribution limit: N-Border Ranges National Park. S-Near Nowra.* | x | x | - | - | x | x |
| Australian Painted Snipe<br>*Rostratula australis*<br>EPBC | E | E | Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | x | - | - | x | x |
| Gang-gang Cockatoo<br>*Callocephalon fimbriatum*<br>OEH | V | - | Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. *Distribution limit: mid north coast of NSW to western Victoria.* | x | marginal | x | ✓ | Not likely | x |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Glossy Black-Cockatoo<br>*Calyptorhynchus lathami*<br>OEH | V | - | Open forests with *Allocasuarina* species and hollows for nesting. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | ✓ | x | ✓ | low | ✓ |
| Little Lorikeet<br>*Glossopsitta pusilla*<br>OEH | V | - | Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. *Distribution limit: N-Tweed Heads. S-South of Eden*. | x | ✓ | x | ✓ | ✓ | ✓ |
| Swift Parrot<br>*Lathamus discolour*<br>OEH EPBC | E | E | Inhabits eucalypt forests and woodlands with winter flowering eucalypts. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |
| Turquoise Parrot<br>*Neophema pulchella*<br>OEH | V | - | Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. *Distribution limit: N-Near Tenterfield. S-South of Eden.* | x | marginal | x | ✓ | Not likely | x |
| Barking Owl<br>*Ninox connivens*<br>OEH | V | - | Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. *Distribution limit: N-Border Ranges National Park. S-Eden.* | x | ✓ | x | ✓ | unlikely | ✓ |
| Powerful Owl<br>*Ninox strenua*<br>OEH | V | - | Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. *Distribution limits: N-Border Ranges National Park. S-Eden.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Masked Owl<br>*Tyto novaehollandiae*<br>OEH | V | - | Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution limit: N-Border Ranges National Park. S-Eden.* | ✓ | - | - | - | - | ✓ |
| Sooty Owl<br>*Tyto tenebricosa*<br>OEH | V | - | Tall, dense, wet forests containing trees with very large hollows. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | x | x | - | - | x | x |
| Brown Treecreeper<br>*Climacteris picumnus victoriae*<br>OEH | V | - | Occupies eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. *Distribution limit: (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.* | x | x | - | - | x | x |
| Eastern Bristlebird<br>*Dasyornis brachypterus*<br>EPBC | E | E | Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | x | - | - | x | x |
| Speckled Warbler<br>*Chthonicola sagittata*<br>OEH | V | - | Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.* | x | x | - | - | x | x |
| Regent Honeyeater<br>*Xanthomyza Phrygia*<br>OEH EPBC | E4A | CE | Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. *Distribution limit: N-Urbanville. S-Eden.* | x | ✓ | x | x | low | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| White-fronted Chat<br>*Epithianura albifrons*<br>OEH | V | - | Found in open damp ground, grass clumps, fencelines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | ✓ | x | x | Not likely | x |
| Painted Honeyeater<br>*Grantiella picta*<br>EPBC | V | V | A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. *Distribution limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.* | x | x | - | - | x | x |
| Grey-crowned Babbler<br>*Pomatostoomus temporalis temporalis*<br>OEH | V | - | Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. *Distribution limit: N-Qld widespread. S-Mornington Pen. E-se SA.* | x | x | - | - | x | x |
| Varied Sittella<br>*Daphoenositta chrysoptera*<br>OEH | V | - | Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | x | ✓ | ✓ | x | ✓ | ✓ |

| Common name<br>*Scientific name*<br>Database source | *BC Act* | *EPBC Act* | Preferred habitat<br>*Distribution limit* | Recorded on site (✓) | If not recorded on site | | | | Further assessment required (✓) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Suitable habitat present (✓) | Nearby and/or high number of record(s) (✓) *Notes 1,2 & 3* | Record(s) from recent years (✓) *Notes 1,2 & 3* | Potential to occur | |
| Dusky Woodswallow<br>*Artamus cyanopterus cyanopterus*<br>OEH | V | - | Found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. Prefers habitat with an open understorey. Often observed in farmland tree patches or roadside remnants. *Widespread in eastern, southern and south-western Australia.* | x | ✓ | x | x | unlikely | ✓ |
| Scarlet Robin<br>*Petroica boodang*<br>OEH | V | - | Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | ✓ | x | x | Not likely | x |
| Diamond Firetail<br>*Stagonopleura guttata*<br>OEH | V | - | Found in eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *Distribution limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.* | x | x | - | - | x | x |
| Spotted-tailed Quoll<br>*Dasyurus maculatus*<br>OEH EPBC | V | E | Dry and moist open forests containing rock caves, hollow logs or trees. *Distribution limit: N-Mt Warning National Park. S-South of Eden.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Koala<br>*Phascolarctos cinereus*<br>OEH EPBC | V | V | Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution limit: N-Tweed Heads. S-South of Eden.* | x | ✓ | ✓ | x | unlikely | ✓ |
| Eastern Pygmy Possum<br>*Cercatetus nanus*<br>OEH | V | - | Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. *Distribution limit: N-Tweed Heads. S-Eden.* | x | Sub-optimal | x | x | unlikely | ✓ |
| Squirrel Glider<br>*Petaurus norfolcensis*<br>OEH | V | - | Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. *Distribution limit: N-Tweed Heads. S-Albury.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |
| Greater Glider<br>*Petauroides volans*<br>EPBC | - | V | Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows *Distribution limit: N-Border Ranges National Park. S- South of Eden.* | x | Sub-optimal | x | x | Not likely | x |
| Long-nosed Potoroo<br>*Potorous tridactylus*<br>EPBC | V | V | Coastal heath and dry and wet sclerophyll forests with a dense understorey. *Distribution limit: N-Mt Warning National Park. S-South of Eden.* | x | x | - | - | x | x |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Grey-headed Flying-fox<br>*Pteropus poliocephalus*<br>OEH EPBC | V | V | Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. *Distribution limit: N-Tweed Heads. S-Eden.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |
| Yellow-bellied Sheathtail-bat<br>*Saccolaimus flaviventris*<br>OEH | V | - | Rainforests, sclerophyll forests and woodlands. *Distribution limit: N-North of Walgett. S-Sydney.* | x | ✓ | x | ✓ | low | ✓ |
| East-coast Freetail Bat<br>*Micronomus norfolkensis*<br>OEH | V | - | Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. *Distribution limit: N-Woodenbong. S-Pambula.* | ✓ | - | - | - | - | ✓ |
| Large-eared Pied Bat<br>*Chalinolobus dwyeri*<br>EPBC | V | V | Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. *Distribution limit: N-Border Ranges National Park. S-Wollongong.* | x | x | - | - | x | x |
| Eastern Falsistrelle<br>*Falsistrellus tasmaniensis*<br>OEH | V | - | Recorded roosting in caves, old buildings and tree hollows. *Distribution limit: N-Border Ranges National Park. S-Pambula.* | x | ✓ | x | ✓ | ✓ | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| Little Bentwing-bat<br>*Miniopterus australis*<br>OEH | V | - | Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution limit: N-Border Ranges National Park. S-Sydney.* | ✓ | - | - | - | - | ✓ |
| Eastern Bentwing-bat<br>*Miniopterus orianae oceanensis*<br>OEH | V | - | Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | ✓ | - | - | - | - | ✓ |
| Large-footed Myotis<br>*Myotis macropus*<br>OEH | V | - | Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | ✓ | - | - | - | - | ✓ |
| Greater Broad-nosed Bat<br>*Scoteanax rueppellii*<br>OEH | V | - | Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution limit: N-Border Ranges National Park. S-Pambula.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |
| Eastern Cave Bat<br>*Vespadelus troughtoni*<br>OEH | V | - | Inhabits drier open forests and woodlands. Roosts in well-lit parts of caves and mineshafts. *Distribution limit: Along GDR from N-Tweed Heads. S-Kempsey.* | x | ✓ | ✓ | ✓ | ✓ | ✓ |

| **Common name**<br>***Scientific name***<br>Database source | ***BC Act*** | ***EPBC Act*** | **Preferred habitat**<br>***Distribution limit*** | **Recorded on site (✓)** | **If not recorded on site** | | | | **Further assessment required (✓)** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | **Suitable habitat present (✓)** | **Nearby and/or high number of record(s) (✓)** *Notes 1,2 & 3* | **Record(s) from recent years (✓)** *Notes 1,2 & 3* | **Potential to occur** | |
| New Holland Mouse<br>*Pseudomys novaehollandiae*<br>EPBC | - | V | Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. *Distribution limit: N-Border Ranges National Park. S-South of Eden.* | x | x | - | - | x | x |
| Giant Dragonfly<br>*Petalura gigantean*<br>OEH | E | - | Inhabits large relatively deep permanent swamps and bogs with high water quality and moss or other soft vegetation along the edge for egg laying. *It occurs in the far NE NSW, south to Kempsey, & in a patch between Gosford & Nowra.* | x | x | - | - | x | x |
| Australian Grayling<br>*Prototroctes maraena*<br>EPBC | Part 2, Section 19 – Protected Fish (*FM Act 1994*) | V | Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls). | x | x | - | - | x | x |

| | |
|---|---|
| OEH | Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* |
| EPBC | Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search |
| TBE | Denotes additional species considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records |
| V | Denotes vulnerable listed species under the relevant Act |
| E or E1 | Denotes endangered listed species under the relevant Act |
| E4A or CE | Denotes critically endangered listed species under the relevant Act |
| NOTE: | 1. This field is not considered if no suitable habitat is present within the subject site<br>2. 'records' refer to those provided by the *Atlas of NSW Wildlife*<br>3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle |

| Common name<br>*Scientific name*<br>Database source | *BC Act* | *EPBC Act* | Preferred habitat<br>*Distribution limit* | Recorded on site (✓) | If not recorded on site | | | | Further assessment required (✓) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Suitable habitat present (✓) | Nearby and/or high number of record(s) (✓)<br>*Notes 1,2 & 3* | Record(s) from recent years (✓)<br>*Notes 1,2 & 3* | Potential to occur | |
| Unlikely | Represents such a low margin but not enough to 100% rule it one. A significance of impact test is required. | | | | | | | | |
| Not likely | Means 0% change of occurring, despite there being potential habitat. A significance of impact test is not applied to these species. | | | | | | | | |

A detailed assessment in accordance with Section 1.7 of the *EPA Act* will be completed for these species in Appendix 3 of this report.

Table A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A2.3.

**Table A2.3** – Migratory fauna habitat assessment

| **Common name**<br>***Scientific name*** | **Preferred habitat**<br>***Migratory breeding*** | **Suitable habitat present (✓)** | **Recorded present (✓)** | **Comments on potential impacts** |
|---|---|---|---|---|
| Oriental or Horsfield's Cuckoo (*Cuculus optatus*) | It mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground. | ✓ | x | No likely impact |
| Osprey<br>*Pandion cristatus* | Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. *Distribution Limit: N-Tweed Heads. S-South of Eden.* | x | - | - |
| White-throated Needletail (*Hirundapus caudacutus*) | Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. *Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.* | ✓ | x | No likely impact |
| Black-faced Monarch (*Monarcha melanopsis*) | Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. *Summer breeding migrant to coastal south east Australia, otherwise uncommon.* | ✓ | ✓ | An individual was heard at a distance within the southern forest area. No potential breeding or likely foraging habitat will be impacted. |
| Spectacled Monarch (*Monarcha trivirgatus*) | Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. *Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept/Oct to May. Uncommon in southern part of range.* | x | - | - |
| Yellow Wagtail (*Motacilla flava*) | The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops. | x | - | - |
| Satin Flycatcher (*Myiagra cyanoleuca*) | Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.* | x | - | - |
| Rufous Fantail (*Rhipidura rufifrons*) | Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. *Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.* | ✓ | x | No likely impact |
| Fork-tailed Swift (*Apus pacificus*) | Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.* | ✓ | x | No likely impact |

# Appendix 3
# Report on the Chain Valley Bay Masked Owls by John Young

**Report on the "Chain Valley Bay"**

# Masked Owls

**By**

## John Young

**(Wildlife Consultant and large forest Owl specialist.)**

**Chain Valley Bay Site, Subject to a Development Proposal**

**Background**

On the eve of 27th June 2019 soon after dusk, Mr Corey Mead of Travers Bushfire and Ecology, a senior Fauna Ecologist, suspecting suitable habitat (several large hollows and mosaic understorey structure) attracted a single Masked Owl by mimicry of the bird's call. The owl approached quietly within minutes of Corey's call and landed on a branch overhead.

Given that this bird arrived rapidly and just after dusk, it was clearly occupying the site and surrounds. The bird was confirmed at the time in torch light as Corey was quite familiar with the species, having worked with many other pairs.

Following this event Mr Mead surveyed the site in the vicinity for all suitable hollows and one in particular stood out as being centrally located within the others and suitable for nesting at point Lat: 33° 14' 44.72881"S – Long: 151° 34' 45.30851"E.

A number of other hollow bearing tree's suitable for roosting were also discovered within a 300m radius of the suspected nest tree.

**Suspected nest tree for Masked Owls discovered by Corey Mead. Typical site.**

**30th August**

On August 30th 2019, I visited the site with Mr Mead for a brief look at the location and all potential use trees identified along with a brief from him of what he had seen and heard.

Later in the afternoon I returned again to within 30 metres of the suspected tree and stayed till well after dark in heavy rain. A useless night as very few owls call when in heavy rain, instead they often sit motionless and quiet. Not surprisingly, not a sound was heard, nor was there any sign of the bird so I departed at 7.55pm.

**31st August**

**Morning session** - I arrived at the site at 3.45am, again in pouring rain and positioned myself across the creek at the same spot and waited until daylight.

Still not a sign or sound, so I departed at 6.30am.

**Evening session** - Once again I arrived at the same spot in heavy rain at 5.15pm.

This time the rain eased and after a long wait a Masked Owl arrived from the east at 7.27pm, cackling softly as it approached with what appeared to be something in its bill.

It did not go to the obvious hollow but, instead went to the dead hollow upright in the centre of the tree and went in.


**Entrance to Masked Owl nest – 31st August 2019**

I expect that both entrances to the hollow will join up. I stayed in position as the rain got heavier but, did not see the bird come out. I departed at 8.21pm.

There is no doubt that this tree is the nesting site of the pair and most likely has been for many years.

**1st September**

**Morning session** - Again, I arrived at the site close to the discovered nest tree at 4.05am in very light rain with clearing skies. Not a sound nor sign of anything until 5.06am then there was a call approximately 200 m to the south east. Seemingly the last call of the night before going to roost in a hollow.

I spent many hours going over the site during the day, looking at all the possible hollows that Mr Mead had discovered and marked, and one in particular seemed to be in line with where I heard the call on daylight, so I decided to come back in the late evening and sit half way between the two discovered sites.

**Showing typical Masked Owl habitat midway between nest site and discovered roost tree**

**Evening session** - I arrived again at the planned site at 5pm and waited.

6.05pm in dim light the male called directly at the suspected roost tree and on my approach, he was clearly visible on a horizontal branch, just out from the hollow preening.

A roost tree at Lat: 33° 10’ 46.72024”S – Long: 151° 34’ 52.36077”E is confirmed.

Within 5 minutes he flew overhead, directly towards the discovered nest tree, cackling softly as he went. He did not have food but was visiting the female.

No further sound was heard so I departed under relatively clear skies at 7.45pm.

**2nd September**

**Morning session** - I arrived back near the nest tree at 3.48am and sat quietly close to the tree and heard nothing. Not a sound or even a sighting of the bird.

These birds become so quiet and secretive when they have young (which I believe they had from 40 years of experience in viewing many nest sites). From normal behaviour of some pairs, you would not know that they even existed in the area.

I departed at 6.10am.

**Evening session** - Again, I sat just across the creek from the discovered nest tree before dusk and waited. This time under very clear skies.

At 6.28pm in dim light the male appeared, seemingly from nowhere, I was lucky to see him. He landed on the rim of the main entrance to the hollow, chuckled softly for a few seconds, then flew south up over the canopy calling once in flight well off in the distance as he went hunting.

With no further sound I departed at 8pm.

**3rd September**

**Last morning session** - I arrived again near the nest tree under clear skies at 4.21am and waited until daylight without hearing or seeing the bird. Not surprising when these birds have young as they will often come in towards midnight with food, then no more.

## Conclusion

The map below shows the locations of all large hollows with potential use, from Corey Meads initial survey work. The authors work has followed on to confirm those findings of suitable hollows, the nest tree and a roost tree.

I expect that the recorded breeding pair of Masked Owls have occupied this area at Chain Valley Bay for many years. The identified nest tree is central to this activity and very important for protection with appropriate buffers.

One hollow was also confirmed as a roost site, however a number of others located by Mr Mead are also potential roost sites. I have taken a precautionary approach to ensure each of these also receive appropriate buffers from development and activity.

The forested habitat surrounding the breeding area is extensive, so provided that these buffers are enforced with some additional measures to screen out development and future activity, I believe the birds will continue to remain here.

**Recommendations**

I have taken the approach that the prescriptive buffers of 100m from a nest tree and 50m from a roost tree be applied to the trees identified.

I am recommending that the “blue” line on the following map is the southern boundary of the proposed development to incorporate the nest tree and a potential roost tree buffers within a protection zone. This outer area should be heavily revegetated with local dense foliage plants to act both as a sound and light barrier. This area may include the stormwater detention basin for the development provided that the same extent of vegetation is planted on either side to permit the sound and light barrier.

Special thanks to Corey Mead for his excellent field work and support during the survey.

Also, to Michael Sheather-Reid, Managing Director of Travers Bushfire and Ecology for his strong support.

John Young.

12th September 2019


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