



Appendix D

Biodiversity assessment report

Heathcote Road Bridge Widening

Biodiversity Assessment Report

Transport for New South Wales | December 2020



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Transport for New South Wales | December 2020

Prepared by NGH Consulting

Document History and Status

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Executive Summary

Transport for NSW propose to widen Bridge No. 152 over the Woronora River on Heathcote Road (the proposal). The main objective is to improve safety on the bridge, and the proposal includes widening the bridge by 1.2 metres on each side as well as widening of the northern and southern bridge approaches for about 250 metres in either direction. The proposed upgrade is within the Sutherland Shire local government area and is adjacent to Heathcote National Park.

NGH Pty Ltd were engaged by Transport for NSW to investigate the biodiversity values within the proposal area to assess any potential impacts as a result of the proposal. Biodiversity values were identified through a combination of background research and field survey. The literature review component of this project considered species records, habitat distribution, vegetation mapping and relevant studies, in order to confirm the presence (or absence) of threatened species in the locality, target survey effort and inform an assessment of the likelihood of occurrence as well as the tests/assessments of significance. Recommendations for appropriate mitigation measures also considered relevant published literature.

The field survey consisted of a random meander search of the entire proposal area along with a 50 m buffer. This enabled all available habitat types to be inspected, identifying suitable habitat for those threatened species highlighted by the literature review. Information recorded during the field survey included:

- Native flora species and vegetation communities present;
- Targeted threatened species identified during background searches;
- Opportunistic fauna sightings where suitable habitat was present;
- Weed species present and their abundance.

Whilst the study area is subject to existing disturbance from Heathcote Road, it otherwise contains relatively high-quality habitat due to the topography of the locality and limited accessibility. The study area is comprised of sandstone vegetation of upper slopes, riparian scrub, and wetland species within the water body.

Three (3) Plant Community Types were identified within the study area:

- **PCT 1250:** Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin (aka **Coastal Sandstone Gully Forest**)
- **PCT 1292:** Water Gum-Coachwood Riparian Scrub Along Sandstone Streams, Sydney Basin (aka **Coastal Sandstone Riparian Scrub**)
- **PCT 781:** Coastal Freshwater Lagoons of the Sydney Basin and South East Corner (aka **Coastal Freshwater Wetland**).

Of these, Coastal Freshwater Wetland is an endangered ecological community under the *Biodiversity Conservation Act 2016*. The proposal would result in the reduction of the local occurrence of Sydney Freshwater Wetlands by 0.05 ha in areas of vegetation beneath Heathcote Bridge. This is not considered to be a significant impact.

No threatened flora species were confirmed during the field survey, however there are six flora species and one population that are considered to have a moderate to high likelihood of occurrence. These are:

- *Allocasuarina diminuta* subsp. *mimica*
- *Astrotricha crassifolia* Thick-leaf Star-hair
- *Grevillea parviflora* subsp. *Parviflora* Small-flower Grevillea
- *Hibbertia stricta* subsp. *furcatula*
- *Leucopogon exolasius* Woronora Beard-heath
- *Melaleuca deanei* Deane's Paperbark

For each of the threatened flora species, a maximum of 2.53 ha of suitable habitat will be removed by the project. Deane's Paperbark has a maximum of 3.12 ha of suitable habitat, as this species may also occur in the riparian area. Additionally, the newly described (and as-yet unlisted) *Hibbertia woronorana* may occur within the proposal area. While a precautionary approach is being taken, none of the species were observed during site surveys and there are no records from within the proposal area. The potential habitat which will be removed, some of which is sub-optimal habitat due to existing edge effects, is adjacent to a much larger area of habitat in the region, including the high-quality habitat throughout Heathcote National Park and Holsworthy Military Reserve. As a result, the proposal is considered unlikely to constitute a significant impact on threatened flora.

The literature review returned a large number of potential threatened species within a 10 km radius of the proposal area, given the proximity to extensive areas of protected area. Of these, threatened fauna considered highly likely to occur includes Powerful Owl *Ninox strenua*, Koala *Phascolarctos cinereus*, Red-crowned Toadlet *Pseudophryne australis* and Rufous Fantail *Rhipidura rufifrons*. Both highly and moderately likely fauna species were considered against the test of significance (Biodiversity Conservation Act five-part test) and/or the assessment of significance (*Environment Protection and Biodiversity Conservation Act 1999*). A maximum of 3.12 ha of habitat will be directly impacted, and the proposal area does not include any preferred Koala feed trees.

Impacts which may arise as a result of the proposal include both direct and indirect impacts, as well as those that are specific to construction and those that may apply during operation:

- Vegetation clearing and removal of native vegetation and threatened fauna habitat
- Impacts to the aquatic environment and/or groundwater dependent ecosystems
- Direct mortality of native fauna
- Loss of connectivity
- Weed spread
- Pest animal predation/competition
- Introduction and/or spread of pathogens
- Hydrological changes
- Noise, light and vibration
- Natural disasters – i.e. bushfire and flood, and accidental ignition of a fire during proposed activities

The proposed works have been designed to minimise vegetation clearing. The proposal design has been refined to use piling wall (as opposed to a batter or retaining earth wall) to reduce both the construction and design footprint. This has avoided potential direct impacts to adjacent sensitive areas including Heathcote Creek, the National Park boundary on the south-west side, and the steep drop to Woronora River channel on the north-east side.

Clearing has also been minimised by using an existing track on the northern side as the access track for works beneath the bridge. While there is some regrowth along the track, this will minimise clearing in other undisturbed areas.

This biodiversity assessment report recommends a variety of mitigation measures to further reduce the chance of negative impacts on ecological values. These include (but are not limited to):

- Preparation of relevant sub-plans as part of the construction environmental management plan (i.e. flora and fauna management, microbat management, weed management procedure, flood preparedness plan).
- Pre-clearing checks of habitat features to determine fauna presence and threatened flora locations (in accordance with *Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011)).
- Vegetation removal in accordance with *Guide 4: Clearing of vegetation and removal of bush rock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).

- Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
- Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bush rock* and *Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).
- Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).

Vehicle strike along Heathcote Road is already a recognized threat to Koala and other native species. The proposal provides an opportunity to decrease this barrier and improve movement opportunity for wildlife. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas and other species under the bridge, along with crossing infrastructure (to provide refuge and assist movement). Targeted restoration under the bridge and following construction will facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit for the Koala and other barrier-sensitive wildlife.

Implementing the avoidance and mitigation measures detailed in this report will reduce any potential impacts on threatened ecological communities, flora and fauna species such that a significant impact on either matters of state or national environmental significance is not considered to be likely.

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Glossary of Terms

Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development (OEH 2017).
Construction footprint	The area to be directly impacted by the proposal during construction activities. Analogous with subject land (see definition for subject land).
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat, and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (the BC Regulation) (BAM 2020)
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	Indirect impacts include but not limited to: (a) indirect impacts on adjacent vegetation and habitat during construction (b) indirect impacts on adjacent vegetation and habitat during operation I impacts on adjacent vegetation and habitat arising from a change in land-use patterns (BAM 2020)
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH 2017).
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality or injury.

Native vegetation	(a) trees (including any sapling or shrub or any scrub), (b) understorey <i>plants</i> , (c) groundcover (being any type of herbaceous vegetation), (d) <i>plants</i> occurring in a wetland. A <i>plant</i> is native to New South Wales if it was established in New South Wales before European settlement (BC Act).
OEH BAM Credit Calculator (BCC)	An online application of the Biodiversity Assessment Method (BAM). The calculator uses the rules and calculations outlined in the BAM and allows the user to apply the BAM at a site and observe the results of the assessment.
Operational footprint	The area that will be subject to ongoing operational impacts from the proposal. This includes the road, surrounding safety verges and infrastructure, fauna connectivity structures and maintenance access tracks and compounds.
Population	A group of organisms, all of the same species, occupying a particular area (BAM 2020).
Proposal area/ proposal site/ development footprint	The area of land that is directly impacted on by the proposal that is being assessed under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014). It includes the construction and operational areas for the proposal.
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014).
Target species	A species has been identified within the study area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the proposal.

Abbreviations

ARKS	Areas of Regional Koala Significance
BAM	Biodiversity assessment method
BC Act	<i>Biodiversity Conservation Act 2016</i> (NSW)
BCD	Biodiversity and Conservation Division (formerly OEH)
BOS	Biodiversity Offset Scheme under the BC Act
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DAWE	Cth Department of Agriculture, Water and the Environment
DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GDE	Groundwater Dependent Ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage (now BCD)
PCT	Plant Community Type
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SPRAT	Species profiles and threats database
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VEC	Vulnerable Ecological Community
VIS	Vegetation information system

1. Introduction

1.1 Background

Transport for NSW (TfNSW) propose to widen Bridge No. 152 over the Woronora River on Heathcote Road (the proposal). The main objective of the proposal is to improve safety on the bridge. The proposal includes widening of the bridge by 1.2 metres on each side to provide one wide through lane in each direction with a shoulder. The proposal will also involve widening of the northern and southern bridge approaches for about 250 metres either side, to improve alignment and provide safer lane widths on approach to the bridge. Additional repair and maintenance works to the bridge are also included within the scope.

The proposal is located along the A6 section of Heathcote Road corridor which is a 5.4 km section between New Illawarra Road, Lucas Heights and the Princes Highway, Heathcote. The proposed upgrade is within the Sutherland Shire LGA and is adjacent to Heathcote National Park. A locality map is provided in Figure 1-1. The context of the proposal area within the broader landscape is shown in Figure 1-2, including proximity to national park(s), national estate and the Georges River Koala Reserve.

This biodiversity assessment is intended to form an appendix to the project review of environmental factors (REF).

1.2 The Proposal

The preferred method of widening is to install headstock extensions to each of the piers. The headstock extensions are post tensioned in place and held by the friction force against the pier. The headstock extensions support new steel box girders. Composite formwork on top of the steel girders allows the bridge deck slab extension to be poured which is followed by the construction of bridge barriers. Both northern and southern approaches to the bridge are proposed to be widened through a combination of removing rock face and construction of retaining walls. The full proposal length is about 630 m including upgrade to the bridge approaches. The proposal includes associated enabling works such as utility relocation and vegetation removal. Ancillary facilities required include site compounds, vehicle access tracks and laydown areas. Key features of the proposal are outlined below and shown in Figure 1-6.

Early Works

- Demarcate approved limits of work
- Implement construction safety barriers along northern abutment where guardrail will be removed for site access
- Establish erosion and sediment controls
- Vegetation removal and import of materials to establish a vehicle access track beneath the bridge. Nominated access tracks are as shown on Figure 1-6.
- Construct a temporary construction vehicle crossing across Woronora River (upstream of the bridge) to access the southern abutment area. The final construction methodology will be subject to an approved construction environmental management plan (CEMP) and Department of Primary Industries input. Indicative construction methodology assumes laying of geo fabric over the natural surface of the river bed and the installation of ballast rock, 4 x 600 mm pipes, coarse granular fill and a capping layer of ballast and bund at either side of the trafficked area

- Geotechnical investigation including establishment of survey markers approx. 40 boreholes within the proposal area. Boreholes will require use of vehicle mounted drilling rigs. Disturbed areas will be backfilled and compacted. Any slurry generated would be contained and cleaned up.
- Possible property boundary works (i.e. fencing)

Site Establishment

- Implement full road closure traffic arrangements
- Setup small on-site office and amenities block within existing road corridor.
- Establish the two nominated off-site construction compounds. This includes delivery of site sheds, delineation of work areas and implementing erosion and sediment controls
- Establish temporary laydown and storage areas within the closed road corridor
- Install personnel protection screens on bridge
- Demarcate approved limits of work
- Establish erosion and sediment controls
- Vegetation removal and import materials to establish area/s for crane platforms.
- Construct multiple crane platforms beneath the bridge. This would include vegetation removal, layered construction of geotextile and load bearing material layers, and perimeter bund.
- Construct scaffolding. This may require both ground and suspended scaffolding.
- Install bridge walkways on both sides (either by crane or scaffolding)
- Establish a small storage area on the northern access track for storage of plant and equipment above the flood level when not in use.
- Utilities adjustment – Protection and relocation of existing optical fibre along the whole length of the proposal area.

Bridge Strengthening and Repair

- Repair and maintenance work to existing bridge includes:
 - Repairs to cracking and concrete spalling
 - Replacement of expansion joints and bearings
 - Anti-carbonation coating. This includes painting a protective coating on the whole bridge structure and may require use of small watercraft to access piers within the waterway and temporary construction of coffer dams around piers to keep piers dry during application.
- Pier protection, earthworks and installation of rip-rap material.
- Install working platforms at abutments and modifications to bridge abutments and associated earthworks, possible retaining wall, installation of bridge aprons
- Bridge widening including installation of permanent formwork (performed from scaffold walkways)
- Deck pouring
- Parapet installation using mobile cranes
- Installation of drainage
- Remove existing rail on bridge
- Install new bridge deck including pavement and temporary line markings.

Upgrade to Northern and Southern Approaches

- Slope stabilisation works to the rock cutting on both northern and southern approaches. This includes removal of vegetation on the face of the cutting and crest of the slope up to maximum five metres behind the crest, scaling of the rock face, shotcreting, rock bolting, installation of rock netting, crest drain repairs, and reconstruction of the drainage gutter along the base of the slope
- Construction of new retaining walls along the length of the approaches. These are proposed to be piled retaining walls to minimise the construction footprint
- Upgrade and extend existing cross culverts (three on northern and three on southern approach) and install scour protection at the outlet
- Construction of widened pavement and line-marking
- Drainage adjustments
- Installation of road furniture features including barriers and signage.

Demobilisation

- Remove scaffolding, site office, crane
- Long term stabilisation of disturbed areas prior to removal of erosion and sediment controls
- Reinstate barrier on bridge
- Undertake permanent line-marking.

Nominated Compound Sites

Two site compounds have been nominated for construction. The locations are described below and as shown in Figure 1-4 and Figure 1-5. Both locations are owned by TfNSW and have previously been used as construction compound locations.

- Location 1 is approximately 2.6 km east of the main works area on the corner of Princes Highway and Wilson Parade intersection, Heathcote. The land is owned by TfNSW and is currently not in use. It is approximately 2100 m², all of which is hardstand area. There is existing temporary perimeter fencing which would remain in place. There is existing vegetation on the roadside edge along Princes Highway and to the south, however, these would not be impacted by the proposal. No vegetation trimming or removal is proposed. The closest residential receivers are located on the far side of Princes Highway (about 60 metres west) and on the other side of the adjacent railway corridor (about 80 metres east). Existing road traffic noise from the highway and railway noise is the dominant noise source.
- Location 2 is approximately 5km west of the main works area and is a fenced compound site on the north-west corner of Heathcote Road and New Illawarra Road intersection, Lucas Heights. It is approximately 700m² with permanent boundary fencing. No vegetation trimming or removal is proposed. The surrounding area is dense bushland. The return trip for construction traffic to and from the main work site would be about 10 km. There are no nearby residential receivers.

In addition to the above nominated compound areas, hardstand areas within the existing road corridor will be utilised during the full road closure for

- an amenities block and optional site office
- temporary stockpiling

- temporary laydown areas for delivery and possible fabrication of bridge components.

Study Area

The study area for the purpose of this biodiversity assessment is shown in Figure 1-3 and includes the main bridge, northern and southern approaches, rock cuttings (where accessible), roadside batters, construction access tracks beneath the bridge, and separate compound sites.

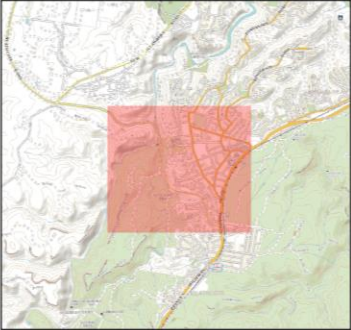
The following definitions are used in this report:

- **Proposal area:** the development footprint including direct impacts and compound sites.
- **Study area:** the proposal area plus additional 50 m buffer to capture potential indirect impacts.
- **Locality:** a 10 km radius surrounding the proposal area.



Heathcote Road Bridge Widening Locality

- Legend**
- Existing Narrow Bridge
 - Suburb
 - NPWS Reserve
 - Waterway



0 250 500 m

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Figure 1-1 Heathcote Road Bridge Locality

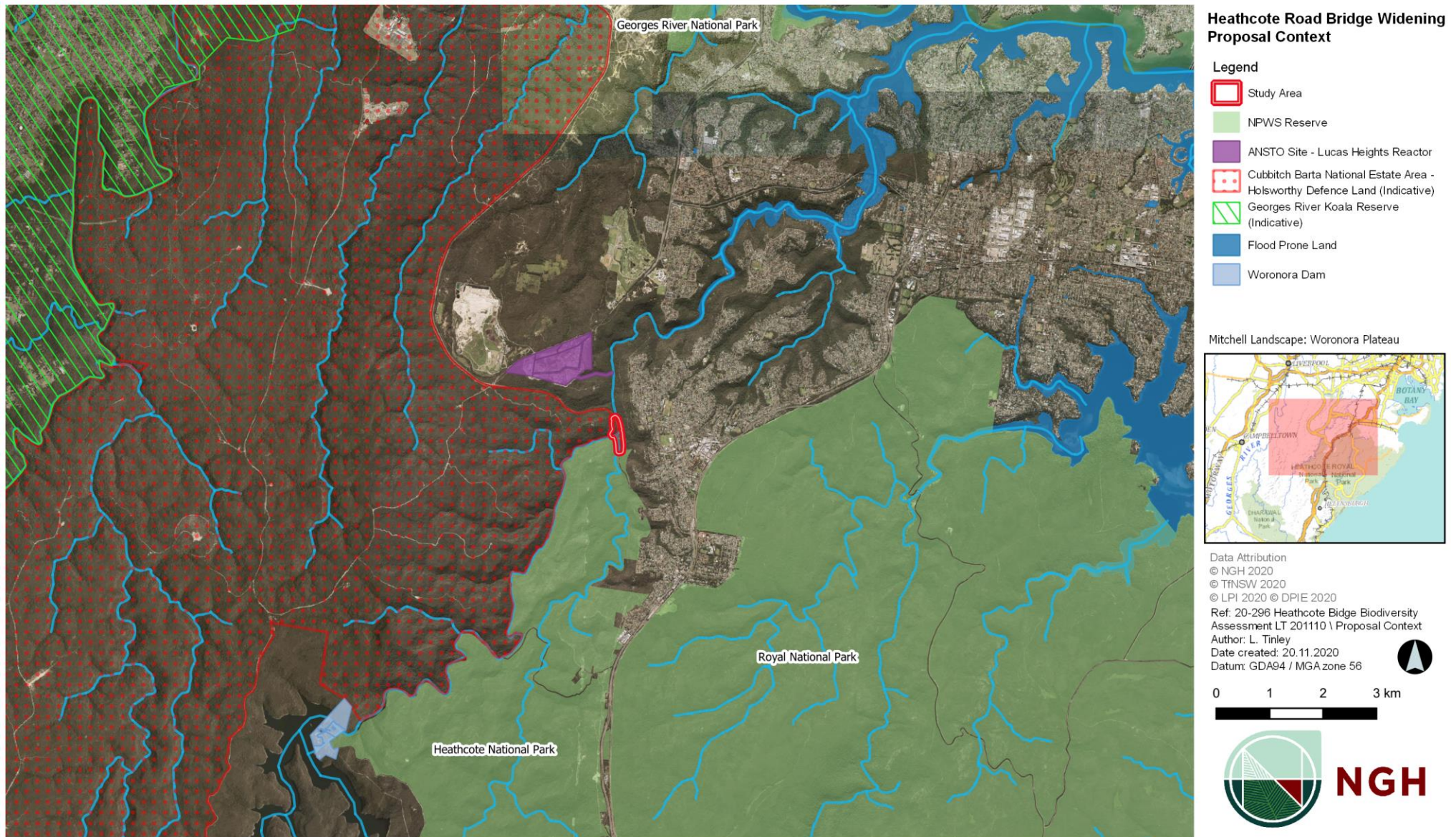


Figure 1-2 Proposal Context

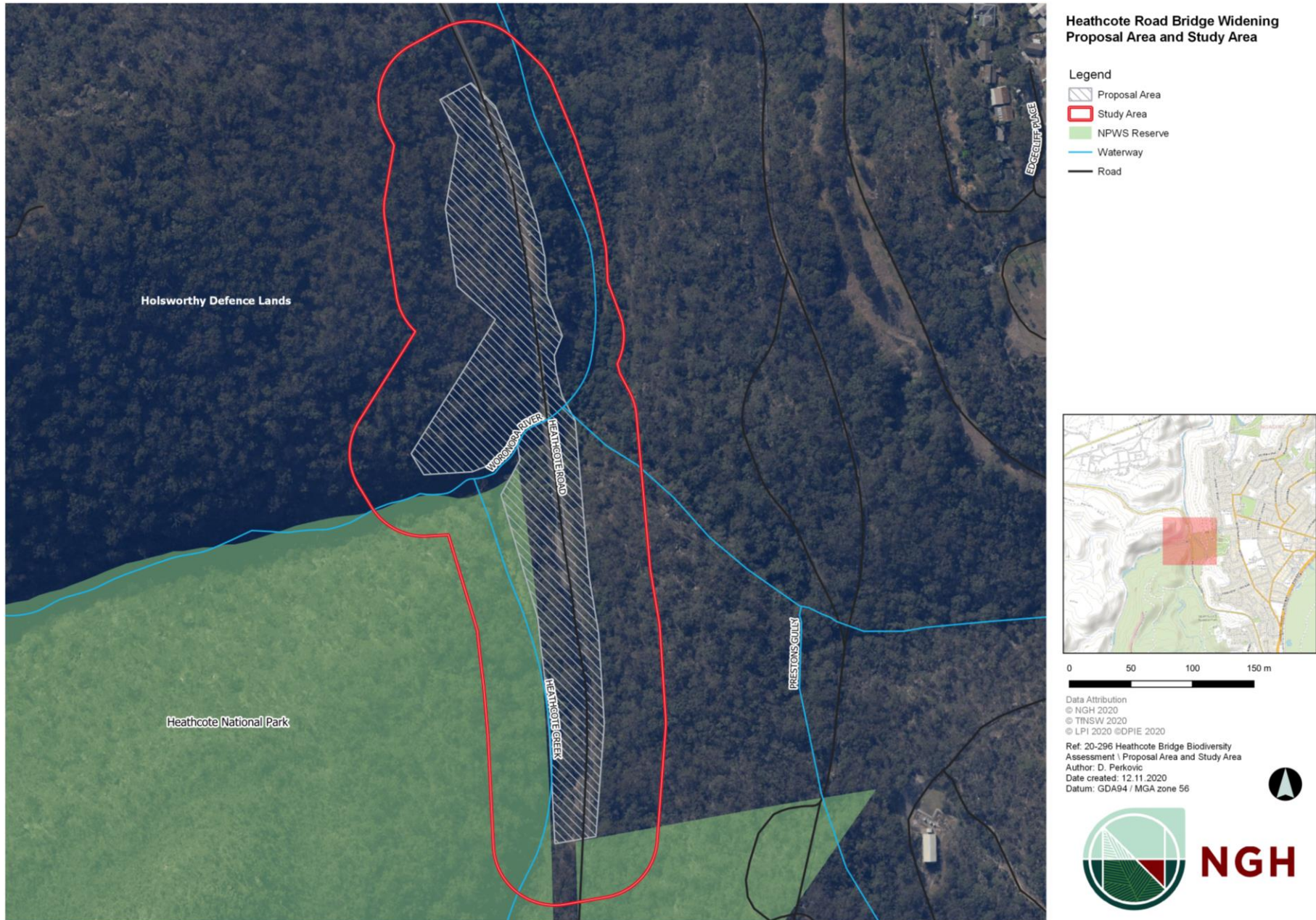


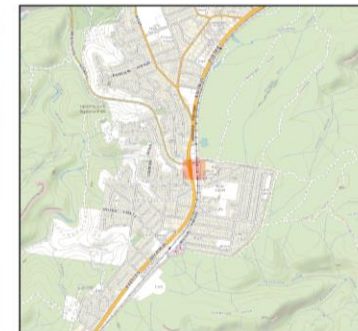
Figure 1-3 Proposal Area and Study Area (compound area shown separately in Figure 1-4 and Figure 1-5)



Heathcote Road Bridge Widening Compound Area

Legend

- Indicative Compound Area
- Pre-start Area
- Storage of traffic control devices and plant
- Toilet
- ↔ Vehicle Movements (in/out)
- Road



0 25 50 m

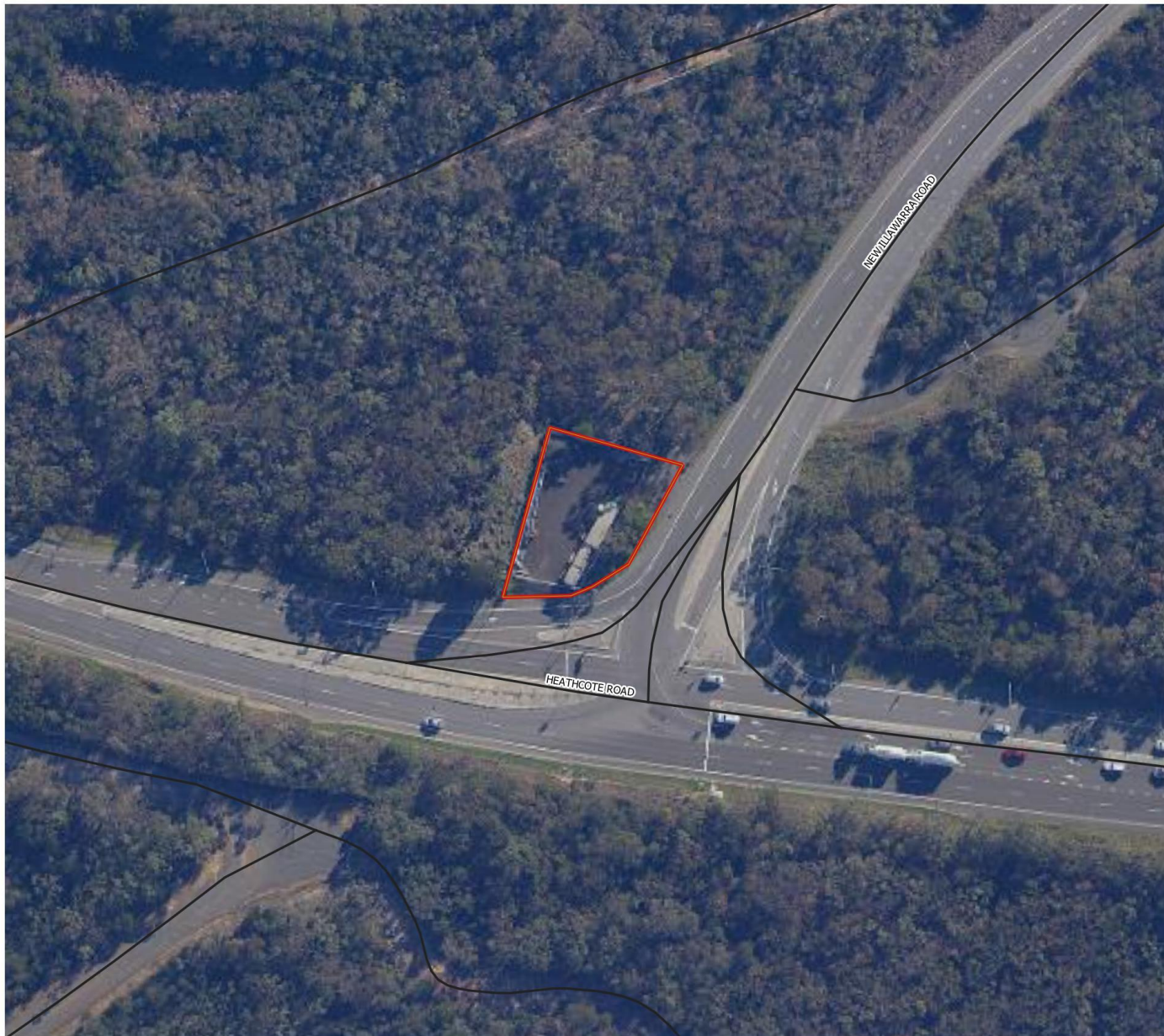
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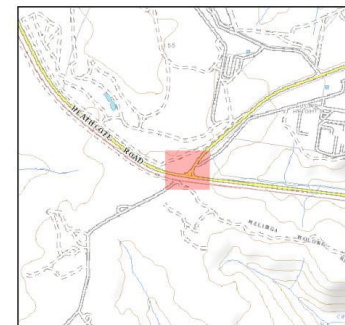
Figure 1-4 Compound Area – Princes Highway



**New Illawarra Road
Compound Area**

Legend

- Indicative Compound Area
- Road



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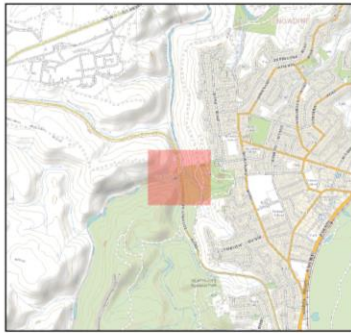
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Figure 1-5 Compound Area - New Illawarra Road



**Heathcote Road Bridge Widening
Key Features of the Proposal**

- Legend**
- Proposal Area
 - NPWS Reserve
 - Indicative Slope Work Areas
 - Indicative Retaining Walls
 - Indicative Access Tracks
 - Construction Access and Crane Platforms
 - Waterway Crossing
 - Waterway
 - Road



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Figure 1-6 Key Features of the Proposal

1.3 Legislative Context

A Review of Environmental Factors (REF) has been prepared to satisfy TfNSW requirements under s.111 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) in order to “examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity” as well as to consider s.112 when making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the Heathcote Road Bridge and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Sections 7.2 A of the *Biodiversity Conservation Act 2016* (BC Act) and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and endangered ecological communities is assessed using a five-part test.

If the following activities form part of the proposal, a permit from the Department of Primary Industries (DPI) under the FM Act is required:

- Aquaculture
- Harm marine vegetation such as mangrove, seagrass or seaweed
- Dredging or reclamation of waterways, including removal of snags or aquatic vegetation (28 days notification) (sections 198 and 199)
- Temporary or permanent blockage of fish passage (section 219).

Public authorities are exempt from obtaining a permit for dredging or reclamation work under Part seven of the FM Act (refer section 201(2)(b)). However, section 199 of the FM Act requires that notification be given to the Minister before a public authority carries out or authorises the carrying out of dredging or reclamation work and any matters raised by the Minister be considered within 28 days after the giving of the notice.

Notification has been provided to DPI, who have confirmed via written correspondence dated 26 October 2020 that “As no marine vegetation is to be harmed in this proposal a section 205 permit under Part 7 of the FM Act is not required. Under s.219(5)(a) any work that is permitted under the FM Act turns off the requirement for a section 219 permit to block fish passage. So a section 219 permit is not required for this project.” As such, no permit is required for the blockage of fish passage.

Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General’s requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

Until such time as the Commonwealth Department of Agriculture, Water and the Environment (DAWE) endorse the Biodiversity Assessment Method, a BDAR will not be pursued as an assessment option by TfNSW for projects with significant impacts on matters of national environmental significance (MNES), without further consultation with DAWE.

In September 2015, a “strategic assessment” approval was granted by the Federal Minister in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval applies to Transport for NSW activities being assessed under Division 5.1 (formerly Part 5) of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities, and migratory species.

As a result, TfNSW proposals assessed via a REF:

- must address and consider potential impacts on nationally listed threatened species, populations, ecological communities, and migratory species, including application of the “avoid, minimise, mitigate and offset” hierarchy
- do not require referral to the DAWE for these matters, even if the activity is likely to have a significant impact.

To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013).

The commencement of the BC Act has affected the operation of the strategic assessment in the following ways:

- The previous biodiversity assessment method, the Framework for Biodiversity Assessment, (FBA) has been superseded by the BAM;
- DAWE have not (yet) endorsed the BAM as a suitable method to assess impacts or calculate offsetting requirements;
- DAWE have not (yet) endorsed the Biodiversity Offset Fund as a suitable avenue to meet offset obligations.

Until DAWE have endorsed the BAM, a BDAR should not be used to assess project impacts or calculate offset requirements for Division 5.1 REF projects that are likely to have a significant impact on nationally listed species and communities without consultation with DAWE.

2. Methods

2.1 Personnel

This biodiversity assessment was undertaken and prepared by appropriately qualified and experienced ecologists, refer to Table 2-1 below.

Table 2-1 Personnel, Role and Qualifications

Name	Role	Qualifications
Aleksei Atkin	Senior Ecologist - technical lead, ecology field surveys, reporting, GIS, technical reviewer	Accredited NSW BAM Assessor (BAAS17093) B. Nat. Sc. (Nature Conservation), Master of Wildlife Management
Elijah Elias	Ecologist - ecology field survey, reporting, GIS	B. BioCons
Teah Wills	Ecologist - ecology field survey, reporting	B. Env Bio., Grad Dip Env Mgmt
Claire Vincent	Ecologist – reporting assistance	B. Sc, Grad Dip (Env Mgt)
Freya Gordon	Senior Ecologist – reporting, technical review	B. Sc. (Hons)
Carissa Free	Senior Ecologist - reporting	B AppSc (Honours), PhD (Ecology)
Beth Kramer	Principal Environmental Consultant – technical review	B. Sc, M Env Mgt

2.2 Background Research

Database analysis was undertaken to identify biodiversity values within the proposal area. This included a search of relevant databases as well as broadscale vegetation mapping and aerial photography (see Table 2-2) to identify:

- Threatened and protected terrestrial and aquatic flora and fauna species and their habitat
- Endangered populations
- Plant community types
- Threatened ecological communities
- Important habitat for migratory species
- Critical habitats.

Table 2-2 Database searches

Resource	Target	Search Date	Search Area
OEH BioNet Atlas	Threatened flora and fauna species, populations and ecological communities listed under the BC Act	22/05/20 and 29/06/20	10 km radius of the proposal area
OEH vegetation information system (VIS) database and Vegetation Types Database	Plant Community Type (PCT) identification.	19/02/19	Study area
DPI Weed Wise	Priority weeds declared in the Sydney Region	26/06/20	Sydney Basin

Resource	Target	Search Date	Search Area
DPI Fisheries Fish Records Viewer	Threatened aquatic species and communities	26/06/20	Study area
EPBC Act Protected Matters Search	Threatened flora and fauna, endangered populations and ecological communities and migratory species	26/06/20	10 km radius of the proposal site
Bureau of Meteorology National Atlas of Groundwater Dependant Ecosystems	Vegetation communities that are likely to rely on groundwater.	26/06/20	Study area
SEED datasets	Plant Community Type (PCT) identification	26/06/20	Study Area
Coastal management areas identified by the Coastal Management SEPP	Identifying areas listed under the Coastal Management SEPP	26/06/20	Study Area
Areas of outstanding biodiversity value (critical habitat)	Identifying any areas of outstanding biodiversity value	26/06/20	Study Area

2.2.1 Literature Review

Biodiversity values of the study area were also identified through a background review of existing information including previous reports (e.g. NGH Consulting 2017), fisheries resources, and other ecological studies with relevance to the study area. Key information sources which contributed to a knowledge of existing environment are outlined below (including Table 2-3), with a complete list of references provided in Section 9. Those reports below have provided confirmation about species presence (or absence) in the locality and informed the survey design, likelihood of occurrence assessment as well as the tests/assessments of significance. Recommendations for mitigation measures have considered relevant published literature.

General Ecology Background Research

- Aerial imagery and topographic maps on the NSW Department of Lands Spatial Information exchange (SixViewer).
- Species profiles and threats database (SPRAT) - Commonwealth
- NSW OEH Threatened Species Database, used to assess the habitat potential for threatened species in the study area which have been recorded, or are predicted to occur, based on known ecological relationships.
- OEH Biodiversity Values Map.
- BioNet VIS vegetation classification database.
- Cumberland Plain Conservation Plan - Georges River Koala Reserve Sub Plan (DPIE 2020a)
- NSW Koala Prioritisation Project – Areas of Regional Koala Significance (ARKS) mapping (DPIE 2020b).
- Legislative report from the Parliamentary inquiry of Koala populations and habitat in NSW
- Review of data held by NGH Consulting.

Table 2-3 Summary of key information from background research

Subject matter	Report title	Key findings with respect to the Study area
Invertebrates	<p>Nomination for listing: Fisheries Scientific Committee (undated). Recommendation <i>Austrocordulia leonardi</i> – Sydney Hawk Dragonfly, Port Stephens Research Centre, Taylors Beach NSW.</p>	<p>The Fisheries Scientific Committee (1994) note that the Sydney Hawk Dragonfly was discovered in 1968 from Woronora River.</p> <p>Intensive surveys by Theischinger and colleagues (Theischinger, pers. comm.) have in recent years failed to detect the presence of any of the life stages of <i>Austrocordulia leonardi</i> along the Woronora River and Kangaroo Creek. The last confirmation of this species in the Proposal area was before the weir was removed in the Woronora River at Heathcote.</p>
Fisheries and Aquatic Environment	<p>Nichols, S. and McGirr, S. (2005) <i>Reviewing and Restoring Fish Passage in Urbanised Waterways, Sydney Catchments</i>. Report to the Sydney Metropolitan Catchment Management Authority. Department of Primary Industries (Aquatic Habitat Rehabilitation section), Cronulla.</p>	<p>Mentions that Australian Bass is known to travel upstream of 'The Needles', a low-level concrete causeway downstream of the proposal area.</p>
	<p>Bruce, A., Gowns, I. and Gehrke, P. (2001). 'Woronora River Macquarie Perch survey'. <i>NSW Fisheries Report Series 32</i>. (NSW Fisheries: Sydney).</p>	<p>Concludes that there is no presence of Macquarie Perch in Woronora River</p>
Holsworthy Military Area	<p>Australian Heritage Database search results for Cubbitch Barta National Estate Area, Old Illawarra Rd, Holsworthy, NSW, Australia</p>	<p>Heritage area listed for outstanding cultural heritage and biodiversity values. Proposal area overlaps with a small portion of this area.</p>
	<p>Biosis Research (1997). <i>Flora and Fauna – Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area, Technical Paper 8</i>. Prepared for Commonwealth Department of Transport and Regional Development.</p>	<p>Threatened species search efforts for the Cubbitch Barta National Estate Area (see Figure 1-2 for proximity to the proposal area) recorded results for Spotted-tailed Quoll, Koala, Broad-headed Snake, Giant Burrowing Frog, Red-crowned Toadlet, Powerful Owl, Grater Broad-nosed Bat and New Holland (1995).</p> <p>The National Estate was found to have high plant diversity (400 + species; including at least eight which are considered to be threatened). These survey efforts were associated with ecological assessment to inform the Sydney Second Airport planning, in which one of the strategic options included Holsworthy Military area.</p>

Subject matter	Report title	Key findings with respect to the Study area
Heathcote Road	NGH Environmental (2017) <i>Preliminary Environmental Investigation – Biodiversity. Heathcote Road – New Illawarra Road to Princes Highway.</i>	Survey included traversing the entire impact area to identify habitat features and threatened species habitat. No threatened flora or fauna surveys were observed.
Heathcote and Royal National Park	Schulz, M. and Magarey, E. (2012). Vertebrate fauna: a survey of Australia's oldest national park and adjoining reserves. <i>Proceedings of the Linnean Society of New South Wales</i> 134, B215-B247.	Describes ecological surveys conducted within Royal National Park, Garawarra State Conservation Area and Heathcote National Park. Targeted survey techniques included call playback, active search, infra-red cameras, tadpole survey. 283 vertebrate fauna species were confirmed, with the high species richness attributed to the diversity of habitats present. Of these, 26 were threatened under State and/or Commonwealth legislation.

2.3 Habitat Assessment

A habitat assessment table was prepared to assess the likelihood of threatened flora, fauna and ecological communities occurring within 10 km of the proposal site. Refer to Appendix B for the full habitat assessment table as well as likelihood of occurrence classification and criteria. This list was developed based on database results and literature review, as well as results of previous surveys.

2.4 Field Survey

A site assessment of the study area was undertaken by two ecologists on the 25th May 2020, followed by additional surveys on the 11th August 2020 (diurnal surveys) and 17th September 2020 (bats and nocturnal surveys) (further details in Section 2.4.3). A random meander search (Cropper, 1993) was used for the site investigation, to allow inspection of all available habitat types within the study area. Criteria recorded during the field survey included:

- Native flora species and vegetation communities present;
- Targeted threatened species identified during background searches;
- Opportunistic fauna sightings where suitable habitat was present;
- Weed species present and their abundance.

Searches for any incidental fauna signs such as tree scratching's, burrows, tracks, nests or dreys, scats and fur was also undertaken. A fauna habitat survey was also completed within the study area to assess habitat availability based on the following attributes:

- Habitat value (leaf litter, fallen timber, ground cover extent and type);
- Condition of vegetation;
- Floristic diversity of vegetation;
- Presence of hollow-bearing trees;
- Presence of species-specific foraging or breeding habitat.

Field survey methods are discussed in more detail below.

2.4.1 Vegetation Surveys

The objectives of the flora survey were to:

- Identify whether threatened species are present, or have the potential to occur, within the proposal site;
- Determine vegetation communities present within the study area, their condition and extent;
- Identify potential Threatened Ecological Communities (TECs) and determine their extent and condition;
- Assess the distribution and abundance of declared weeds at the proposal site.

An assessment and description of the vegetation communities present within the proposal site was undertaken with reference to the structure and condition of vegetation and available vegetation mapping. Two (2) BAM plots were conducted for diagnostic purposes for PCT mapping, with one rapid assessment at Woronora River. PCTs were matched to vegetation communities identified onsite.

Vegetation plots were conducted in accordance with the NSW BAM. These included the use of nested 400 m² plots, with five 1 m x 1 m sub-plots to assess groundcover composition. Plot data collected are detailed in Table 2-4 and Table 2-5 below. Plot numbers were calculated in accordance with Table 2-6 below. Vegetation plot locations are shown in Figure 2.1 below. Note that random meander transect locations are not shown as these were conducted throughout the study area.

Table 2-4 Vegetation Survey Data Collected within Plots

Attribute	Survey Requirement
Stratum (& layer)	Stratum & layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	Estimate the % foliage cover across the plot of each species rooted in or overhanging the plot. Cover should be recorded in decimals if less than 1% (0.1, 0.2...), or whole numbers up to 5% (1,2,3...), or to the nearest 5% where greater than 5% cover (5,10,15,20,25...)
Abundance rating	For species with cover less than or equal to 5%, count or estimate the number of individuals or shoots of each species within the plot, using the following intervals: 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000,1500,2000, etc. Numbers above 20 are estimates only, and the recorded abundance is the upper end of each class (e.g. 50 represents an estimated abundance of between 20 and 50) For species with cover greater than 5%, abundance estimates are not required (but may be recorded if desired)

Table 2-5 Growth form groups and attributes used to assess the composition, structure, and function components of vegetation integrity

Growth form groups used to assess composition and structure	Attributes used to assess function
a) Tree b) Shrub c) Grass and grass like d) Forb e) Fern f) Other	a) Number of large trees b) Tree regeneration c) Tree stem size class d) Total length of fallen logs e) Litter cover f) High threat exotic vegetation cover g) Hollow bearing trees

Within areas of suitable habitat, targeted searches for those threatened flora species, populations, or ecological communities of state or national significance were undertaken where identified within the habitat assessment table as having potential to occur (Appendix B). Targeted searches and habitat assessments were undertaken for the species identified within the habitat tables provided in Appendix B as having a moderate to high likelihood of occurrence. A full list of the flora and fauna species recorded within the study area is presented in Appendix A.

Table 2-6 Minimum number of plots required per zone area

Vegetation zone area (ha)	Minimum number of plots
<2	1 plot
>2-5	2 plots
>5-20	3 plots
>20-50	4 plots
> 50–100	5 plots
> 100–250	6 plots
> 250–1000	7 plots; more plots may be needed if the condition of the vegetation is variable across the zone
> 1000	8 plots; more plots may be needed if the condition of the vegetation is variable across the zone

2.4.2 Targeted Flora Surveys

Within areas of suitable habitat, targeted searches for those threatened flora species, populations, or ecological communities of state or national significance were undertaken where identified within the habitat assessment table (Appendix B) as having moderate or high potential to occur (see Table 3-5).

2.4.3 Targeted Fauna Surveys

A targeted bat survey was undertaken for 2 hours at the bridge to observe bats (via thermal imaging camera) emerging from the bridge and surrounding vegetation on dusk on the 17th of September 2020 by two Ecologists. One Anabat (Titley Scientific) was placed at the bridge for four nights to record bats using the bridge and surrounding areas.

Surveys for the Sydney Hawk Dragonfly were conducted at two suitable pools on 25th May 2020. Surveys consisted of two 20-point counts at each pool using binoculars.

Koalas were surveyed using the Spot Assessment Technique (SAT) in which two people assessed 30 trees for the presence of Koala scratches or scat.

Opportunistic fauna surveys were conducted within the proposal site. Detection of a variety of fauna species was limited, however opportunistic sightings of common fauna and their traces (e.g. scats, tracks, scratches) when observed were recorded and are presented in Appendix A (also see Section 3.5).

2.4.4 Aquatic Habitat Assessment

Detailed aquatic habitat assessment within the Woronora River was undertaken within the Heathcote Road Preliminary Environmental Investigation (NGH, 2017). During that assessment, the habitat value of each waterway (i.e. habitat sensitivity and classification of waterways for fish passage) was characterised in accordance with NSW DPI (Fisheries) document Policy and Guidelines for fish habitat conservation and management (2013 update).

An assessment of waterway habitat included:

The ecosystem type (e.g. wetlands, streams, lakes).

- Flow regime.
- Bed substrate (e.g. rocks, gravel, sand, mud).
- Instream habitat features (pools, riffles, snags, macrophytes).
- Existing infrastructure and barriers to fish movement (natural or artificial).
- Width and condition of riparian vegetation.
- Water quality based on visual observations.

Results of this assessment were confirmed during the current surveys through rapid assessment of aquatic habitat conditions throughout the site.

2.4.5 Summary of Survey Effort and Limitations

A summary of the survey effort and the targeted species survey methodology is provided in Table 2-7 and Table 2-8 respectively below.

Table 2-7 Summary of Survey Effort

Method	Survey completed	Total survey hours
BAM plot/transects	1 BAM plot/transect in PCT1250 and 1 BAM plot/transect in PCT1292. 1 rapid assessment in PCT781	2 hours
Random meander transects	Undertaken throughout the study area	2 hours
Fauna habitat assessment	Undertaken as part of each BAM plot/transect and during random meander surveys. Four hours of habitat assessment including quantification of hollow tree resources, fallen woody debris cover, and vegetation composition and structure.	
General fauna survey	Undertaken opportunistically throughout the 4 hours while on site. No strict timed surveys were undertaken.	

Table 2-8 Targeted Species Survey Summary

Species	Minimum survey requirements	Survey completed
Sydney Hawk Dragonfly <i>Austrocordulia leonardi</i>	Searches in areas of suitable habitat such as deep and rocky river pools with cooler water and slow permanent flows. Steep banks and vegetation also appear to be important habitat features. It is strictly a diurnal dragonfly that requires open, sunlit space.	A habitat assessment was conducted which detected two suitable pools. Two 20-minute point count surveys were completed at each pool with binoculars. Total survey effort – 80 person minutes
Microbats	<p>Anabat - Two sound activated recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights. Survey timing depends on the species targeted.</p> <p>Spotlighting and transect walking: For targeted survey near likely food resources: 2 x 1 hour spotlighting on two separate nights. All year.</p> <p>Day search: Search for bat excreta at or near potential habitats. All year</p>	<p>Anabat and flyout monitoring from the bridge at dusk were conducted by two ecologists</p> <p>Four Anabat nights (static) along creekline and under bridge. Two Anabat nights beneath scuppers on north-eastern side of bridge as well as flyout watch (2 hrs).</p> <p>These surveys were conducted by two ecologists.</p>
Koala	Search for scats and signs: 30 minutes searching each relevant habitat, including trees for scratch marks.	Tree-based sampling methodology that provides presence/absence data. Spot Assessment Technique (SAT) was undertaken. Two people assessed 30 trees. Searches for scratches, signs etc. Incidental searches for individuals was also undertaken.

Limitations

A thorough search of areas to be affected by the proposal was undertaken, where possible. There were limitations associated with the accessibility of certain areas, such as the 8-13 m vertical rock cutting on the southern side approach, the 8-10 m vertical rock cutting on the northern side approach, and along the crest of cuttings. These areas were observed visually from key viewpoints using binoculars.

As the flora field surveys were undertaken in May, the flora species list reflects plant species usually detectable during late autumn, and therefore there is the potential for some flora species that were not in flower at the time of the survey to have gone undetected. However, the lists are considered sufficient to identify vegetation communities present within the study area and therefore to evaluate the probability of threatened flora species to occur.

Areas mapped as PCT 781 were identified using a rapid assessment, rather than a traditional BAM Plot as they occur in water. Species were identified as best as possible from the bank without closer inspection. Results from the aquatic assessment conducted for the PEI (NGH 2017) have been included in this report.

Detailed habitat assessments were made within the study area, so local occurrence of fauna can be predicted. A precautionary approach has been taken as to the likelihood of the presence of threatened species so fauna species unlikely to be detected during the time of the survey are assessed.

The survey timing and weather conditions may have impacted on the lack of sightings of the Sydney Hawk Dragonfly in the study area. Although most Australian dragonfly species do not follow strict seasonal flight periods, adult dragonflies generally appear in the summer months. Furthermore, dragonflies are most active during calm, sunny and dry conditions so it is possible that the weather conditions were less than optimal for dragonfly surveys (Theischinger & Hawking 2006). However, this species has not been recorded at the Woronora River since the 1980s despite targeted surveys, which may be attributed to the removal of the weir in the Woronora River at Heathcote (Hawking & Theischinger, 2004).

3. Existing Environment

The study area is located within the Sydney Cataract sub-region of the Sydney Basin Bioregion. The study area is within the Mitchell landscape known as the Woronora Plateau which is developed on Triassic quartz sandstone and has a general elevation of 400 to 500 m. Rock outcrops are common on ridgelines and in creeks. The vegetation of the Woronora Plateau is typified by woodlands with a shrubby understorey of Silvertop Ash *Eucalyptus sieberi*, Sydney Peppermint *Eucalyptus piperita*, Old Man Banksia *Banksia serrata*, Smooth-barked Apple *Angophora costata*, on ridges. Shrublands of Heath Banksia *Banksia ericifolia*, Hairpin Banksia *Banksia spinulosa*, Dagger Hakea *Hakea teretifolia*, She-oak *Allocasuarina* spp. and Soft Geebung *Persoonia mollis* with *Gahnia* spp. on slopes and extensive hanging swamps in saturated organic sands on the lowest slopes and valley floors with heath of; *Hakea* spp., Swamp Banksia *Banksia robur*, Button Grass *Gymnoschoenus sphaerocephalus* and grass trees *Xanthorrhoea* spp. Contour parallel patterned ground of ridges and trenches is common.

The study area is subject to disturbance from Heathcote Road, but otherwise contains relatively high-quality habitat due to the topography of the locality and limited access.

The study area at Woronora River is monitored by Sutherland Shire Council and was given an overall water quality of 'Excellent' in 2018/2019, which is similar to previous years. This rating is based on physical/chemical and biological (macroinvertebrate) analyses. The old weir is located just upstream of the study area.

The study area is comprised of sandstone vegetation of upper slopes, riparian scrub, and wetland species within the water body. The upper slopes were dominated by Sydney Peppermint *Eucalyptus piperita*, Smooth-Barked Apple *Angophora costata* and Black She-Oak *Allocasuarina littoralis*. Riparian vegetation was dominated by Water Gum *Tristaniopsis laurina* and Black She-Oak *Allocasuarina littoralis*. Aquatic vegetation comprised of Bare Twig-rush *Baumea juncea*, Tall Sedge *Carex appressa*, and *Cyperus polystachyos*.



Figure 3-1 –Bridge context

3.1 Plant Community Types

Three (3) Plant Community Types (PCTs) were identified within the study area (see Figure 3-2):

- **PCT 1250:** Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin (aka **Coastal Sandstone Gully Forest**)
- **PCT 1292:** Water Gum-Coachwood Riparian Scrub Along Sandstone Streams, Sydney Basin (aka **Coastal Sandstone Riparian Scrub**)
- **PCT 781:** Coastal Freshwater Lagoons of the Sydney Basin and South East Corner (aka **Coastal Freshwater Wetland**)

Plot-based surveys were undertaken within this site to determine species present in all strata. Likely PCTs were identified through the PCT ID tool within the Bionet Vegetation Classification, and where canopy trees were present, search parameters of Scientific Name: *Tristaniopsis laurina* and IBRA Subregion: Sydney Cataract were entered. This produced a short list of a number of PCTs; plot data was then quantitatively assessed against the species composition within the Scientific. PCTs identified within the study area are summarised in Table 3-1 and are shown in Figure 3-2. Descriptions of each PCT are presented below.

Table 3-1 Plant Community Types

Plant Community Type (PCT)	Vegetation Zone	Vegetation Integrity Score	Patch Size (ha)	Threatened Ecological Community?	Area (ha) in Study Area
1250	1250 Moderate Condition	72.1	>100	No	8.35
1292	1292 Moderate Condition	65.3	>100	No	2.36
781	781 High Condition	100 (assumed benchmark)	<5	Yes (BC Act)	0.06
Exotic Vegetation	Exotic Vegetation	N/A	N/A	No	0.04
Total					10.81

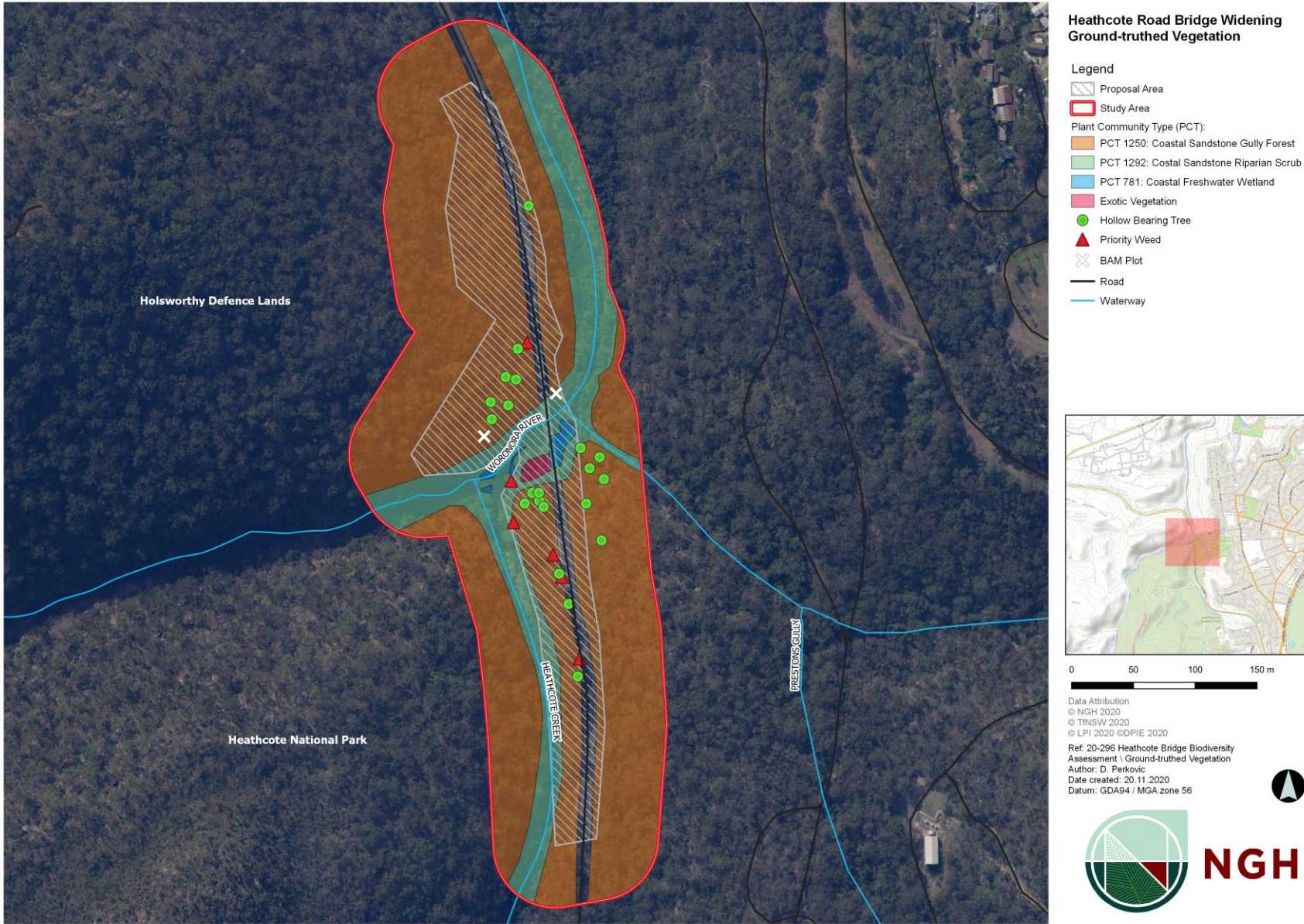


Figure 3-2 Ground-truthed Vegetation and Survey Results

PCT 1292 Coastal Sandstone Riparian Scrub

Vegetation Formation: Forested Wetlands

Vegetation Class: Eastern Riverine Forests

PCT: 1292 Water Gum-Coachwood Riparian Scrub Along Sandstone Streams, Sydney Basin

Conservation Status: No associated TECs

Estimate of Percent Cleared: 10%

Condition: Moderate

Extent in the Study Area: 2.36 ha

Plots Completed: 1

Composition Condition Score	Structure Condition Score	Function Condition score	Vegetation Integrity Score
45.3	61.4	100	65.3

Growth Form	Typical Species
Trees	<i>Tristaniopsis laurina</i> , <i>Allocasuarina littoralis</i> , <i>Ceratopetalum apetalum</i>
Shrubs	<i>Leptospermum polygalifolium</i> , <i>Acacia floribunda</i>
Grass and grass like	<i>Lomandra fluviatilis</i> , <i>Entolasia stricta</i> , <i>Oplismenus aemulus</i>
Forb	<i>Acianthus fornicatus</i>
Fern	-
Other	<i>Smilax australis</i>

Description

The vegetation at BAM Plot 1 had a canopy dominated by Water Gum *Tristaniopsis laurina* and Black She-Oak *Allocasuarina littoralis*. The midstorey included both native and exotics; Tautoon *Leptospermum polygalifolium*, White Sally *Acacia floribunda*, Coachwood *Ceratopetalum apetalum*, Small-leaved Privet *Ligustrum sinense*, and Senna *Senna pendula* var. *glabrata*. Groundcover was dominated by *Lomandra fluviatilis*, with other scattered grasses such as Wiry Panic *Entolasia stricta*, and Basket Grass *Oplismenus aemulus*. BAM Plot 1 revealed 24 species comprised of 20 native and four (4) exotics. Of the 20 native species identified, 11 (55%) were diagnostic to PCT 1292 Water Gum-Coachwood Riparian Scrub Along Sandstone Streams, Sydney Basin, see Figure 3-3.



Figure 3-3 Vegetation at BAM Plot 1 (PCT 1292)

PCT 1250 Coastal Sandstone Gully Forest

Vegetation Formation: Dry Sclerophyll Forests (Shrubby sub-formation)

Vegetation Class: Sydney Coastal Dry Sclerophyll Forests

PCT: 1250 Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin

Conservation Status: No associated TECs

Estimate of Percent Cleared: 30%

Condition: Moderate

Extent in the Study Area: 8.35 ha

Plots Completed: 1

Composition Condition Score	Structure Condition Score	Function Condition Score	Vegetation Integrity Score
60.1	62.5	100	72.1

Growth Form	Typical Species
Trees	<i>Allocasuarina littoralis</i> , <i>Eucalyptus piperita</i> , <i>Angophora costata</i>
Shrubs	<i>Pittosporum undulatum</i> , <i>Persoonia pinifolia</i> , <i>Dodonaea triquetra</i>
Grass and grass like	<i>Lomandra longifolia</i> , <i>Oplismenus aemulus</i> , <i>Entolasia stricta</i>
Forb	<i>Dianella</i> spp.
Fern	<i>Pteridium esculentum</i>
Other	<i>Doryanthes excelsa</i> , <i>Billardiera scandens</i>

Description

The vegetation at BAM Plot 2 had a canopy dominated by Black She-Oak *Allocasuarina littoralis*, Sydney Peppermint *Eucalyptus piperita*, and Smooth-Barked Apple *Angophora costata*. The midstorey contained a vast number of native species including but not limited to Pine-leaved Geebung *Persoonia pinifolia*, Large-leaf Hop-bush *Dodonaea triquetra*, and Needlebush *Hakea sericea*. Ground cover was dominated by Spiny-headed Mat-rush *Lomandra longifolia*, Wiry panic *Entolasia stricta*, and Basket Grass *Oplismenus aemulus*. BAM Plot 2 revealed 37 species comprised of 31 Native and 6 exotics. Of the 31 native species identified, 23 (74.2%) were diagnostic to PCT 1250 Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin, see Figure 3-4.



Figure 3-4 Vegetation at BAM Plot 2 (PCT 1250)

PCT 781 Coastal Freshwater Wetland

Vegetation Formation: Freshwater Wetlands

Vegetation Class: Coastal Freshwater Lagoons

PCT: 781 Coastal Freshwater Lagoons of the Sydney Basin and South East Corner

Conservation Status: BC-EEEC Sydney Freshwater Wetlands in the Sydney Basin Bioregion (Part)

BC-EEEC Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Part)

Estimate of Percent Cleared: 74%

Condition: High

Extent in the Study Area: 0.06 ha

Plots completed: 1 (Rapid Assessment Plot only)

Composition Condition Score	Structure Condition Score	Function Condition Score	Vegetation Integrity Score
100 (assumed benchmark)	100 (assumed benchmark)	-	100 (assumed benchmark)

Growth Form	Typical Species
Trees	<i>Tristaniopsis laurina</i> , <i>Allocasuarina littoralis</i> , <i>Ceratopetalum apetalum</i>
Shrubs	<i>Leptospermum polygalifolium</i> , <i>Acacia floribunda</i>
Grass and grass like	<i>Lomandra fluviatilis</i> , <i>Entolasia stricta</i> , <i>Oplismenus aemulus</i>
Forb	<i>Acianthus fornicatus</i>
Fern	-
Other	<i>Smilax australis</i>

Description

The Woronora River traverses through the middle of the proposal site, pockets of aquatic macrophytes were observed including Bare Twig-rush *Baumea juncea*, Tall Sedge *Carex appressa*, and *Cyperus polystachyos*. These three species were diagnostic to PCT 781 Coastal Freshwater Lagoons of the Sydney Basin and South East Corner, see Figure 3-5. Fauna habitat values of this PCT are described in Section 3.4.



Figure 3-5 PCT 781 Coastal Freshwater Lagoons within the proposal area

Exotic Vegetation

High threat exotics are species listed within the BAM, which have an impact on the calculation of vegetation integrity scores based on the recoverability of vegetation in the presence of these species. These plants are not native to Australia that if not controlled will invade and outcompete native plant species. Four (4) high threat exotics were recorded within the BAM plots including Mistflower (*Ageratina riparia*), Small-leaved Privet (*Ligustrum sinense*), Asparagus Fern (*Asparagus aethiopicus*), and Crofton Weed (*Ageratina adenophora*) (Appendix A).

Priority weeds listed under the *Biosecurity Act 2015* that were observed opportunistically within the study area are listed in Table 3-2.

Table 3-2 Priority weeds recorded within the study area

Common Name	Scientific Name	Duty
African olive	<i>Olea europaea subsp. cuspidata</i>	Regional Recommended Measure. An exclusion zone is established for all lands in Blue Mountains City Council local government area and in Penrith local government area west of the Nepean River. The remainder of the region is classified as the core infestation area. Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers prevent spread from their land where feasible. Land managers reduce impacts from the plant on priority assets.
Ground Asparagus	<i>Asparagus aethiopicus</i>	Prohibition on dealings. Must not be imported into the State or sold *this requirement also applies to the Western Cape form of bridal creeper
Lantana	<i>Lantana camara</i>	Prohibition on dealings. Must not be imported into the State or sold
Primrose	<i>Ludwigia peruviana</i>	Regional Recommended Measure. Land managers mitigate the risk of the plant being introduced to their land. Land managers prevent spread from their land where feasible. Land managers reduce the impact on priority assets. The plant should not be bought, sold, grown, carried or released into the environment. Local Control Authority is notified if the plant is found on the land.
Alligator Weed	<i>Alternanthera philoxeroides</i>	Prohibition on dealings. Must not be imported into the State or sold. Biosecurity Zone. The Alligator Weed Biosecurity Zone is established for all land within the state except land in the following regions: Greater Sydney; Hunter (but only in the local government areas of City of Lake Macquarie, City of Maitland, City of Newcastle or Port Stephens). Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone Regional Recommended Measure. Exclusion zone: Blue Mountains City Council area. Core infestation area: the remainder of the region. Whole region: Land managers prevent spread from their land where feasible. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers mitigate the risk of

Common Name	Scientific Name	Duty
		new weeds being introduced to their land. Land managers reduce the impact on priority assets.

3.2 Threatened Ecological Communities

The Bionet vegetation classification identified one threatened PCT present within the study area:

- PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner.

PCT 781 is a component of the threatened ecological community Sydney Freshwater Wetland listed as an Endangered Ecological Community under the BC Act.

3.3 Groundwater Dependent Ecosystems

A search of the Bureau of Meteorology’s National Atlas of Groundwater Dependent Ecosystems (GDEs) shows that the section of the Woronora River that occurs within the study area is listed as high potential aquatic GDE. These include aquatic ecosystems that rely on the surface expression of groundwater which includes surface water ecosystems which may have a groundwater component (i.e. Rivers). Habitat along the Woronora River is classified as moderate to high potential terrestrial GDE (from national assessment) (Figure 3-6). These are ecosystems that rely on the subsurface presence of groundwater and they include all vegetation ecosystems. No subterranean GDEs (i.e. cave and aquifer ecosystems) have been analysed within the study area.

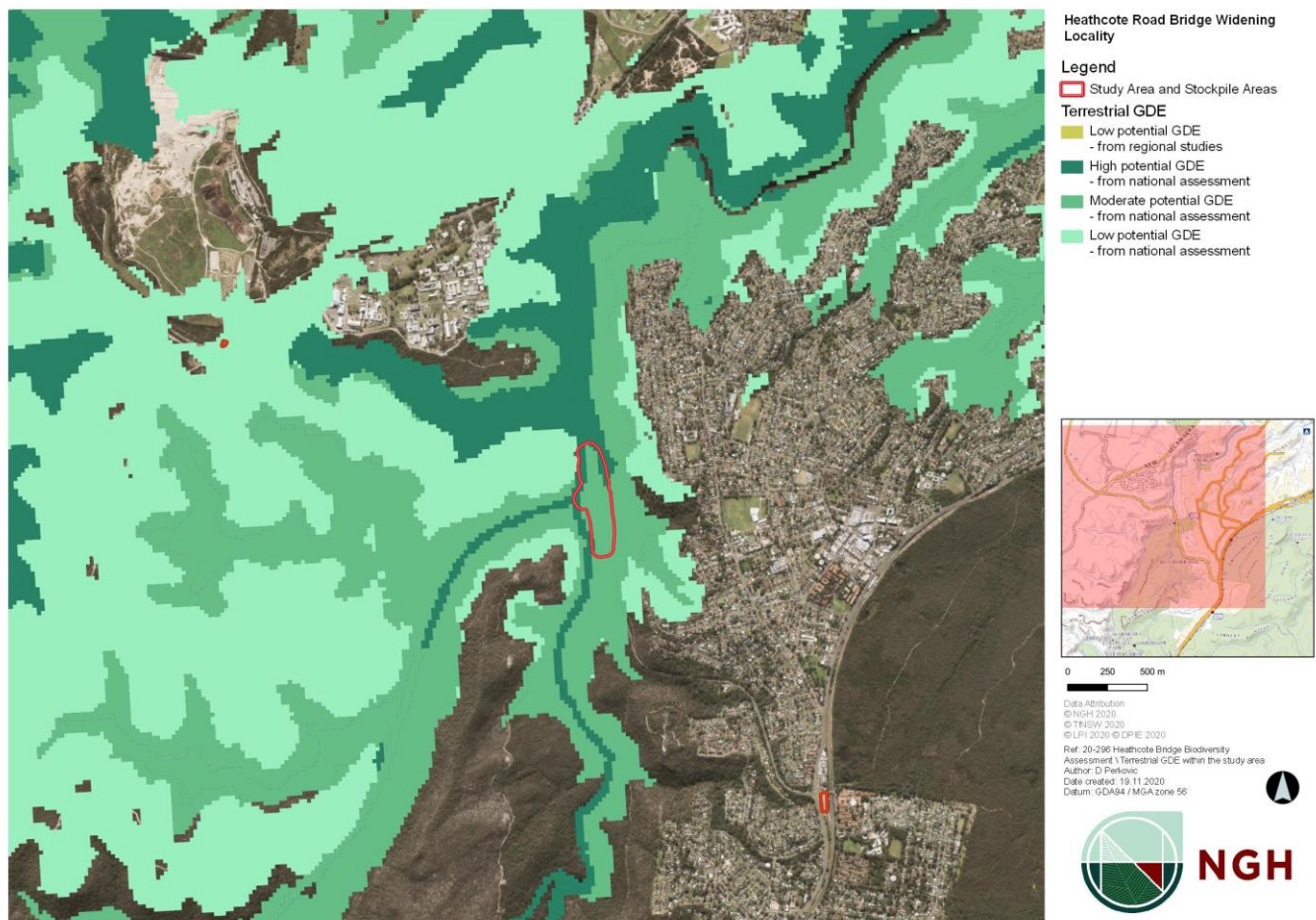


Figure 3-6 Terrestrial GDE within the study area

3.4 Aquatic Habitat

The Woronora River traverses through the study area which generally flows south to north from the upper reaches of the catchment, to Georges River. The river is considered key fish habitat and may provide suitable habitat for other aquatic fauna such as, turtles, amphibians, waterbirds, and benthic invertebrates. Water flow was moderate at the time of the survey. Riffle zones and deep pools were observed which may provide habitat to varying species, including fish and macroinvertebrates. An abundance of trailing bank vegetation as well as aquatic macrophytes may provide refuge and foraging habitat for species such as amphibians and invertebrates. The aquatic area was deemed as good habitat for the Sydney Hawk Dragonfly (see Section 3.6.2). *Gambusia holbrooki*, an introduced and predatory fish, is present within both the Woronora River and Heathcote Creek.

Key fish habitat occurs along the Woronora River and Heathcote Creek (Table 3-4). The FM Act applies to these waterways. The freshwater fish community status of these waterways is classified as 'fair' (Figure 3-7), which is derived from three condition indicators – expectedness, nativeness and recruitment.

Table 3-3 Aquatic assessment results (from NGH 2017)

Assessment	Woronora River	Heathcote Creek
Ecosystem type	River	Creek
Flow regime	Permanent	Permanent
Bed substrate	Sandstone – bedrock, boulders	Sandstone – bedrock, boulders, pebbles
Instream habitat features (pools, riffles, snags, macrophytes)	Large woody debris, pools,	Pools, riffles
Barriers to fish movement	No	No
Condition of riparian veg	Moderate to good quality - bank trailing and fringing vegetation. Riparian weeds present	Good quality - bank trailing and fringing vegetation
Water quality (visual)	Clear, some artificial debris on river bank	Clear, no artificial debris
Fauna or fauna habitat	Incidental observations during site visit included Pied Cormorant, Pacific Black Ducks, <i>Litoria phyllochroa</i> (calling from fringing vegetation), <i>Gambusia holbrooki</i> , freshwater river mussels (discarded on sand bank), dragonfly species, and Australian Monarch Butterfly (<i>Danaus plexippus</i>). Waterway provides foraging habitat for Southern Myotis.	<i>Gambusia holbrooki</i>
Other comments	Rated as 'excellent' for condition of riparian vegetation, water quality and macroinvertebrate diversity (Georges River Report Card 2017/18).	Extends for approximately 800 m. Rated as 'excellent' for water quality and macroinvertebrate diversity, and 'good' for condition of riparian vegetation (Georges River Report Card 2017/18).

Table 3-4 Key fish habitat present within the study area

Waterway	Description of habitat based on surveys	Strahler Stream Order	Standard buffer distance (m) ¹	Key Fish Habitat Classification ²	Waterway classification ³
Woronora River	At junction with Heathcote Road	5	40	Type 1	Class 1
Heathcote Creek	Located within Heathcote National Park	4	40	Type 1	Class 1

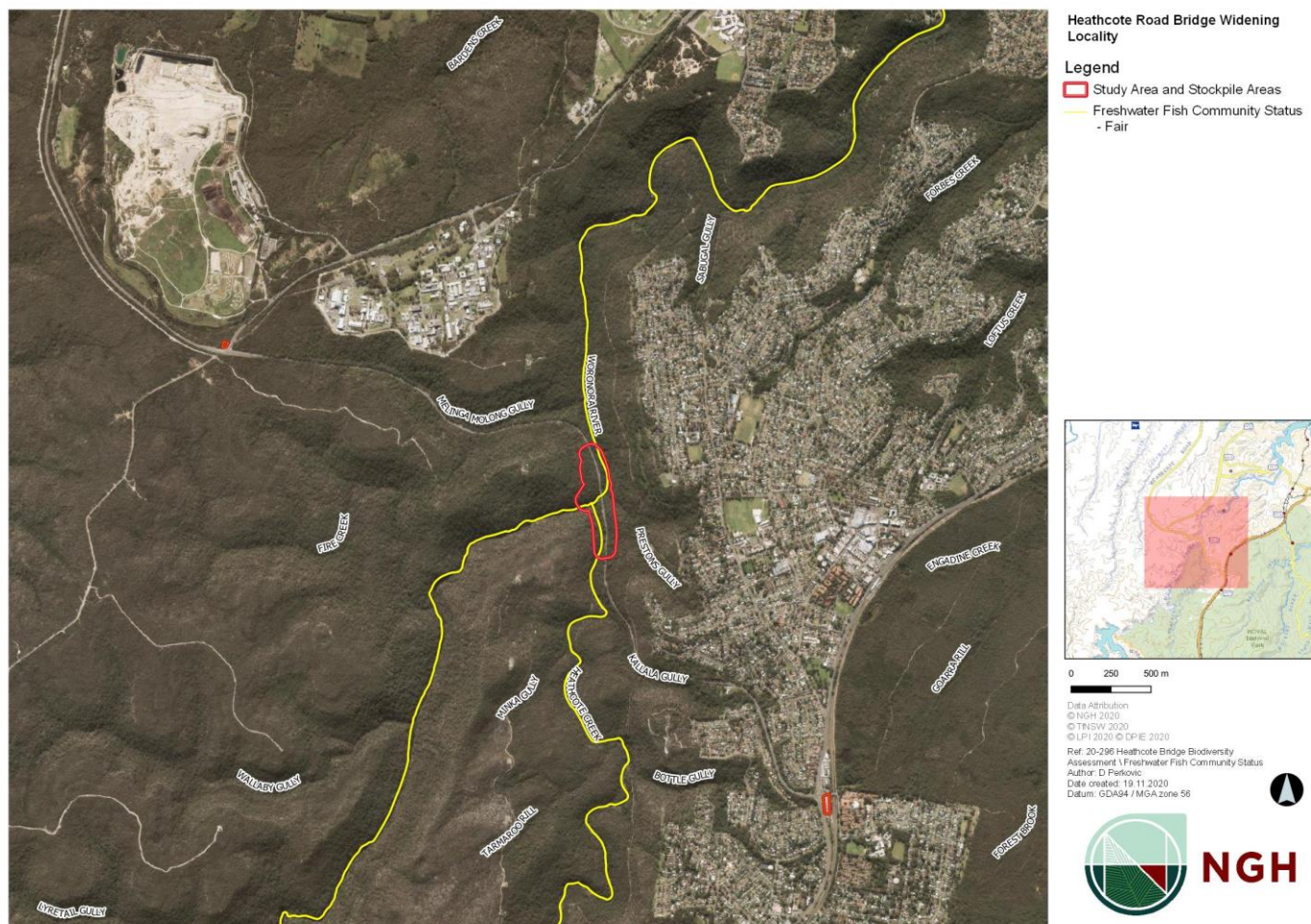


Figure 3-7 DPI Fisheries NSW Data Portal results

3.5 Fauna and Habitat

Potential habitat for fauna exists in the form of high-quality nesting and foraging habitat within native vegetation along the Woronora River and Heathcote Creek. Twenty-one (21) habitat trees were identified within the study area (Figure 3-2) including 16 hollow-bearing trees, stags, and trees with arboreal termite mounds. Hollows ranged in size from small (5-10 cm) to large (>20 cm), and provide potential habitat for parrots, owls, gliders, possums, and some microbats. Approximately one-third (five) of hollow-bearing trees contained large (>20 cm) hollows. Suitable habitat for Red-crowned Toadlet *Pseudophryne australis* (BC Act – Vulnerable) was identified in three soaks within the proposal area.

Rocks and boulders provide good shelter habitat for reptiles and small mammals, as well as basking habitat for reptiles. Evidence of reptiles during the survey effort included one Broad-tailed Gecko *Phyllurus platurus* observed beneath a rocky overhang, the skink *Saproscincus mustelinus* was observed in leaf litter and reptile scratches were noted on trees. Evidence of mammals during the survey effort included wallaby tracks and scats observed beneath both the northern and southern side bridge abutments, and two observations of brushtail possum (both roadkill).

Decorticating bark, rock crevices and the bridge scuppers of Heathcote Bridge as well as the six pipe culverts beneath the road also provide potential roosting habitat for microbats (see Section 3.6.3). While the proposal site itself provides marginal habitat for some species (e.g. Spotted-tailed Quoll), due to the extent of high-quality vegetation in the locality it does provide suitable movement habitat for species with large home ranges. Incidental observations made during targeted surveys include common bird species (e.g. Australian Magpie, Laughing Kookaburra).

3.6 Threatened Species

3.6.1 Threatened Flora Species and Populations

A search of the NSW BioNet database undertaken on the 21st of October 2020 identified 16 threatened flora species with the potential to occur within the locality. Results are provided in Appendix E. Of these, five species and one population were considered to have a moderate to high likelihood of occurrence (Table 3-5). No threatened flora species were recorded in the study area during the site survey despite substantial targeted searches in accordance with the guidelines ‘*Surveying threatened plants and their habitats*’ (DPIE 2020).

Table 3-5 Threatened flora species likelihood of occurrence

Scientific Name	Common Name	BC Act status	EPBC Act status	Likelihood of Occurrence
<i>Allocasuarina diminuta</i> subsp. <i>mimica</i>	<i>Allocasuarina diminuta</i> subsp. <i>mimica</i> population in the Sutherland and Liverpool local government areas	E		Moderate
<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair		V	Moderate
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Moderate
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	E		High
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	Moderate

Scientific Name	Common Name	BC Act status	EPBC Act status	Likelihood of Occurrence
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Moderate

3.6.2 Threatened Fauna Species - Aquatic

Targeted surveys were completed for the Sydney Hawk Dragonfly (see Table 3-6), however no individuals were recorded. The species has specific habitat requirements which include slow-flowing water in rocky rivers with steep sides that provide shady resting areas. Despite intensive surveys, the Sydney Hawk Dragonfly has not been collected from the Woronora River since the removal of the weir in the Woronora River at Heathcote in the 1980's (Hawking & Theischinger, 2004). However, given the availability of potential habitat this species has been given a moderate likelihood of occurrence (See Appendix B).

Potential habitat is present for the Australian Grayling, Australian Bass and Macquarie Perch. The Australian Grayling (*Prototroctes maraena*), listed as Endangered under the FM Act and Vulnerable under the EPBC Act, potentially occurs in the wider Woronora estuary (WBM 2008), however the Heathcote River has not been identified as habitat for this species on the NSW DPI Fisheries Spatial Data Portal. The closest important population within the Sydney Basin Bioregion occurs on the Shoalhaven River (DAWE 2020). Potential habitat for Macquarie Perch (*Macquaria australasica*) (FM-V) occurs within the proposal area, however extensive surveys conducted in 2001 as well as an examination of historical records, suggests that there is unlikely to be a population of Macquarie Perch within the Woronora River system (NSW Fisheries 2001).

3.6.3 Threatened Fauna Species - Terrestrial

An assessment of the likelihood of occurrence of species returned from the NSW BioNet database search undertaken on the 21st of October 2020 identified 39 threatened fauna species with the potential to occur within the locality. Results are provided in Appendix E. Of these, 14 species are considered to have a moderate to high likelihood of occurrence due to the high-quality habitat present within the study area (see Table 3-6).

Threatened species that may rely on hollow-bearing tree resources which are present include Powerful Owl, Sooty Owl, Eastern Pygmy Possum, and Southern Myotis (see Table 3-6). The Powerful Owl and Sooty Owl require hollows with a diameter greater than 40 cm (DEC 2006). High numbers of Powerful Owl records exist within the locality, however the hollows available on site are considered too small to support breeding of the species. The high number of records are likely due to the ability to detect the species easily, and the presence of high quality habitat in the locality would likely support multiple home ranges.

Additionally, the Broad-headed Snake could potentially utilise hollow-bearing trees for as a breeding resource. The species predominantly occurs within rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring, moving to tree hollows in summer. Limited suitable exposed cliffs occur within the study area, and the species would be considered a low likelihood of occurrence within the study area.

Other threatened and/or migratory species with broad habitat preferences include the Large-eared Pied Bat, as well as birds including Dusky Woodswallow, Black-faced Monarch, Rufous Fantail and Varied Sittella. Flowering eucalypt species provide foraging habitat for the Grey-headed Flying-fox. A Grey-headed Flying-fox camp has been detected at Forum Drive, no more than 2 km east of the proposal site, along Kallala Gully.

The bridge itself provides roosting habitat for some microbats in the form of bridge scuppers and crevices. Southern Myotis were recorded during flyout monitoring surveys and also inhabiting the bridge scuppers in September 2020 (Figure 3-8). The Little Bentwing-bat and Southern Myotis were recorded foraging in close

proximity to the bridge. The Large-eared Pied Bat also has the potential to utilise bird nests under the bridge as non-breeding habitat, as well as sandstone crevices and cracks which are present in the locality. Eastern Horseshoe Bats (not threatened) and potentially Southern Myotis may use the existing cross culvert pipes beneath the road, but they are unlikely to be a permanent roost site. Decorticating bark within the study area provides potential non-breeding roosting habitat for a range of microbat species.

Habitat throughout the locality provides suitable foraging and shelter habitat for the Koala. The proposal area provides connectivity to areas of koala habitat within the Campbelltown LGA which contains a key population. No key feed tree species identified for the Wollondilly koala population were recorded during the survey, however within the 10 km Study area, there are 186 Koala records stretching back to 1934 and including 13 records to date in 2020 (BioNet accessed October 2020; see also **Error! Reference source not found.**). This includes two roadkill records from Heathcote Road at the proposal site (in 2018, carcasses found together). This indicates that the study area does provide habitat and is a corridor for movement. The test of significance for Koala includes a more detailed discussion of the population and potential impacts on this species (Appendix C).

Suitable habitat is available within the study area for the Australasian Bittern, which inhabits edges of pools and waterways, with tall dense vegetation such as sedges, rushes and reeds. They breed during summer and occupy large home ranges at low densities. This species has been detected in Royal National Park (Schulz & Magarey 2012).

While the Woronora River and Heathcote Creek are unlikely to provide habitat for the Giant Burrowing Frog and Red-crowned Toadlet, habitat adjacent to the river provides potential habitat. Rock pools adjacent to the river may provide suitable breeding habitat for the Giant Burrowing Frog; the majority of their time is spent up to 300 m from breeding sites in heath, woodland or open sclerophyll forest, therefore there is an abundance of potential habitat in the locality. The Red-crowned Toadlet is known to inhabit periodically wet drainage lines below sandstone ridges, sheltering under rocks and masses of dense vegetation or leaf litter. Red-crowned Toadlet surveys were done for the Heathcote Road slope stabilisation project to the east of the study area in 2017 (NGH 2017), but this species was not detected. Given nearby records, the Red-crowned Toadlet has been given a moderate likelihood of occurrence.

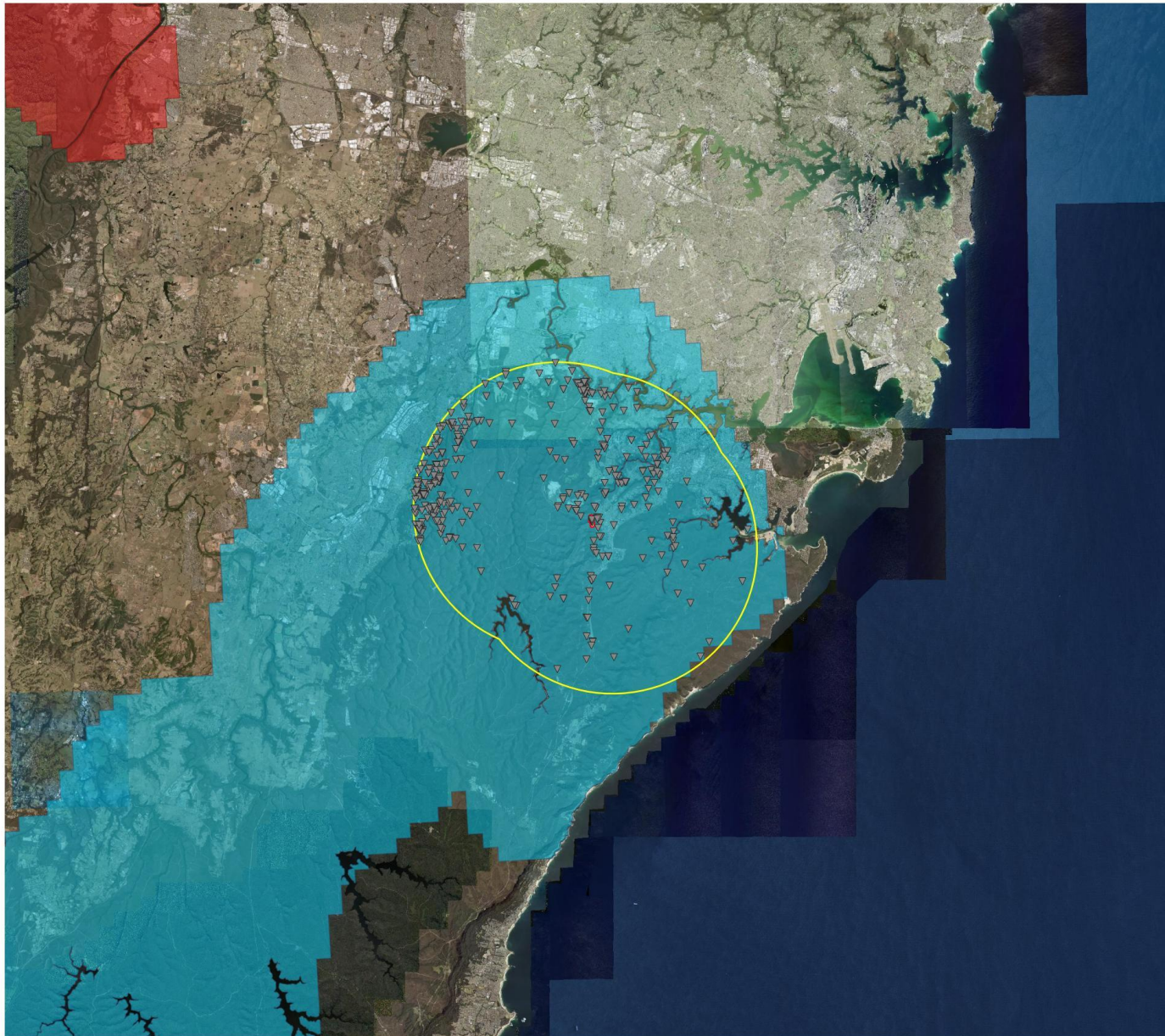
Migratory species with a moderate to high likelihood of occurrence, which includes the Black-faced Monarch and Rufous Fantail, are discussed in Section 3.10 as MNES.



Figure 3-8 Southern Myotis in bridge scuppers (September 2020)

Table 3-6 Threatened fauna species likelihood of occurrence

Scientific Name	Common Name	BC Act status	EPBC Act status	Likelihood of Occurrence
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V		Moderate
<i>Austrocordulia leonardi</i>	Sydney Hawk Dragonfly	E		Moderate
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Moderate
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	V		Moderate
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Moderate
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Moderate
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Moderate
<i>Miniopterus australis</i>	Little Bentwing-bat	V		Recorded
<i>Monarcha melanopsis</i>	Black-faced Monarch		Migratory	Moderate
<i>Myotis macropus</i>	Southern Myotis	V		Recorded
<i>Ninox strenua</i>	Powerful Owl	V		High
<i>Phascolarctos cinereus</i>	Koala	V	V	High
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		High
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Moderate
<i>Rhipidura rufifrons</i>	Rufous Fantail		Migratory	High
<i>Tyto tenebricosa</i>	Sooty Owl	V		Moderate

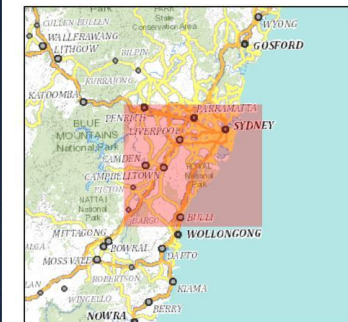


**Heathcote Road Bridge Widening
Koala Records and ARKS**

Legend

- Study Area
- 10 km Buffer Area
- ▼ BioNet Koala Records
- Areas of Regional Koala Significance (ARKS):
- High Security
- Moderate Security
- Low Security

Scale 1:250,000



Data Attribution
 © NGH 2020
 © TINSW 2020
 © LPI 2020 © OPIE 2020
 Ref: 20-296 Heathcote Bridge Biodiversity
 Assessment \BioNet Koala Records 10km and
 ARKS
 Author: D. Perkovic
 Date created: 18.11.2020
 Datum: GDA94 / MGA zone 56



NGH

Figure 3-9 Koala Records and ARKS

3.6.4 Migratory Species

A search of the NSW BioNet database undertaken on the 21st of October 2020 identified three (3) migratory species listed under CAMCA, JAMBA and ROKAMBA with the potential to occur within the locality. Results are provided in Appendix E. These species were considered to have a low likelihood of occurrence within the study area.

Australian Grayling is considered a migratory species, which undertakes annual downstream migrations towards the top of the estuary to spawn before returning upstream (DELWP 2015). The downstream spawning migrations tend to occur in Autumn but is also associated with an increase in flow. Artificial barriers which restrict movement of the Australian Grayling include in-stream dams, weirs, and culverts or anything that impedes this migration. The Needles which is located downstream of the proposal area is likely to be a barrier to movement for this species.

Australian Bass (*Macquaria novemaculeata*) is also a migratory fish species. Adults migrate into estuaries to spawn in winter but they spend most of their juvenile and adult life in freshwater. Upstream migration of juveniles occurs from January to May. Adults use both still and flowing water, particularly pools with submerged snags, undercut banks and overhanging vegetation (Industry & Investment NSW 2010). Australian Bass has previously been observed on either side of the Pass of Sabugal (or 'The Needles'), a low-level concrete causeway downstream of the proposal area (Nichols & McGirr 2005).

Migratory species listed under the EPBC Act are discussed in Section 3.10.

3.7 Areas of Outstanding Biodiversity Value

The study area does not contain any declared areas of outstanding biodiversity value as per the Biodiversity Conservation Act.

3.8 Wildlife Connectivity Corridors

Wildlife corridors are connections across the landscape that link up areas of habitat. They support natural processes that occur in a healthy environment, including the movement of species to find resources, such as food and water. Corridors can contribute to the resilience of the landscape in a changing climate and help to reduce future greenhouse gas emissions by storing carbon in native vegetation.

The Sutherland Shire Biodiversity Strategy (2013) identifies major habitat corridors relevant to this investigation including:

- Bushland link between Royal National Park, Heathcote National Park, Holsworthy Military Reserve, Sydney Water Catchment, and the bushland of Wedderburn and the south west.
- Bushland link along the Woronora River Valley linking Heathcote and Georges River National Parks.

Greenweb is a strategy to conserve and enhance Sutherland Shire's bushland and biodiversity by identifying and appropriately managing key areas of bushland habitat and establishing and maintaining interconnecting linkages and corridors (Sutherland Shire Council 2001). The study area is identified as 'core' habitat which includes areas containing key habitat areas, key linkages and threatened species, or EECs (Sutherland Shire Council 2001). See Figure 3-10 for Council's Greenweb mapping of the study area. A variety of species with large home ranges are likely to use the proposal site as a wildlife corridor, such as Koala, forest owls, and microbats.

Koala roadkill records at the proposal site (BioNet, two individuals found together in August 2018) are evidence that the existing road does act as a barrier to movement. DPIE (2020b) have mapped the proposal area within the Bungonia ARKS and identified a high threat to Koala from vehicle strike risk. Impacts on

connectivity are discussed in Section 5.2.1, along with proposed mitigation in Section 6.1. Appendix C provides specific information relative to Koala.

The Woronora River and Heathcote Creek and various tributaries are likely to provide important corridors and habitat linkages for both aquatic (fish) and aerial species (birds, bats). Existing barriers to movement for aquatic species occur along the Woronora River at The Needles which is a low-level causeway downstream of the proposal area. See Section 3.6.4 for a discussion of barriers to movement for Australian Grayling.



Figure 3-10 Greenweb mapping (Sutherland Shire Council (2020), accessed 26/06/20, <<https://maps.ssc.nsw.gov.au/ShireMaps/>>.)

3.9 SEPPs

On 1 March 2020, SEPP No 44 — Koala Habitat Protection was repealed and replaced by SEPP (Koala Habitat Protection) 2019. Activities assessed under Part 5 of the EP&A Act are not subject to the Koala Habitat Protection SEPP, including this proposal. Impacts to Koalas as a result of the proposal are assessed under the BC Act and EPBC Act. For details see Sections 4 and 5 of this report.

3.10 Matters of National Environmental Significance

MNES are protected under the EPBC Act. Relevant to this investigation are listed threatened species and migratory species. The Protected Matters Search Tool revealed the potential for 76 threatened species, 47 migratory species, and 13 threatened ecological communities (TEC) within 10 km of the study area. Marine species were not assessed further in this assessment due to the lack of marine habitat within the study area.

No world heritage places occur within the 10 km of the study area. Royal National Park and Garawarra State Conservation Area are listed as a National Heritage Property and Towra Point Nature Reserve is a wetland of international importance, both located within the locality. Two Commonwealth Heritage Places occur within the locality including Cubbitch Barta National Estate Area (Indigenous) and Old Army / Internment Camp Group Holsworthy (Historic).

Due to the availability of habitat and broad habitat preferences, the following migratory species listed under the EPBC Act are likely to occur within the study area on occasion: Black-faced Monarch *Monarcha melanopsis* and Rufous Fantail *Rhipidura rufifrons*. The Rufous Fantail was recorded (as roadkill) along the eastern end of Heathcote Road during an ecological survey conducted by NGH Consulting for the Heathcote Road slope stabilisation project in April 2017.

An assessment of threatened species and ecological communities, including those listed under the EPBC Act, is included in Section 3.6 and Section 3.5 above. The significance of any impacts from the proposal on MNES is detailed in Appendix D.

4. Avoidance and Minimisation

The proposed works have been designed to minimise vegetation clearing, where possible, and minimise potential impacts to specific threatened species and threatened ecological communities that may be present at the proposal site.

The proposal design has been refined to use piling wall (as opposed to a batter or retaining earth wall) to reduce both the construction and design footprint of the proposal on the approaches. This has avoided potential direct impacts to adjacent sensitive areas including Heathcote Creek, the National Park boundary on the south-west side, and the steep drop to Woronora River channel on the north-east side.

Clearing has been minimised by using an existing/former access track on the northern side as the access track for works beneath the bridge. While there is some regrowth along the track, it has minimised clearing in other undisturbed areas.

Alternative construction equipment (e.g. long reach arm equipment specialised for bridge works) was explored to enable works to be conducted from the bridge and potentially minimise the construction footprint beneath the bridge, however the equipment was not feasible for the construction activities required (i.e. it was suited to physical inspections and minor works beneath bridge structures, but not for activities such as lifting large heavy bridge beams into place).

Works within the waterway are subject to the outcomes of consultation with the Department of Primary Industries and will be conducted in accordance with the CEMP.

5. Impact Assessment

The proposal will involve the removal of native vegetation, including canopy trees, midstorey and groundcover vegetation primarily for access. Additionally, a temporary water crossing will be created across the Woronora River for plant access. The most recent project design equates to 3.12 ha of vegetation being impacted by the proposal. Impacts of the proposed works are discussed below.

Impacts which have been considered in this biodiversity assessment include both direct and indirect impacts, as well as those that are specific to construction and those that may apply during operation:

- Vegetation clearing and removal of native vegetation and threatened fauna habitat
- Impacts to the aquatic environment and/or groundwater dependent ecosystems
- Direct mortality of native fauna
- Loss of connectivity
- Weed spread
- Pest animal predation/competition
- Introduction and/or spread of pathogens
- Hydrological changes
- Noise, light and vibration
- Natural disasters – i.e. bushfire and flood, and accidental ignition of a fire during proposed activities.

5.1 Construction Impacts - Direct

5.1.1 Removal of Native Vegetation

Vegetation removal would be required for construction of the access track, crane platforms, and waterway crossing. Vegetation beneath the bridge and adjacent to abutments would require removal for construction. Vegetation removal would also be required for construction of both the southern and northern side widening including vegetation directly impacted by piling wall construction. Vegetation would also be directly impacted by drainage modifications including culvert extensions and scour protection. Slope maintenance work would require removal of vegetation on the face of the rock cutting as well as along the crest of cuttings to 3 m and within the drainage line. The amount of vegetation with potential to be impacted as result of the proposed work is approximately 3.12 ha (Table 5-1). Of this, up to 0.05 ha is consistent with the EEC Sydney Freshwater Wetlands in the Sydney Basin Bioregion under the BC Act final determination. The removal of this vegetation will marginally reduce the availability of current and future roosting, shelter and foraging habitat for woodland birds, arboreal fauna and terrestrial fauna, however the small area of reduction given the extent of habitat in the locality is not considered likely to impact the abundance or diversity of flora and fauna in the region in the long-term.

Table 5-1 Impacts to vegetation

Plant Community Type (PCT)	Status		PCTs within Study Area (ha)	Area Impacted (ha)
	BC Act	EPBC Act		
PCT 1250	No	No	8.35	2.53
PCT 1292	No	No	2.36	0.50
PCT 781	EEC	No	0.06	0.05

Plant Community Type (PCT)	Status		PCTs within Study Area (ha)	Area Impacted (ha)
	BC Act	EPBC Act		
Exotic Vegetation	No	No	0.04	0.04
Total			10.81	3.12

5.1.2 Removal of Threatened Fauna Habitat

Threatened fauna habitat exists within the study area in the form of foraging habitat from flowering Eucalypts, native trees, and shrubs. This flora likely constitutes foraging habitat for resident and migratory threatened fauna. Nesting, roosting and shelter habitat also occurs within the study area as hollow-bearing trees for arboreal mammals and birds, dense midstorey for Sooty Owl, dense groundcover habitat for terrestrial fauna (e.g. rodents, wallabies) and reptiles. The proposal would also remove a number of culverts and scuppers within the bridge structure which constitute known habitat for threatened microbats, in addition to impacts to suitable foraging habitat in the form of remnant vegetation and open areas of water.

It is considered unlikely that the threatened fauna utilising the vegetation at the proposal site would be solely reliant on it considering the proximity of Heathcote Road and the extensive high-quality habitat available throughout Heathcote National Park and Holsworthy Military Reserve. Up to 16 hollow-bearing trees would be impacted by the proposal. There is potential for bush rock to be disturbed, which is a key threatening process (NSW Scientific Committee) for threatened species which may occur in the project area (i.e. Broad-headed Snake, Red-crowned Toadlet).

The proposed works may result in the loss of up to 3.12 ha of foraging, roosting and shelter habitat for threatened fauna such as the Red-crowned Toadlet, Australasian Bittern, Powerful Owl, Sooty Owl, Dusky Woodswallow, Varied Sittella, Eastern Pygmy Possum, Koala, Large-eared Pied Bat, Southern Myotis and Grey-headed Flying-fox. While not listed as threatened under the BC Act, the following migratory species listed under the EPBC Act have the potential to occasionally utilise habitat at the proposal site; Black-faced Monarch and Rufous Fantail.

Table 5-2 Impacts on threatened fauna and fauna habitat

Scientific Name	Common Name	Potential occurrence (Moderate, High, Recorded)	Significant Impact?	Area Impacted (ha)
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	Moderate	No	3.12
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Moderate	No	0.05
<i>Cercartetus nanus</i>	Eastern Pygmy Possum	Moderate	No	3.12
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Moderate	No	3.12
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Moderate	No	3.12

Scientific Name	Common Name	Potential occurrence (Moderate, High, Recorded)	Significant Impact?	Area Impacted (ha)
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Moderate	No	3.12
<i>Monarcha melanopsis</i> (EPBC-M)	Black-faced Monarch	Moderate	No	3.12
<i>Myotis macropus</i>	Southern Myotis	Moderate	No	0.05
<i>Ninox strenua</i>	Powerful Owl	High	No	3.12
<i>Phascolarctos cinereus</i>	Koala	Moderate	No	3.07
<i>Pseudophryne australis</i>	Red-crowned Toadlet	Moderate	No	3.12
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Moderate	No	3.07
<i>Rhipidura rufifrons</i> (EPBC-M)	Rufous Fantail	High	No	3.12
<i>Tyto tenebricosa</i>	Sooty Owl	Moderate	No	3.12

5.1.3 Removal of Threatened Flora

Despite no threatened flora species listed under the BC Act or EPBC Act being recorded during the site surveys, listed flora species with a moderate to high likelihood of occurrence were assessed. The impacts to potential habitat for each species is shown in table 5.3 below.

Table 5-3 Impacts on Threatened Flora

Scientific Name	Common Name	Ecosystem or species credit species	Status		Habitat to be impacted (ha)	Habitat in the study area (ha)
			BC Act	EPBC Act		
<i>Allocasuarina diminuta</i> subsp. <i>mimica</i>	-	Species Credit Species	E		3.03	10.71
<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	Species Credit Species		V	3.03	10.71

Scientific Name	Common Name	Ecosystem or species credit species	Status		Habitat to be impacted (ha)	Habitat in the study area (ha)
			BC Act	EPBC Act		
<i>Grevillea parviflora subsp. parviflora</i>	Small-flower Grevillea	Species Credit Species	V	V	3.03	10.71
<i>Hibbertia stricta subsp. furcatula</i>	Hibbertia sp. nov. 'Menai'	Species Credit Species	E		3.03	10.71
<i>Leucopogon exolasius</i>	Woronora Beard-heath	Species Credit Species	V	V	3.03	10.71
<i>Melaleuca deanei</i>	Deane's Paperbark	Species Credit Species	V	V	3.03	10.71

5.1.4 Aquatic Impacts

Aquatic impacts during the construction phase present a high risk to downstream water quality through the introduction of sedimentation, potential erosion of river banks and access track from physical disturbance (e.g. crane platforms and vegetation removal), and potential bed erosion if there is insufficient scour protection. Anti-carbonation coating treatment and the construction of a temporary crossing structure and pad footings within the riverbed during the works also poses potential water quality impacts.

There is a risk of spill events from machinery which highlights the importance of complying with the standard 40 m riparian buffer (where feasible). There is also a risk of contamination of the proposal area from slurry generated by geotechnical and piling activities. The construction, use and decommissioning of a temporary waterway crossing has the potential to create a barrier to the movement of fish, including migratory species which have the potential to occur along the Woronora River.

Water quality may be adversely impacted by tannin discharge from stockpile(s) of mulched vegetation.

There may be some loss of riparian and/or aquatic habitat such as relocation or removal of snags during the construction and operation of the temporary crossing.

No threatened aquatic species, populations and communities have been identified within the study area or are considered to have a moderate to high likelihood of occurrence. Mitigation measures have been recommended in Section 6 to ensure general aquatic impacts are prevented and minimised during the construction phase. A CEMP would provide protocols for the management of erosion and sediment, which will be implemented during works within the study area.

5.1.5 Injury and Mortality

Wildlife injury or death could occur during the construction phase of the proposed works. The clearing of vegetation may result in injury or death to resident fauna. Species at risk include arboreal fauna, reptiles, amphibians, and small mammals. There is also the risk of displaced fauna succumbing to predation, or stress induced by competing with existing resident populations for resources, particularly shelter / refuge habitat.

In summary, injury and mortality of fauna could occur during construction activities, including:

- During construction when vegetation and habitat are being cleared,
- Operation of machinery and plant, and
- Construction-related traffic movements.

Pre-clearing surveys and clearing supervision would be as per the RMS Biodiversity Guidelines.

5.2 Indirect and/or Operational Impacts

5.2.1 *Wildlife Connectivity and Habitat Fragmentation*

Whilst there is potential for short term impacts to occur through the removal of vegetation and processes such as excavation, it is unlikely that habitat fragmentation will increase, or connectivity will be impacted because of the proposal. This is due to the small amount of vegetation removal within a relatively large habitat corridor. Species which are highly mobile, such as flying-fox and birds, are unlikely to be impacted by the proposal.

Heathcote Road already acts as a barrier to movement for less mobile species, including Koala (as evidenced by roadkill records) along with smaller forest birds, microbats, reptiles, macropods and other mammals.

Connectivity beneath the bridge will remain both during and post-construction (with some potential for temporary disruption during construction). Construction, operation and decommissioning of the temporary waterway crossing has the potential to impact on fish passage.

The proposal provides an opportunity to incorporate mitigation structures in an effort to reduce roadkill and therefore have a benefit for local wildlife. Mitigation measures will include fencing and installation of crossing structures (see also Section 6.1).

The proposal area is surrounded by large tracts of intact native vegetation. Habitat fragmentation is not expected to be significant.

5.2.2 *Edge Effects on Adjacent Native Vegetation and Habitat*

The native vegetation within and adjacent to the study area is relatively high quality, but is subject to existing edge effects due to the proximity of Heathcote Road and visitors to the Woronora River. Human-induced edge effects that may result from the proposal include weed incursion, further habitat fragmentation, loss of foraging habitat, and erosion. As such, the proposal does have the potential to exacerbate these edge effects for the study area.

5.2.3 *Invasion and Spread of Weeds*

The *Biosecurity Act 2015* dictates that all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any land managers or authorities who deal with any plant has a duty to ensure the risk is prevented, eliminated, or minimised, so far as is reasonably practicable. Within the Greater Sydney region, there are 108 listed priority weeds (Appendix D). The duty and actions required for the priority weeds observed within the study area are listed in Table 3-2. Other environmental weeds were also recorded within the study area (see Appendix A). Although these are not declared priority weeds, they pose a significant risk to the surrounding vegetation and waterways.

The proposal will involve the removal of vegetation and construction of a temporary waterway crossing. The use of machinery and equipment has the potential to introduce and spread weeds into the site in the form of soil-stored seed. The disturbance of vegetation on either side of the Woronora River also has the potential to spread (both terrestrial and aquatic) weeds downstream of the study area. There is the potential for weed spread if green waste is contaminated and taken from the proposal area for use elsewhere. Appropriate weed

management controls should be created prior to the commencement of construction and adhered to throughout the construction process (see Section 6).

5.2.4 Invasion and Spread of Pests

Pests such as foxes (*Vulpes vulpes*), cats (*Felis catus*), Black Rat (*Rattus rattus*) and invasive fish species such as *Gambusia holbrooki* are likely to occur within the study area, but as they are already established and water would not be pumped upstream (in case areas upstream are *Gambusia* free) the proposal is unlikely to cause further spread of these pest species. A Construction Environment Management Plan would be implemented during works within the study area to provide protocols for the management of invasive species.

5.2.5 Invasion and Spread of Pathogens and Disease

The spread of amphibian chytrid fungus is a potential risk at the proposal site. It is likely to be a primary factor in the suspected loss of the Green and Golden Bell Frog and Stuttering Frog from the Royal and Heathcote National Parks (DECCW 2011). However, the risk of spread would only be exacerbated if handling of amphibians was to occur, or if staff was working between multiple sites. If handling of amphibians is required in accordance with pre-clearing monitoring protocols, hygiene protocols to prevent transmission of amphibian chytrid fungus have been recommended.

There was no observed evidence of *Phytophthora cinnamomi* and there is currently no statewide map of *Phytophthora* risk areas in NSW. There is potential for transmission of *Phytophthora cinnamomi* due to the transportation of machinery between sites. The project Construction Environment Management Plan would provide protocols for the management of soil-borne pathogens, and this plan will be implemented during works within the study area.

5.2.6 Changes to Hydrology

The temporary construction of a vehicle crossing across Woronora River (upstream of the bridge) to access the southern abutment area would temporarily alter the hydrology of the proposal site. This impact would be temporary and flow would be maintained following the construction of the vehicle crossing, however the works will be subject to approved CEMP and Department of Primary Industries input. During operation there would be no change to hydrology or depth of the creeks.

Vehicle accident spills or general runoff are existing risks to hydrology that would continue to be a risk at the proposal site during the operational phase. The new drainage structure outlets and scupper discharge may create a minor increase in stormwater volume due to the small overall increase in road surface area. Given that the Woronora River and Heathcote Creek are both key fish habitat, sensitive urban design features have been recommended.

5.2.7 Noise, Light, and Vibration

Estimated construction schedule is 22 months duration including both day and night works. Noise and vibration impacts from construction machinery will occur during the works, however, will be temporary in nature (only during construction phase). Similarly, light from night works during construction may impact fauna in the immediate surrounds, however, will be temporary in nature.

5.2.8 Groundwater Dependent Ecosystems

Riparian vegetation and the freshwater wetland within the proposal site would be considered high ecological value GDEs. The installation of a temporary waterway crossing is required as a part of the proposed works and will lead to changes in surface water flow, which is an identified threat to the Sydney Freshwater Wetlands EEC. The indicative design for the crossing uses geofabric, ballast rock, and pipes to allow water flow. Although there may be a slight reduction in water flow in the short term, any impacts would be temporary in nature. Exact details of the crossing design and construction methodology would be subject to the CEMP and consultation with DPI as per the Fisheries Management Act.

5.3 Cumulative Impacts

Cumulative impacts include an assessment of past, current and proposed projects within the broader region which have the potential to impact on ecological values at the proposal site. Table 5.4 below provides a summary of these projects.

Table 5-4 Past, Present and Future Projects

Project	Biodiversity Value Impacted	Construction scope	Operational outcome	Time Completed
Heathcote Road Bank Stabilisation	0.16 ha	Remediate subject slopes	Improved safety	Unspecified
Princes Highway/Heathcote Road upgrade	0.24 ha	Intersection upgrade to allow more lanes	Increased traffic flow and improved safety	April 2019
Heathcote Road/New Illawarra Road intersection upgrade	1.3 ha	Intersection upgrade to allow more lanes	Increased traffic flow and improved safety	April 2019
Heathcote Road upgrade, Holsworthy	Unspecified	Widening from 2 to 4 lanes, bridge duplication, etc.	Reduced traffic congestion and improved safety	Not completed
ANSTO Innovation & Research Precinct	Unspecified	Expansion of ANSTO's Lucas Heights campus	Precinct for science and innovation	Unspecified

5.4 Assessments of Significance

Assessments of significance for species listed under the EPBC Act were undertaken for Australasian Bittern, Black-faced Monarch, Rufous Fantail, Koala, Large-eared Pied Bat, Grey-headed Flying-fox, *Astrotricha crassifolia*, *Grevillea parviflora subsp. parviflora*, *Leucopogon exolasius* and *Melaleuca deanei* (None were considered to have a likely significant impact as a result of the proposal.

Table 5-5). Details of these assessments are provided in Appendix E of this report. None were considered likely to result in a significant impact.

Assessments of significance have been prepared for threatened entities listed under the BC Act with a moderate to high likelihood of occurrence (None were considered to have a likely significant impact as a result of the proposal.

Table 5-5). None were considered to have a likely significant impact as a result of the proposal.

Table 5-5 Summary of Assessments of Significance

BC Act Significance Assessments						
Threatened species, or communities	Significance assessment question ¹					Likely significant impact?
	a	b	c	d	e	
Sydney Freshwater Wetlands TEC	X	N	N	N	N	No
Sydney Hawk Dragonfly	N	X	N	N	N	No
Giant Burrowing Frog	N	X	N	N	N	No

BC Act Significance Assessments						
Threatened species, or communities	Significance assessment question ¹					Likely significant impact?
	a	b	c	d	e	
Red-crowned Toadlet	N	X	N	N	N	No
Broad-headed Snake	N	X	N	N	N	No
Dusky Woodswallow	N	X	N	N	N	No
Australasian Bittern	N	X	N	N	N	No
Black-faced Monarch	N	X	N	N	N	No
Powerful Owl	N	X	N	N	Y	No
Rufous Fantail	N	X	N	N	N	No
Sooty Owl	N	X	N	N	Y	No
Varied Sittella	N	X	N	N	N	No
Eastern Pygmy Possum	N	X	N	N	N	No
Koala	N	X	N	N	N	No
Large-eared Pied Bat	N	X	N	N	N	No
Grey-headed Flying-fox	N	X	N	N	N	No
Southern Myotis	N	X	N	N	N	No
Macquarie Perch	N	X	N	N	N	No
Australian Grayling	N	X	N	N	N	No
<i>Allocasuarina diminuta</i> subsp. <i>mimica</i> population in the Sutherland and Liverpool local government areas	N	X	N	N	N	No
Thick-leaf Star-hair	N	X	N	N	N	No
Small-flower Grevillea	N	X	N	N	N	No
Woronora Beard-heath	N	X	N	N	N	No
Deane's Paperbark	N	X	N	N	N	No
<i>Hibbertia stricta</i> subsp. <i>furcatula</i>	N	X	N	N	N	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

5.4.1 KTPs Relevant to the Proposal

Key Threatening Processes	
BC Act	Relevance
Clearing of native vegetation	Native vegetation would be removed as part of the proposed works. This vegetation is in moderate to high condition. The works will not prevent future recruitment. Weed control and management at the proposal sites would prevent the spread of weeds and associated decline in biodiversity values.
Bushrock removal	Rocks and boulders may be disturbed which provide good shelter habitat for reptiles and small mammals, as well as basking habitat for reptiles.
Loss of Hollow-bearing Trees	21 HBTs were identified within the study area, up to 16 of which may be removed as part of the proposed works.
Removal of dead wood and dead trees	Numerous stags and coarse woody debris were identified within the proposal area, some of which will be removed by the proposed works. This will be avoided when possible and will adhere to the advice of G40.
Invasion of native plant communities by exotic perennial grasses	Exotic perennial grasses were recorded within the proposal sites and can benefit from disturbance to natural vegetation. Weed management at the sites would help prevent these species from spreading within or between sites.
Invasion, establishment and spread of Lantana (<i>Lantana camara</i>)	Weed management at the proposal sites would prevent contributing to this process while maintaining habitat complexity.
Invasion of native plant communities by African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)	Weed management at the proposal site would prevent contributing to this process while maintaining habitat complexity.
Invasion and establishment of exotic vines and scramblers	Weed management at the proposal site would prevent contributing to this process while maintaining habitat complexity.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Evidence of this pathogen was not observed at the proposal sites during the surveys and will be managed throughout construction.

6. Mitigation

6.1 Mitigation Measures

The proposed works would be conducted in accordance with the project CEMP, which have specific inclusions from the RMS G36 and G40 Specifications. Specific impact mitigation measures are provided in Table 6.1 below.

Table 6-1 Mitigation Measures


Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Detailed design	Effective	No residual impacts anticipated
	Preparation of Flora and Fauna Management Sub-plan within Construction Environment Management Plan to include the following: <ul style="list-style-type: none"> • Pre-clearing procedure • Clearing Protocol • Habitat relocation procedure • Unexpected threatened species find procedure • Waterway crossing design Pre-clearing surveys will be undertaken by the ecologist and environment officer in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Prior to construction	Effective	
	Pre-clearing Check. <ul style="list-style-type: none"> • Prior to commencement of clearing, detailed pre-clearing check of all areas of potential fauna habitat to be impacted undertaken • Habitat features to include trees containing hollows and/or nests, logs, and bushrock • All features to be mapped using GPS or equivalent portable GIS software • Each feature to be flagged with pink flagging tape, with unique identifying number written on tape • Report to be prepared including detailed maps of habitat features, and locations to be incorporated into sensitive area plans 			
	Vegetation removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bush rock of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
	<ul style="list-style-type: none"> • Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees • In areas to clear that are adjacent to areas to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance • FFMP to identify trees will be cut to base only (i.e. no grubbing) to minimise ground disturbance and risk of impacts to the waterway from erosion. • Access track to be made from inert hardstand material (not crushed sand) to further prevent potential erosion. • Where large woody native vegetation is being removed, keep material for reuse as snags (i.e. >3m and +300mm) if recommended by onsite ecologist 			
	<p>Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). Progressive stabilisation of disturbed areas will be implemented.</p> <ul style="list-style-type: none"> • Plan to incorporate planting out of disturbed areas to restore native vegetation • plantings of locally endemic species, targeted to the structure and plant community type of the original landscape • Plantings to include complex mid-stratum to increase habitat for woodland birds and support small faunal movement • Rehabilitation to be targeted around any fauna furniture or corridor crossing structures – dense mid stratum of vegetation and connectivity with larger patches to be enhanced • Rehabilitation used to enhance fauna habitat connectivity along movement corridor • Incorporation of felled timber and recovered habitat features in rehabilitation to enhance small mammal, reptile and invertebrate habitat 	Post construction	Effective	
	<p>The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.</p>	During construction	Proven	
Removal of threatened species habitat and habitat features	Habitat removal will be minimised through detailed design.	Detailed design	Effective	No residual impacts anticipated
	<p>Microbat Management Plan to be prepared and implemented</p> <ul style="list-style-type: none"> • A protocol for the survey and exclusion of cave-dependent microbats utilising the bridge structures is to be developed. • Protocol to include identification during pre-clearing survey, followed by inspection day prior to disturbance of habitat (if identified) 	Construction		

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
	<ul style="list-style-type: none"> • Where roosting bats identified, bats to be captured and relocated at or after dusk. Survey to confirm any bats not captured have left roost for the night • Once bats have left roost, roost habitat to exclude re-entry. Measures such as using shade cloth, geofabric or expanding foam may be suitable to exclude bats • Survey report to be prepared detailing species, number, and relocation and/or other actions undertaken to discourage occupancy • Develop suitable artificial habitat beneath bridge for Southern Myotis as part of design process in consultation with project managers from similar projects or microbat expert. 			
	<p>Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bush rock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p> <ul style="list-style-type: none"> • Clearing to be undertaken as close as is practical following pre-clearing survey so as to minimise chance of missing newly created habitat (such as nests or possum dreys) • Area to be cleared to be re-checked on day prior to clearing to ensure no new fauna habitat present • Non-habitat to be cleared, following confirmation of habitat feature locations with clearing contractor • Clearing within wooded vegetation, PCTs, TECs and in locations of threatened species identified to be supervised by ecologist • Habitat features to be isolated and left overnight to allow for fauna relocation • Habitat features to be cleared following day in the presence of a trained ecological or licensed wildlife handler • Trees to be felled with minimal impact where possible – this may include use of arborists to section and lower hollow sections from trees, or use of excavators with grabs to avoid uncontrolled felling of trees • All hollows, fissures, logs and rocks to be checked by ecologist, and any fauna present caught and housed. Habitat features to be moved to allow all hollows to be inspected. • Hollows to be inspected by ecologists using torch and/or boroscope within deeper fissures. Crow bar to be used to crack open sections of dead limbs and check under bark • Uninjured fauna to be released in adjacent suitable habitat on day of clearing • Injured fauna to be euthanised on site if severely injured, or taken to vet for assessment • Records to be kept of number of hollows, number and species of individuals captured, and outcome of capture • Habitat features to be left on ground overnight prior to removal following day 	During construction	Effective	

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
	<p>Explore opportunities to replace or re-instate habitat in accordance with <i>Guide 5: Re-use of woody debris and bush rock</i> and <i>Guide 8: Nest boxes</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p> <ul style="list-style-type: none"> • Relocation of habitat features (fallen timber, hollow logs) from within the development footprint to retained areas within the study area in consultation with project ecologist. • Incorporate fauna crossing structures beneath bridge including timber logs with connection to adjacent vegetation to account for arboreal fauna movement, and woody ground debris to allow for terrestrial fauna movement, in accordance with NSW RMS guidelines. Crossing structures would be appropriate to locate on both northern and southern sides of corridor. Fauna connectivity feature design will be confirmed during the Project's detailed design phase. • Install exclusion fencing on either side of Heathcote Bridge to discourage road crossing by fauna such as koalas. Fencing is to include Koala friendly structures to aid traversal of Koala across their range. 	During construction	Proven	
	<p>The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site. Toolbox talks will highlight the potential for unexpected species finds prior to construction works.</p>	During construction	Proven	
	<p>Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p> <ul style="list-style-type: none"> • measures will need to be developed within a Microbat Management Plan that will detail the following: <ul style="list-style-type: none"> ○ Species ecology ○ Required pre-construction surveys ○ Actions on identification of roosting microbats within structure ○ Exclusion options ○ Physical removal protocols (hand capture/netting) ○ Bat handling and care techniques ○ Release protocol ○ Impact minimisation techniques for overwintering bats ○ Habitat compensation recommendations 			
Removal of threatened plants	<p>Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p>	During construction	Proven	

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal site. Toolbox talks will highlight the potential for unexpected species finds prior to construction works.	During construction	Proven	No threatened flora identified in field surveys
Aquatic impacts	<p>Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).</p> <ul style="list-style-type: none"> • Toolbox talks will highlight the importance of aquatic exclusion zones prior to construction works. • Works over waterways and crane platform construction is subject to an Environmental Work Method Statement (EWMS). • Temporary water crossing is subject to Fisheries permit requirements and separate EWMS. • Where practicable, incorporate exclusion fencing to delineate buffer of riparian zones. • Measures will be implemented to prevent accidental spills, damage to the waterway banks and riverbed: no scaffolding will be placed within waterway, provide spill response kits on site, comply with minimum bunding requirements • An erosion and sediment control plan would be prepared in conjunction with the final design and implemented • Access track is to be made from inert hardstand material (not crushed sand) • To prevent risk of tannins, mulching and stockpiling is to occur offsite. Comply with RMS tannin guidelines (2012). 	Detailed design During construction	Effective	No impacts to aquatic habitat
	Consult with DPI (Fisheries) before clearing to identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway (and/or for fauna furniture)	Detailed design, during construction	Effective	
Groundwater dependent ecosystems	Any potential interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design in consultation with DPI (Fisheries).	Detailed design	Effective	No impacts to GDEs
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective	No impacts to hydrology

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
Fragmentation of identified habitat corridors	<p>Connectivity measures will be implemented in accordance with the <i>Wildlife Connectivity Guidelines for Road Projects</i> (RTA 2011) and with consideration of other relevant guidelines (i.e. TMR 2010; NSW Legislative Council 2020). This should include the installation of fauna fencing to funnel Koalas (and other wildlife) under the bridge, and specific Koala crossing infrastructure and targeted restoration to facilitate movement under the bridge and adjacent to Woronora River.</p> <ul style="list-style-type: none"> • Any connectivity measures will be designed and installed with input from a suitably experienced ecologist. • Bridge design principles relevant to the current proposal should include: <ul style="list-style-type: none"> ○ Natural substrate ○ Unimpeded riparian vegetation ○ Minimum width of 3 m between the toe of scour protection and the top of bank (where possible), with refuge areas (i.e. logs, fauna furniture). • An example of an appropriate crossing structure is provided below. 	Detailed design, during construction and post construction	Effective	No impacts to habitat corridor connectivity

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
Edge effects on adjacent native vegetation and habitat	<p>Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).</p> <ul style="list-style-type: none"> • Toolbox talks will highlight the importance of exclusion zones prior to construction works. • Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees • In areas to clear that are adjacent to areas to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance • Restrictions on 'hot works' during summer to avoid bushfire risk 	Detailed design During construction	Effective	No edge effects anticipated
Injury and mortality of fauna	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	No residual impacts
Invasion and spread of weeds	<p>Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include:</p> <ul style="list-style-type: none"> • Toolbox talks to highlight the potential for and identification of priority weed species prior to construction works. • Management protocol for declared priority weeds under the <i>Biosecurity Act 2015</i> during and after construction • Weed hygiene protocol in relation to plant, machinery, and fill (e.g. All machinery (e.g. bulldozers, excavators, trucks, loaders etc.) will be cleaned using a high-pressure washer (or other suitable device) prior to entering and exiting work site. Native and weed material green waste will be separated. All plant material containing seed heads, weeds that have allelopathic properties, and weeds that are able to reproduce vegetatively, including topsoil containing weed propagules, will be disposed of at an appropriate waste management facility or otherwise properly treated to prevent weed growth. 	During construction	Effective	No residual impacts
Invasion and spread of pests	If any pest species are observed during construction (e.g. fox, rabbit), consultation with an ecologist will be undertaken to ascertain whether management within the proposal site is required.	During construction	Effective	No residual impacts

Impact	Mitigation Measures	Timing and Duration	Likely Efficacy of Mitigation	Residual Impacts Anticipated
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	No residual impacts
Noise, light and vibration	Construction Environmental Management Plan will include <ul style="list-style-type: none"> • measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as possible. • Shading and artificial light impacts will be minimised through detailed design. • Direct lights away from vegetation during night works 	Detailed design Construction	Effective	No noise, light or vibration impacts anticipated
Natural disaster (bushfire or flood)	The risk of a flood event during construction can be addressed by: <ul style="list-style-type: none"> • a flood preparedness plan • storage of equipment and materials above high flood level • extra expectations for bunding requirements 	Construction	Effective	No residual impacts

7. Offset Strategy

7.1 Quantification of Impacts

The updated project design suggests a total of 3.12 ha of native vegetation will be impacted by the proposal; 2.53 ha of PCT 1250 Sydney Peppermint-Smooth-barked Apple-Red Bloodwood Shrubby Open Forest on Slopes of Moist Sandstone Gullies, Eastern Sydney Basin, 0.5 ha of PCT 1292 Water Gum-Coachwood Riparian Scrub Along Sandstone Streams, Sydney Basin, and 0.05 ha of PCT 781 Coastal Freshwater Lagoons of the Sydney Basin and South East Corner. PCT 781 forms part of the TEC Sydney Freshwater Wetlands in the Sydney Basin Bioregion. The other PCTs are not associated with TECs.

As per the Guideline for Biodiversity Offsets (RMS 2011), the residual impact to biodiversity from the proposal are not considered to trigger the need for offsetting as:

- Overall proposed vegetation clearing is <5 ha
- There will not be more than 1 ha of listed TEC being cleared.
- There will not be more than 1 ha of a nationally or NSW listed threatened species' habitat removed.

8. Conclusion

The study area contains relatively high-quality habitat due to the topography of the locality and limited accessibility and is comprised of sandstone vegetation of upper slopes, riparian scrub, and wetland species within the water body.

Habitat quality is subject to sub-optimal when compared to the surrounding landscape, due to existing edge effects from Heathcote Road. The study area is adjacent to much larger tracts of protected and high-quality habitat throughout Heathcote National Park, Royal National Park and Holsworthy Military Reserve.

Three (3) PCTs were identified within the study area, one of which, Coastal Freshwater Wetland, is an endangered ecological community under the Biodiversity Conservation Act. The proposal would result in the reduction of the local occurrence of Sydney Freshwater Wetlands by 0.05 ha in areas of vegetation beneath Heathcote Bridge. This is not considered to be a significant impact.

No threatened flora species were confirmed during the present study, however there are five flora species and one population that are considered to have a moderate to high likelihood of occurrence in the study area. These are:

- *Allocasuarina diminuta* subsp. *mimica*
- *Astrotricha crassifolia* Thick-leaf Star-hair
- *Grevillea parviflora* subsp. *parviflora* Small-flower Grevillea
- *Hibbertia stricta* subsp. *furcatula*
- *Leucopogon exolasius* Woronora Beard-heath
- *Melaleuca deanei* Deane's Paperbark

For each of the threatened flora species, a maximum of 2.53 ha of suitable habitat will be removed by the project. Deane's Paperbark has a maximum of 3.12 ha of suitable habitat, as this species may also occur in the riparian area. Additionally, the newly described (and as-yet unlisted) *Hibbertia woronorana* may occur within the proposal area. While a precautionary approach is being taken, none of the species were observed during site surveys and there are no records from within the proposal area. As a result, the proposal is considered unlikely to constitute a significant impact on threatened flora.

Threatened fauna considered highly likely to occur includes Powerful Owl *Ninox strenua*, Koala *Phascolarctos cinereus*, Red-crowned Toadlet *Pseudophryne australis* and Rufous Fantail *Rhipidura rufifrons*. Both highly and moderately likely fauna species were considered against the test of significance (Biodiversity Conservation Act five-part test) and/or the assessment of significance (Environment Protection and Biodiversity Conservation Act). A maximum of 3.12 ha of habitat for threatened will be directly impacted, which will not include any preferred Koala feed trees.

Impacts which may arise as a result of the proposal include both direct and indirect impacts, as well as those that are specific to construction and those that may apply during operation.

The proposed works have been designed to minimise vegetation clearing. The proposal design has been refined to use piling wall (as opposed to a batter or retaining earth wall) to reduce both the construction and design footprint. This has avoided potential direct impacts to adjacent sensitive areas including Heathcote Creek, the National Park boundary on the south-west side, and the steep drop to Woronora River channel on the north-east side.

Clearing has also been minimised by using an existing track on the northern side as the access track for works beneath the bridge. While there is some regrowth along the track, this will minimise clearing in other undisturbed areas.

This biodiversity assessment report recommends a variety of mitigation measures to further reduce the chance of negative impacts on ecological values.

Vehicle strike along Heathcote Road is already a recognized threat to Koala and other native species. The proposal provides an opportunity to decrease this barrier and improve movement opportunity for wildlife. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas and other species under the bridge, along with crossing infrastructure (to provide refuge and assist movement). Targeted restoration under the bridge and following construction will facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit for the Koala and other barrier-sensitive wildlife.

Implementing the avoidance and mitigation measures detailed in this report will reduce any potential impacts on threatened ecological communities, flora and fauna species such that a significant impact on either matters of state or national environmental significance is not considered to be likely.

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Appendix A –Species Recorded

Recorded Flora

BAM Plot 1 (PCT 1292)

Scientific Name	Common Name	Family	% Cover	Abundance
<i>Acacia floribunda</i>	White Sally	Fabaceae (Mimosoideae)	5	10
<i>Acacia paramatensis</i>	Kangaroo Thorn	Fabaceae (Mimosoideae)	1	1
<i>Acianthus fornicatus</i>	Pixie Caps	Orchidaceae	0.5	5
<i>Ageratina riparia</i>	Mistflower	Asteraceae	2	100
<i>Allocasuarina littoralis</i>	Black She-Oak	Casuarinaceae	5	5
<i>Asparagus aethiopicus</i>	Asparagus Fern	Asparagaceae	0.5	1
<i>Cassytha sp.</i>	#N/A	#N/A	1	2
<i>Ceratopetalum apetalum</i>	Coachwood	Cunoniaceae	2	5
<i>Dodonea triquetra</i>	Large-leaf Hop-bush	Sapindaceae	1	5
<i>Entolasia stricta</i>	Wiry Panic	Poaceae	2	20
<i>Ficus coronata</i>	Creek Sandpaper Fig	Moraceae	1	1
<i>Grevillea oleoides</i>	Red Spider Flower	Proteaceae	0.5	3
<i>Leoneima dentatum</i>	Toothed Phebalium	Rutaceae	0.5	2
<i>Leptospermum polygalifolium</i>	Tantoon	Myrtaceae	2	3
<i>Ligustrum sinense</i>	Small-leaved Privet	Oleaceae	5	200
<i>Lomandra fluviatilis</i>	River Mat-rush	Lomandraceae	10	100
<i>Monotoca elliptica</i>	Tree Broom-heath	Ericaceae	2	10
<i>Oplismenus aemulus</i>	Basket Grass	Poaceae	0.1	5
<i>Pittosporum undulatum</i>	Sweet Pittosporum	Pittosporaceae	1	2
<i>Senna pendula var. glabrata</i>	Senna	Fabaceae (Caesalpinioideae)	2	20
<i>Smilax australis</i>	Lawyer Vine	Smilacaceae	0.1	1
<i>Sticherus flabellatus</i>	Shiny Fan Fern	Gleicheniaceae	0.5	2
<i>Tristania neriifolia</i>	Water Gum	Myrtaceae	1	2
<i>Tristaniopsis laurina</i>	Kanooka	Myrtaceae	65	50

BAM Plot 2 (PCT 1250)

Scientific Name	Common Name	Family	% Cover	Abundance
<i>Acacia longifolia</i>		Fabaceae (Mimosoideae)	2	2
<i>Ageratina adenophora</i>	Crofton Weed	Asteraceae	2	20
<i>Ageratina riparia</i>	Mistflower	Asteraceae	2	20

Scientific Name	Common Name	Family	% Cover	Abundance
<i>Allocasuarina littoralis</i>	Black She-Oak	Casuarinaceae	30	10
<i>Angophora costata</i>	Sydney Red Gum	Myrtaceae	30	3
<i>Banksia serrata</i>	Old-man Banksia	Proteaceae	5	1
<i>Billardiera scandens</i>	Hairy Apple Berry	Pittosporaceae	0.1	2
<i>Caustis flexuosa</i>	Curly Wig	Cyperaceae	1	5
<i>Cynodon dactylon</i>	Common Couch	Poaceae	5	100
<i>Dianella spp.</i>		Phormiaceae	0.5	5
<i>Dodonaea triquetra</i>	Large-leaf Hop-bush	Sapindaceae	2	5
<i>Doryanthes excelsa</i>	Gymea Lily	Doryanthaceae	5	6
<i>Dracophyllum secundum</i>		Ericaceae	0.1	1
<i>Entolasia stricta</i>	Wiry Panic	Poaceae	1	10
<i>Epacris longiflora</i>	Fuchsia Heath	Ericaceae	1	4
<i>Eucalyptus piperita</i>	Sydney Peppermint	Myrtaceae	15	1
<i>Grevillea mucronulata</i>		Proteaceae	2	5
<i>Hakea sericea</i>	Needlebush	Proteaceae	2	4
<i>Kunzea ambigua</i>	Tick Bush	Myrtaceae	1	1
<i>Lasiopetalum ferrugineum</i>		Malvaceae	2	3
<i>Leionema dentatum</i>	Toothed Phebalium	Rutaceae	2	4
<i>Lepidosperma laterale</i>		Cyperaceae	0.5	1
<i>Ligustrum sinense</i>	Small-leaved Privet	Oleaceae	2	20
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Lomandraceae	10	30
<i>Microlaena stipoides</i>	Weeping Grass	Poaceae	1	
<i>Oplismenus aemulus</i>	Basket Grass	Poaceae	2	50
<i>Persoonia pinifolia</i>	Pine-leaved Geebung	Proteaceae	5	5
<i>Phytolacca octandra</i>	Inkweed	Phytolaccaceae	0.5	1
<i>Pittosporum undulatum</i>	Sweet Pittosporum	Pittosporaceae	5	10
<i>Platysace linearifolia</i>		Apiaceae	0.2	2
<i>Pteridium esculentum</i>	Bracken	Dennstaedtiaceae	1	6
<i>Senna pendula var. glabrata</i>	Senna	Fabaceae (Caesalpinioideae)	2	20
<i>Smilax australis</i>	Lawyer Vine	Smilacaceae	0.5	2
<i>Solenogyne bellioides</i>	Solengyne	Asteraceae	1	50
<i>Tristaniopsis laurina</i>	Kanooka	Myrtaceae	5	1
<i>Verbena bonariensis</i>	Purpletop	Verbenaceae	0.5	2

Scientific Name	Common Name	Family	% Cover	Abundance
<i>Zieria pilosa</i>	Pilose-leafed Zieria	Rutaceae	0.5	5

Recorded Fauna

Taxa/Fauna group	Scientific Name	Common name	Observation type	Status	
				BC Act	EPBC Act
Reptilia		Unidentified skink	Observed (TfNSW)	No	No
Aves	<i>Acridotheres tristis</i>	Common Myna	Observed (NGH)	No	No
Aves	<i>Anas superciliosa</i>	Pacific Black Duck	Observed (TfNSW)	No	No
Aves	<i>Cracticus tibicen</i>	Australian Magpie	Observed (NGH)	No	No
Amphibia	<i>Crinia signifera</i>	Common eastern froglet	Heard (TfNSW)	No	No
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Observed(TfNSW)	No	No
Insecta	<i>Danaus plexippus</i>	Australian Monarch Butterfly	Observed (TfNSW)	No	No
Aves	<i>Grallina cyanoleuca</i>	Magpie-lark	Observed (NGH)	No	No
Mollusca	<i>Hyridella spp.</i>	Freshwater mussel	Observed (TfNSW)	No	No
Amphibia	<i>Litoria phyllochroa</i>	Leaf green tree frog	Heard (TfNSW)	No	No
Aves	<i>Manorina melanocephala</i>	Noisy Miner	Observed (NGH)	No	No
Insecta	<i>Odonata spp.</i>	Unidentified dragonfly	Observed (TfNSW)	No	No
Aves	<i>Petrochelidon ariel</i>	Fairy Martin	Nest under bridge	No	No
Aves	<i>Phalacrocorax spp.</i>	Cormorant	Observed (TfNSW)	No	No
Reptilia	<i>Phyllurus platurus</i>	Broad-tailed gecko	Observed (archaeologist)	No	No
Mammalia	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	Roadkill (TfNSW)	No	No
Mammalia	<i>Wallabia bicolor</i>	Swamp Wallaby (roadkill)	Scats, tracks	No	No

Appendix B – Habitat Assessment Table

Likelihood of Occurrence Criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area. Based on a field assessment of the habitat constraints or microhabitats on the study area , the habitat is identified as being substantially degraded such that the species is unlikely to utilise the study area (or specific vegetation zones), or an expert report that is prepared that states the species is unlikely to be present on the study area or specific vegetation zones.

To be included in the habitat assessment, the following criteria need to be met:

- the species is known or predicted to occur within the IBRA subregion,
- the species is associated with a PCT identified in the study area,
- the study area meets the native vegetation cover criteria and minimum patch size for the species
- the study area contains any geographic constraints associated with the species
- the study area contains any habitat constraints associated with the occurrence of the threatened species
- past records of the species occur in the study area

Habitat Assessment Table

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
FISH						
<i>Epinephelus daemeli</i> Black Rockcod		V	Adult black cod can grow to 2 m in length and at least 80 kg in weight, but it is more common to see smaller fish (up to 1m/30kg). A large, reef-dwelling, carnivorous grouper species. They are found in warm temperate and subtropical parts of the south-western Pacific, and naturally occurred along the entire NSW coast including Lord Howe Island. Adult black cod are usually found in caves, gutters and beneath bomboras on rocky reefs. They are territorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries. Black cod are opportunistic carnivores, eating mainly other fish and crustaceans. They can change from one colour pattern to another in just a few seconds. They are usually black in estuaries and banded around clear water reefs.		Absent	None
<i>Macquaria australasica</i> Macquarie Perch	E	E	Macquarie perch grow to a maximum size of 400mm. They are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. The conservation status of the different populations is not well known, but there have been long-term declines in their abundance. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries. They are quiet, furtive fish that feed on aquatic insects, crustaceans and molluscs. Sexual maturity occurs at two years for males and three years for females. Macquarie perch spawn in spring or summer in shallow upland streams or flowing parts of rivers. Females produce around 50,000-100,000 eggs which settle among stones and gravel of the stream or river bed. Despite extensive surveys in 2001, it is considered unlikely that there is a population of Macquarie Perch within the Woronora River system (NSW Fisheries 2001).		Present	Low
<i>Prototroctes maraena</i>	E	V	Australian Grayling were historically known to occur in coastal catchments <200 m above sea level (a.s.l), generally in the freshwater, estuarine and marine reaches of south-eastern Australia along New South Wales (NSW), Victoria, Tasmania and South Australia. The majority of past observations		Present	Low

¹ Information sourced from species profiles on NSW OEH's threatened species database or the Australian Government's Species Profiles and Threats database (SPRAT) unless otherwise stated.

OEH threatened species database: <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>

SPRAT: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Australian Grayling			have been from the NSW south coast, from the Shoalhaven River catchment to the Victorian border it has been suggested that the highest recorded NSW abundances occur in the Deua River (Kaminskas pers. comms. in DAWE 2019), emphasising the importance of this river system to the conservation of the species. The Australian Grayling is a diadromous species that spends its larval stages in marine water and its adult life mainly in freshwater. Australian Grayling migrate to brackish waters to spawn and larvae are swept into marine waters, where they spend approximately six months or reach ~45–65 mm long before returning to freshwater. The Shoalhaven River is the only river in the Sydney Basin Bioregion that has been identified as containing an important population (Backhouse <i>et al.</i> 2008).			
AMPHIBIANS & REPTILES						
<i>Caretta caretta</i> Loggerhead Turtle	E	E	The Loggerhead Turtle is a large sea turtle to 1.5 m in length. The shell is an elongated heart-shape, dark brown above and white, cream or yellowish below. The large head is dark brown on top becoming pale at the sides, with darker blotches. Loggerhead Turtles are found in tropical and temperate waters off the Australian coast. In NSW they are seen as far south as Jervis Bay and have been recorded nesting on the NSW north coast and feeding around Sydney.	1	Absent	Low
<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	The Giant Burrowing Frog occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone. It has been found from the coast to the Great Dividing Range. Found in heath, woodland and open forest with sandy soils. Generally lives in the heath or forest and will travel several hundred metres to creeks to breed. Burrows into deep litter or loose soil, emerging to feed or breed after rain. Diet includes ground-dwelling invertebrates such as ants, beetles and spiders. Breeds from August to March and the eggs are laid in a white foam-mass under vegetation in creeks or in yabby holes.	48	Present – rock pools adjacent to Woronora River	Moderate
<i>Hoplocephalus bungaroides</i> Broad-headed Snake	E	V	The Broad-headed Snake is restricted to the Sydney Basin and within a radius of about 200km of Sydney on Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges. Four key distribution areas; Blue Mountains, southern Sydney, an area north west of the Cumberland Plain and the Nowra hinterland. The sites where they occur are typified by exposed sandstone outcrops and benching and in these locations the vegetation is mainly woodland, open woodland and/or heath. They shelter in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. These rocky outcrops typically face north or west. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of	63	Marginal	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			escarpments in summer. Some of the canopy tree species found to regularly co-occur at known sites include <i>Corymbia eximia</i> , <i>C. gummifera</i> , <i>Eucalyptus sieberi</i> and <i>E. piperita</i> . Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Females produce young from January to March. Nocturnal.			
<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	Its former distribution was predominantly coastal but extended inland to the central and southern tablelands, including Bathurst in the west. It was known from the northern coastal part of NSW from around Brunswick Heads south along the entire NSW coast extending into the north-eastern portion of Victoria. There are presently 43 identified remaining key populations, most of which have a small fragmented distribution of mainly near coastal locations. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast. There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing Typha (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Tadpoles feed on algae and other plant-matter; adults eat mainly insects, but also other frogs. Preyed upon by various wading birds and snakes.	3	Marginal	Low – locally extinct (Schulz & Magarey 2012). <i>Gambusia</i> present along the Woronora River.
<i>Litoria littlejohni</i> Littlejohn's Tree Frog	V	V	Occurs in scattered locations between the Watagan Mountains in eastern New South Wales and Buchan in north-east Victoria. It occurs within the Hunter-Central Rivers, Southern Rivers (NSW) and East Gippsland (Victoria) Natural Resource Management Regions. Inhabits forest, coastal woodland and heath from 100 to 950 m above sea level, but is not associated with any specific vegetation types. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground. Breeding is triggered by heavy rain and can potentially occur all year, but is usually from late summer to early spring. Eggs and tadpoles are mostly found in still or slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools.		Marginal	Low
<i>Litoria raniformis</i> Southern Bell Frog		V	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Breeding		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			occurs during the warmer months and is triggered by flooding or a significant rise in water levels. The species has been known to breed anytime from early spring through to late summer/early autumn (Sept to April) following a rise in water levels. During the breeding season animals are found floating amongst aquatic vegetation (especially cumbungi or Common Reeds) within or at the edge of slow-moving streams, marshes, lagoons, lakes, farm dams and rice crops. Outside the breeding season animals disperse away from the water and take shelter beneath ground debris such as fallen timber and bark, rocks, grass clumps and in deep soil cracks.			
<i>Mixophyes balbus</i> Stuttering Frog	E	V	Stuttering Barred Frogs occur along the east coast of Australia from southern Queensland to the north-eastern Victoria. The species has suffered a marked decline in distribution and abundance, particularly in south-east NSW. It is the only <i>Mixophyes</i> species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Feed on insects and smaller frogs. Breed in streams during summer after heavy rain. Eggs are laid on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose.		Marginal	Low
<i>Pseudophryne australis</i> Red-crowned Toadlet	V		The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Eggs are laid in moist leaf litter, from where they are washed by heavy rain; a large proportion of the development of the tadpoles takes place in the egg. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter. Known to inhabit ephemeral and intermittent drainage lines in the locality.	107	Present	High
<i>Varanus rosenbergi</i> Rosenberg's Goanna	V		Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. They are found in heath, open forest and woodland.	33	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<p>Rosenberg's Goanna is associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat, feeding on carrion, birds, eggs, reptiles and small mammals.</p> <p>They shelter in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. The females lay up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds.</p> <p>There is a record of this species near New Illawarra Road compound, however that site is more elevated, with termite mounds present.</p>			
BIRDS						
<p><i>Actitis hypoleucos</i></p> <p>Common Sandpiper</p>		M	<p>A small sandpiper of 19–21 cm in length with a wingspan of 32–35 cm. Breeding plumage of the Common Sandpiper is dark brown above, with a greenish gloss to feathers of cap, hindneck and mantle. Brown colouring is interspersed with irregular barring. Feathers are white underneath. The species has a prominent white eye-ring and indistinct dark eye-stripe from the bill to the rear of the ear coverts. White patches amongst darker feathers on the sides of the breast area are also notable. The species has a long tail that extends behind the wings when at rest, short legs, and a medium length bill. Found along all coastlines of Australia and in many areas inland. The population that migrates to Australia breeds in the Russian far east. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.</p>	2	Marginal	Low
<p><i>Anthochaera phrygia</i></p> <p>Regent Honeyeater</p>	E	CE	<p>The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding</p>	3	Marginal – non-breeding habitat	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<p>areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises <i>E. maculata</i>, <i>E. polyanthemos</i>, <i>E. mollucana</i>, <i>Corymbia robusta</i>, <i>E. crebra</i>, <i>E. caleyi</i>, <i>Corymbia gummifera</i>, <i>E. mckieana</i>, <i>E. macrorhyncha</i>, <i>E. laevopinea</i>, and <i>Angophora floribunda</i>. Nectar and fruit from the mistletoes <i>A. miquelii</i>, <i>A. pendula</i> and <i>A. cambagei</i> are also eaten during the breeding season. When nectar is scarce lerp and honeydew comprise a large proportion of the diet. A shrubby understorey is an important source of insects and nesting material. The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. Also nest in mistletoe haustoria.</p>			
<p><i>Apus pacificus</i> Fork-tailed Swift</p>		M	<p>It has a length of 18–21 cm, a wingspan of 40–42 cm and weighs around 30–40 g. It is a medium-sized Swift, with a slim body with long scythe-shaped wings that taper to finely pointed tips. It is characterized by a long and deeply forked tail. There is also a white patch on the chin and throat. In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal</p>	5	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			sand-dunes. The Fork-tailed Swift usually arrives in Australia around October and leaves southern Australia from mid-April. Breeds in siberia.			
<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	V		Found in open forests/woodlands; timbered paddocks; coastal/sub-inland scrubs; golf courses, orchards, roadside timber and street trees. Ranging from eastern Australia to Tasmania; from Atherton Tableland to Kangaroo Island and Bright coast (SA); in WA, from Bright coast inland to c. Menzies-Paynes Find west to Moora. Summer breeding to upper Flinders R.-Windorah (q)l Paroo R. - Broken Hill (NSW)l Flinders Ras. - Kingoonya - Cook (SA).	22	Marginal	Moderate
<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	In NSW, this species occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. Occurs in permanent freshwater wetlands with tall, dense vegetation. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. <i>Phragmites</i> , <i>Cyperus</i> , <i>Eleocharis</i> , <i>Juncus</i> , <i>Typha</i> , <i>Baumea</i> , , <i>Bolboschoenus</i>) or cutting grass (<i>Gahnia</i>) growing over muddy or peaty substrate. Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch. In Australia, the Bittern occurs with the Australian Painted Snipe <i>Rostratula benghalensis australis</i> .		Marginal	Moderate
<i>Burhinus grallarius</i> Bush Stone-curlew	E		The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. The species is largely nocturnal, being especially active on moonlit nights.	3	Absent	Low
<i>Calidris acuminata</i> Sharp-tailed Sandpiper		M	The Sharp-tailed Sandpiper is found throughout most of Australia and mostly found in the wetlands of Victoria, South-western New South Wales and eastern South Australia. This species prefers non-tidal wetlands, especially freshly exposed mudflats in drying lakes and on intertidal mudflats. This species feeds in mud or shallow water from saline wetlands to freshwater wetlands and therefore eats a variety of food, including aquatic and terrestrial insects, small shellfish and grass seeds and polychaete worms.	1	Absent	Low
<i>Calidris canutus</i> Red Knot		E, M	Breeding in the Arctic Circle between August and April, it visits Australian shores in large numbers and frequents coastal sand flats and the margins of estuaries and rivers. It feeds in close-packed flocks that move in unison.		Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Calidris ferruginea</i> Curlew Sandpiper		CE, M	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. This species does not breed in Australia. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds.		Absent	Low
<i>Calidris melanotos</i> Pectoral Sandpiper		M	This species breeds in high-arctic tundra from the Yamal Peninsula eastwards to the Bearing Strait in Siberia and in arctic Alaska and Canada. It is known to migrate mostly through the USA and Mexico and spends most of its non-breeding months in South America. A small number of these birds are known to reach Australia and are believed to be concentrated in south-eastern Australia. This species prefers freshwater mudflats.		Absent	Low
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V		The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. May also occur in sub-alpine Snow Gum <i>Eucalyptus pauciflora</i> woodland and occasionally in temperate rainforests. Moves to lower altitudes in winter, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Favours old growth attributes for nesting and roosting.	6	Marginal	Low
<i>Calyptorhynchus lathami</i> Glossy Black- Cockatoo	V		The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Dependent on large hollow-bearing eucalypts for nest sites. One or two eggs are laid between March and August. Inhabits open forest and woodlands of the coast and the Great Dividing	7	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur. In the Riverina area, inhabits open woodlands dominated by Belah (<i>Casuarina cristata</i>). Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill.			
<i>Chthonicola sagittata</i> Speckled Warbler	V		<p>The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.</p> <p>The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees.</p> <p>Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding.</p> <p>The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.</p> <p>A clutch of 3-4 eggs is laid, between August and January, and both parents feed the nestlings. The eggs are a glossy red-brown, giving rise to the unusual folk names 'Blood Tit' and 'Chocolatebird'.</p> <p>Some cooperative breeding occurs. The species may act as host to the Black-eared Cuckoo.</p> <p>Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellow-rumped, Buff-rumped, Brown and Striated Thornbills.</p>	7	Marginal	Low
<i>Circus assimilis</i> Spotted Harrier	V		The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. They occur in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is	2	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (eg bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.			
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies)	V		The Brown Treecreeper, Australia's largest treecreeper, is a grey-brown bird with black streaking on the lower breast and belly and black bars on the undertail. Pale buff bands across the flight feathers are obvious in flight. The face is pale, with a dark line through the eye, and a dark crown. Sexes differ slightly in all plumages, with small patches of black and white streaking on the centre of the uppermost breast on males, while the females exhibit a rufous and white streaking. Juveniles differ from adults mainly by the pattern of the under-body, and by their a pale bill and gape. Subspecies victoriae is distinguished from subspecies picumnus by colour differences on the face, body and tail markings. The two subspecies grade into each other through central NSW. Individuals are active, noisy and conspicuous, and give a loud 'pink' call, often repeated in contact, and sometimes given in a series of 5 - 10 descending notes. Breeds from July to Feb across its range. The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. The western boundary of the range of <i>Climacteris picumnus victoriae</i> runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper <i>Climacteris picumnus picumnus</i> which then occupies the remaining parts of the state. The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. The population density of this subspecies has been greatly reduced over much of its range, with major declines recorded in central NSW and the northern and southern tablelands. Declines have occurred in remnant vegetation fragments smaller than 300 hectares, that have been isolated or fragmented for more than 50 years.	1	Marginal	Low
<i>Daphoenositta chrysoptera</i> Varied Sittella	V		The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. The Varied Sittella	32	Marginal	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Foraging and nesting habitat present within study area in woodlands and forests with rough barked trees. Species is generally sedentary and has been recorded nearby.			
<i>Dasyornis brachypterus</i> Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. The estimated population size is less than 2000 individuals occupying a total area of about 120 sq km. There are now only four populations in the southern Queensland/northern NSW area with a total of 35 birds, compared to 15 years ago when 14 populations and 154 birds were recorded. This population once extended as far south as at least Dorrigo and has recently been identified as a separate ultrataxon (<i>monoides</i>) but further research is being undertaken to determine the validity of this. The remaining populations are the nominate ultrataxon (<i>brachypterus</i>) and once extended at least to what is now the Sydney urban area. The Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. The southern population in Nadgee Nature Reserve and Howe's Flat is around 200 birds. Further surveys are required in parts of Ben Boyd National Park and Sydney Catchment Authority lands to determine whether further populations of the Eastern Bristlebird occur in these areas. Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously. Shy and cryptic and rarely flies, although can be seen scampering over the ground; when approached, may move to a lookout perch 1 m or more above the ground, then retreat into dense vegetation. Feeds on a variety of insects, particularly ants. Nests are elliptical domes constructed on or near the ground amongst dense vegetation. Suitable habitat is present in upland swamps and heaths.	1	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<p><i>Epthianura albifrons</i> White-fronted Chat population in the Sydney Metropolitan Catchment Management Area</p>	V		<p>In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly. The nearest extant populations outside Sydney Metropolitan CMA are at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong. White-fronted Chats were previously recorded at Penrith Lakes (2001), Hawkesbury Swamps (2002), Tuggerah Lake (1997) and Lake Macquarie (1998). Regularly observed in the saltmarsh of Newington Nature Reserve (with occasional sightings from other parts of Sydney Olympic Park and in grassland on the northern bank of the Parramatta River). Current estimates suggest this population consists of 8 individuals. Regularly observed in the saltmarsh and on the sandy shoreline of a small island of Towra Point Nature Reserve. This population is estimated to comprise 19-50 individuals.</p> <p>The Newington and Towra Point populations are thought to be disjunct from each other (and from the nearest populations outside Sydney Metropolitan CMA). Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).</p>	3	Marginal	Low
<p><i>Falco hypoleucos</i> Grey Falcon</p>	E	V	<p>The Grey Falcon is a medium-sized, compact, pale falcon with a heavy, thick-set, deep-chested appearance. It is smaller than the Peregrine Falcon but similar in shape and flight, although with longer wings. Upperparts are uniform light grey, shading to blackish on the primaries, forming conspicuous dark wing tips. The tail has narrow blackish bars. The chin, throat and cheeks are white, and the rest of the underbody is pale grey. The eye-ring, cere and base of the bill are bright orange-yellow, and the tip of the bill black. The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range. There are possibly less than 5000</p>		Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			individuals left. Population trends are unclear, though it is believed to be extinct in areas with more than 500mm rainfall in NSW.			
<i>Gallinago hardwickii</i> Latham's Snipe		M	Latham's Snipe is a medium sized wader, and the largest snipe in Australia, with a length of 29-33 cm, a wingspan of 50-54 cm Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia. occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). known to occur in the upland wetlands of the New England Tablelands and Monaro Plateau.	22	Marginal	Low
<i>Glossopsitta porphyrocephala</i> Purple-crowned Lorikeet	V		"A small (17 - 18.5cm) parrot. Upper parts are bright green, with a wash of bronze across the nape and mantle, while underparts are greenish-yellow with a pale blue belly. The crown is purple, appearing black in the field while the ear coverts and forehead are orange-yellow. The bend of the wing is narrowly edged bright blue while the underwing coverts are bright red and obvious in flight. They are more often heard than seen, calling often in flight. The call is a high-pitched slightly metallic 'tziet, tziet, tziet'. It occurs across the southern parts of the continent from Victoria to south-west Western Australia. It is uncommon in NSW, with records scattered across the box-ironbark woodlands of the Riverina and south west slopes, the River Red Gum forests and mallee of the Murray Valley as far west as the South Australian border, and, more rarely, the forests of the South Coast. The species is nomadic and most, if not all, records from NSW are associated with flowering events. It is found in open forests and woodlands, particularly where there are large flowering eucalypts. Also recorded from mallee habitats. It feeds primarily on nectar and pollen of flowering Eucalypts, including planted trees in urban areas. It breeds away from feeding areas, utilising hollow branches or holes in trees. Also roosts in dense vegetation up to several kilometres away from feeding areas."	1	Absent	Low
<i>Glossopsitta pusilla</i> Little Lorikeet	V		The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering	25	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like <i>Allocasuarina</i> . Nesting season extends from May to September.			
<i>Grantiella picta</i> Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> . Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.		Marginal	Low
<i>Haematopus fuliginosus</i> Sooty Oystercatcher	V		Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations. The species favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.	2	Absent	Low
<i>Haematopus longirostris</i> Pied Oystercatcher	E		The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. 'Pied' Oystercatchers are occasionally recorded on Lord Howe island but it is uncertain which species is involved. The species favours intertidal flats of inlets and bays, open beaches and sandbanks.	4	Absent	Low
<i>Haliaeetus leucogaster</i>	V	M	White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. Birds form permanent pairs that inhabit territories	36	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
White-bellied Sea-Eagle			throughout the year. Their loud “goose-like” honking call is a familiar sound, particularly during the breeding season. Birds are normally seen, perched high in a tree, or soaring over waterways and adjacent land. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India. The White-bellied Sea-Eagle feeds mainly off aquatic animals, such as fish, turtles and sea snakes, but it takes birds and mammals as well. It is a skilled hunter, and will attack prey up to the size of a swan. Sea-Eagles also feed on carrion (dead prey) such as sheep and fish along the waterline. They harass smaller birds, forcing them to drop any food that they are carrying. Sea-Eagles feed alone, in pairs or in family groups. White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession. The nest can be located in a tree up to 30m above the ground, but may be also be placed on the ground or on rocks, where there are no suitable trees. At the start of the breeding season (May to October), the nest is lined with fresh green leaves and twigs. The female carries out most of the incubation of the two white eggs, but the male performs this duty from time to time.			
<i>Hieraaetus morphnoides</i> Little Eagle	V		The Little Eagle is a medium-sized bird of prey that is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Lays two or three eggs during spring, and young fledge in early summer. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.	9	Marginal	Low
<i>Hirundapus caudacutus</i> White-throated Needletail		V, M	White-throated Needletails often occur in large numbers over eastern and northern Australia. They arrive in Australia from their breeding grounds in the northern hemisphere in about October each year and leave somewhere between May and August. They are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees, and radio-tracking has since confirmed that this is a regular activity. The White-throated Needletail feeds on flying insects, such as termites, ants, beetles and flies. They catch the insects in flight in their wide gaping beaks. Birds usually feed in rising thermal currents associated with storm fronts and bushfires and they are commonly seen moving with wind fronts. White-throated Needletails are non-breeding migrants in Australia.	18	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Hydroprogne caspia</i> Caspian Tern		M	<p>"The largest tern in Australia, the Caspian Tern has long, slender backswept wings and a slightly forked tail. The heavy bill is red with a dusky tip. The sexes are similar, with a body length between 53 and 60 centimetres long, and an average weight of 680 grams (Higgins & Davis 1996).</p> <p>The Caspian Tern has a white body, with a black and white streaked crown from bill to nape and a short shaggy crest. The mantle and upperwings are grey and the flight feathers are darker. The eye is dark brown and legs are black (Higgins & Davis 1996). When breeding, the crown is black. Immature birds are similar to non-breeding adults. Younger birds are mottled grey and brown (Birds Australia 2010a).</p> <p>This species is gregarious when breeding, though single nesting does occur. Outside of breeding, the Caspian Tern occurs mostly singly or in small groups. Occasional larger groups of 30 or more birds are seen, often at rich fishing areas or at nightly roost sites, where they may roost with other terns. The species may also aggregate into flocks on passage (migration) (Higgins & Davies 1996).</p> <p>Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat "</p>	4	Absent	Low
<i>Ixobrychus flavicollis</i> Black Bittern	V		<p>Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. When disturbed, freezes in a characteristic bittern posture (stretched tall, bill pointing up, so that shape and streaked pattern blend with upright stems of reeds), or will fly up to a branch or flush for cover where it will freeze again. Generally solitary, but occurs in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young.</p>	2	Marginal	Low
<i>Lathamus discolor</i> Swift Parrot	E	CE, M	<p>Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where</p>	9	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . These were not observed in the project area. Commonly used lerp infested trees include Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> . Return to home foraging sites on a cyclic basis depending on food availability.			
<i>Limicola falcinellus</i> Broad-billed Sandpiper	V	M	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	2	Absent	Low
<i>Limosa lapponica</i> Bar-tailed Godwit		M	Bar-tailed Godwits arrive in Australia each year in August from breeding grounds in the northern hemisphere. Birds are more numerous in northern Australia. Bar-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large flocks and in the company of other waders.	5	Absent	Low
<i>Lophoictinia isura</i> Square-tailed Kite	V		"The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland."	7	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Lophochroa leadbeateri</i> Major Mitchell's Cockatoo	V		An unmistakable cockatoo of the dry inland, Major Mitchell's Cockatoo is the only Australian cockatoo that is salmon-pink below and white above. It is also called the Pink Cockatoo, and until recently was listed under the name of <i>Cacatua leadbeateri</i> . It is smaller than the Sulphur-crested Cockatoo <i>C. galerita</i> , but slightly larger than a Galah <i>Eolophus roseicapillus</i> . Its most prominent feature is its large white-tipped crest that is banded in red and gold. Its call is a distinctive stammering whinny. Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and about Jurien. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east than that.	1	Marginal	Low
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater (eastern subspecies)	V		The eastern subspecies extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. The birds occupy mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). They also inhabit open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. A gregarious species usually seen in pairs and small groups of up to 12 birds. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares. The species breeds solitarily or co-operatively, with up to five or six adults, from June to December. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage. It is a compact, suspended, cup-shaped nest.	4	Marginal	Low
<i>Monarcha melanopsis</i> Black-faced Monarch		M	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. The Black-faced		Present	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Monarch forages for insects among foliage, or catches flying insects on the wing. The Black-faced Monarch builds a deep cup nest of casuarina needles, bark, roots, moss and spider web in the fork of a tree, about 3 m to 6 m above the ground. Only the female builds the nest, but both sexes incubate the eggs and feed the young.			
<i>Monarcha trivirgatus</i> Spectacled Monarch		M	Has a very large range. Populate the north-east and east coast of Australia during their breeding season. In winter the southern races migrate northwards. During the breeding season, found along the east coast and the eastern slopes of the ranges from the Hunter estuary in NSW up to about the Whitsundays, QLD. Spectacled Monarchs can usually be found in wet forest and mangroves.		Absent	Low
<i>Motacilla flava</i> Yellow Wagtail		M	The Yellow Wagtail is a regular wet season visitor to northern Australia. Increasing records in NSW suggest this species is an occasional but regular summer visitor to the Hunter River region. The species is considered a vagrant to Victoria, South Australia and southern Western Australia. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.		Absent	Low
<i>Myiagra cyanoleuca</i> Satin Flycatcher		M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. The Satin Flycatcher is a migratory species, moving northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring. The Satin Flycatcher takes insects on the wing, foraging actively from perches in the mid to upper canopy.		Marginal	Low
<i>Neophema chrysogaster</i> Orange-bellied Parrot		CE	On the mainland, the Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire hermland or taller coastal shrubland. Recent records from unexpected places, including Shellharbour and Maroubra suggest that the species may be expanding their selection of habitats and foraging plant		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			species. Birds seen in NSW in 2003 were foraging on weed species several hundred metres from the coast.			
<i>Neophema pulchella</i> Turquoise Parrot	V		The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	1	Marginal	Low
<i>Ninox strenua</i> Powerful Owl	V		The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW the Powerful Owl lives in forests and woodlands occurring in the coastal, escarpment, tablelands and western slopes environments. Specific habitat requirements include eucalypt forests and woodlands on productive sites on gentle terrain; a mosaic of moist and dry types, with mesic gullies and permanent streams; presence of leafy sub-canopy trees or tall shrubs for roosting; presence of large old trees to provide nest hollows. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials. Roosts in groves of dense mid-canopy trees or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines, but also adjacent to cliff faces and below dry waterfalls. Species commonly used for roosting include the She-oaks <i>Allocasuarina</i> spp., rainforest species such as Coachwood <i>Ceratopetalum apetalum</i> , Lilly Pilly <i>Acmena smithii</i> and Sassafras <i>Doryphora sassafras</i> , Black Wattle <i>Acacia melanoxylon</i> , Turpentine <i>Syncarpia glomulifera</i> and eucalypts. Roosting sites are commonly among small groves of up to 2 ha of similar-sized trees with dense foliage in the height range 3-15 m. Nests in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines, with hollows greater than 45 cm diameter and greater than 100 cm deep; surrounded by canopy trees and subcanopy or understorey trees or tall shrubs. Hollow entrances are greater than 6 m above ground, commonly more than 20 m where the forest permits, in trees of at least 80 cm diameter at breast height. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters. Nesting occurs from late autumn to mid-winter, but is slightly earlier in north-eastern NSW (late summer – mid autumn). The Powerful Owl is highly sensitive to nest disturbance during the egg and chick stages and will readily abandon the nest if disturbed. Home range has been estimated as 300-1500 ha according to habitat productivity. Moist forest in unlogged corridors in gully systems is used for nesting and roosting, and also	1057	Present	High

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			preferentially for foraging although much foraging is also conducted in dry and regrowth forest. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider.			
<i>Numenius phaeopus</i> Whimbrel		M	Whimbrels are common across northern Australia and uncommon to rare further south. They breed in central Siberia to Iceland. The subspecies <i>variegatus</i> is the one mainly found in Australia and also the Bay of Bengal through to Melanesia, Micronesia and to New Zealand in small numbers. Whimbrels are found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores. Whimbrels are migratory, moving north from Australia to breed in the northern hemisphere, leaving the north and north east coasts by late April. On return to Australia, they move down the coast of east Asia, leaving the breeding areas in July, along the East Asian-Australasian Flyway, arriving in the north of Australia from August to October, then moving southwards along the east coast. Small numbers over-winter in Australia and there is some local movement	2	Absent	Low
<i>Numenius madagascariensis</i> Eastern Curlew		CE, M	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The Eastern Curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline. The Eastern Curlew roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. It occasionally roosts on reef-flats, in the shallow water of lagoons and other near-coastal wetlands.	9	Marginal	Low
<i>Pachyptila turtur subantarctica</i> Fairy Prion (southern)		V	The fairy prion (southern) breeds on Macquarie Island and a number of other subantarctic islands outside of Australia. There are 80 to 250 breeding pairs in Australia and a global population of 80 000. In Australia, breeding is recorded on two rock stacks off Macquarie Island and on the nearby Bishop and Clerk Island. The population may have been larger prior to the arrival of black rats on Macquarie Island. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Feeds by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter		Absent	Low
<i>Pandion cristatus</i>	V		Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species also favours	15	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Eastern Osprey			coastal areas, especially the mouths of large rivers, lagoons and lakes. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.			
<i>Petroica boodang</i> Scarlet Robin	V		The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees. The Scarlet Robin is a quiet and unobtrusive species which is often quite tame and easily approached. Birds forage from low perches, fence-posts or on the ground, from where they pounce on small insects and other invertebrates which are taken from the ground, or off tree trunks and logs; they sometimes forage in the shrub or canopy layer. Scarlet Robin pairs defend a breeding territory and mainly breed between the months of July and January; they may raise two or three broods in each season. This species' nest is an open cup made of plant fibres and cobwebs and is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub. Eggs are pale greenish-, bluish- or brownish-white, spotted with brown; clutch size ranges from one to four. Birds usually occur singly or in pairs, occasionally in small family parties; pairs stay together year-round. In autumn and winter, the Scarlet Robin joins mixed flocks of other small insectivorous birds which forage through dry forests and woodlands.	1	Marginal	Low
<i>Petroica phoenicea</i> Flame Robin	V		The Flame Robin is a small Australian robin that reaches 14 cm in length. The male has a dark grey head and upperparts, a small white forehead patch, and white wing stripes and white tail-edges. The male has a bright orange-red throat, breast and upper-belly. The lower belly is white. The female is brown, darker above, and has a whitish throat and lower belly. The	1	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			whitish mark on the female's forehead is inconspicuous. Female Flame Robins also have white and buffish marked wings and tail. Immature males resemble females. The main call of the Flame Robin is a thin, pretty, piping descending song. The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands.			
<i>Petroica rodinogaster</i> Pink Robin	V		The male Pink Robin has a sooty black throat and upperparts. The wings have faint, tan-buff wing-bars. The breast and belly are deep lilac-pink, and there is a small white patch on the forehead. The tail is plain, making this species the only 'red' robin with no white markings on the tail. It differs from the similar, and more common Rose Robin <i>Petroica rosea</i> , which is dark grey above, with a deeper rose-pink breast and white belly, and white outer tail feathers. The female has warm olive-brown upperparts and cinnamon-buff underparts, a buff forehead spot, and may have a slight pink wash on the breast. The chestnut-buff wings and the absence of white in the tail, distinguishes the female from all other female robins. The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW.	2	Marginal	Low
<i>Pezoporus wallicus wallicus</i> Eastern Ground Parrot	V		The Ground Parrot is a stunningly beautiful bird. It is a distinctive, bright grass-green, long-tailed, ground-dwelling parrot of the coastal and sub-coastal heaths, reaching 30 cm long. The green upperparts are heavily mottled with yellow and black, and the greenish-yellow underparts are barred brown. Sexes are alike. The forehead of individuals older than three or four months is orange-red. This species has a distinctive call, given at dawn and dusk, that consists of a series of piercing, resonating whistles, rising in steps, with each note flowing on almost unbroken, but abruptly higher than the preceding note. The species is rarely seen unless flushed, although birds can be seen fluttering low over heath at dusk. There are three recognised subspecies of the Ground Parrot in Australia, though the subspecies in Tasmania (<i>leachii</i>) is not always recognised. Recently, the possibility that the western subspecies (<i>flaviventris</i>) may be a separate species has been raised. The eastern subspecies (<i>wallicus</i>) inhabits south-eastern Australia from southern Queensland through NSW to western Victoria. It formerly occurred in South Australia, but was last recorded in 1945. In NSW	1	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			populations have declined and contracted to islands of coastal or subcoastal heathland and sedgeland habitats. The species is found in relatively large numbers on the north coast (Broadwater, Bundjalung, Yuraygir and Limeburners Creek NPs) and in smaller numbers at Myall Lakes on the central coast. There are also large populations on the NSW south coast, particularly Barren Grounds NR, Budderoo NP, the Jervis Bay area and Nadgee NR. Small numbers are recorded at Morton and Ben Boyd NP and other areas on the south coast. Estimated population size is about 2000 birds.			
<i>Pluvialis fulva</i> Pacific Golden Plover		M	Within Australia, the Pacific Golden Plover is widespread in coastal regions, though there are also a number of inland records (in all states), sometimes far inland and usually along major river systems, especially the Murray and Darling Rivers and their tributaries. Most Pacific Golden Plovers occur along the east coast, and are especially widespread along the Queensland and NSW coastlines. Elsewhere, they are recorded at scattered sites in the south-east, with most records in Victoria along the coast between Jack Smith Lake (south of Sale) and the Bellarine Peninsula, including Western Port and Port Phillip Bay.	1	Absent	Low
<i>Pluvialis squatarola</i> Grey Plover		M	The Grey Plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia, mostly to the west and south coasts. It is generally sparse but not uncommon in some areas. It is occasionally found inland. It is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts.	1	Absent	Low
<i>Ptilinopus regina</i> Rose-crowned Fruit-dove	V		"Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. They are shy pigeons, not easy to see amongst the foliage, and are more often heard than seen. They feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits. Some populations are migratory in response to food availability - numbers in north-east NSW increase during spring and summer then decline in April or May."	1	Absent	Low
<i>Ptilinopus superbus</i>	V		Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may	2	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Superb Fruit-dove			also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn. Breeding takes place from September to January. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species. The male incubates the single egg by day, the female incubates at night.			
<i>Puffinus assimilis</i> Little Shearwater	V		A small shearwater, bluish black above and chalky white below, with a white face and white underwings with narrow black margins. Bill short, slender and grey-black, legs bright cobalt-blue with black markings, feet pale bluish with webs tending to be flesh coloured, eyes brown. A widespread species in the subtropical Atlantic, Pacific and Indian Oceans. Lord Howe Island has one of the larger breeding colonies in the Australian region.	2	Absent	Low
<i>Rhipidura rufifrons</i> Rufous Fantail		M	The Rufous Fantail is found in northern and eastern coastal Australia, being more common in the north. It is also found in New Guinea, the Solomon Islands, Sulawesi and Guam. The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas. Strongly migratory in the south of its range, it moves northwards in winter, and virtually disappears from Victoria and New South Wales at this time. The Rufous Fantail feeds on insects, which it gleans from the middle and lower levels of the canopy. It is a very active feeder and constantly fans tail and flicks wings and body while foraging. The Rufous Fantail builds a small compact cup nest, of fine grasses bound with spider webs, that is suspended from a tree fork about 5 m from the ground. The bottom of the nest is drawn out into a long stem.	1 (NGH 2017)	Present	High
<i>Rostratula australis</i> Australian Painted Snipe	E	E	Little is known of the ecology, habitat requirements and reproductive biology of Australian Painted Snipe. They feed in shallow water or at the waters' edge and on mudflats, taking seeds and invertebrates such as insects, worms, molluscs and crustaceans. Females, which are larger and more brightly coloured than males, are thought to sometimes be polyandrous, mating with several males and leaving each one to incubate and raise chicks. They lay 3-4 eggs per clutch and incubation lasts about 15-16 days. Most records of Australian Painted Snipe are from temporary or infrequently filled freshwater wetlands and although they have occurred at many sites, no site can be identified in which they are resident or regular in occurrence. This may suggest the species is nomadic but the extent to which its cryptic		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			behaviour may contribute to this belief is uncertain. The birds are able to remain hidden in rank vegetation, but many reports are of birds not being secretive, but rather still and unobtrusive. Primarily occurs along the east coast from north Queensland (excluding Cape York) to the Eyre Peninsula in South Australia, including the majority of Victoria and NSW. In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Inhabits inland and coastal shallow freshwater wetlands. The species occurs in both ephemeral and permanent wetlands, particularly where there is a cover of vegetation, including grasses, Lignum and Samphire. Individuals have also been known to use artificial habitats, such as sewage ponds, dams and waterlogged grassland. Nests on the ground amongst tall vegetation, such as grass tussocks or reeds. Forages nocturnally on mud flats and in shallow water. Breeding is often in response to local conditions; generally occurs from September to December.			
<i>Stagonopleura guttata</i> Diamond Firetail	V		The Diamond Firetail is a large (length 10 to 12 cm, weight 17 grams), striking finch with a bright red bill, and red eyes and rump. The white throat and lower breast are separated by a broad black breast-band that extends into the strongly white-spotted, black flanks. It has a grey back and head, and ashy-brown wings. The call is a plaintive, drawn-out, nasal 'twoo-wheee'. Flight is low and direct, with slight undulations. Given good views it should not be confused with any other species. The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River.	1	Absent	Low
<i>Sternula nereis nereis</i> Australian Fairy Tern		V	The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.		Marginal	Low
<i>Thalasseus bergii</i> Crested Tern		M	The Greater Crested Tern (<i>Thalasseus bergii</i>) is a seabird in the tern family which nests in dense colonies on coastlines and islands in the tropical and subtropical Old World. Its five subspecies breed in the area from South Africa around the Indian Ocean to the central Pacific and Australia, all populations dispersing widely from the breeding range after nesting.	11	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Tringa nebularia</i> Common Greenshank		M	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia. In NSW, the species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions.	1	Absent	Low
<i>Tyto longimembris</i> Eastern Grass Owl	V		The Eastern Grass Owl is a medium-sized, ground-dwelling bird (35 cm) with a facial disc typical of the Tyto owls. The upperparts are dark brown, buff and yellow-orange, with fine silvery spots. Underparts are white in the male, and buffy in the larger female, with sparse dark spots. The long legs are mostly bare and in flight protrude well beyond the tail, distinguishing the Eastern Grass Owl from the similar Barn Owl. When roosting the posture is tall and upright. The main call is similar to a Barn Owl - a hoarse, wavering reedy screech 'sk-air' or 'skee-air'. They also use a thin, quavering whistle that can be heard by clicking the icon above. [Note: The Grass Owl <i>T. capensis</i> has been split into two species and the Australian species is now known as the Eastern Grass Owl <i>Tyto longimembris</i> .] Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.	1	Absent	Low
<i>Tyto novaehollandiae</i> Masked Owl	V		Extends from the coast where it is most abundant to the western plains. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. Habitat for this species is also widespread throughout the dry eucalypt forests of the tablelands, western slopes and the undulating wet-dry forests of the coast. Optimal habitat includes an open understorey and a mosaic of sparse (grassy) and dense (shrubby) ground cover on gentle terrain. Roosts in hollows in live or occasionally dead eucalypts; dense foliage in gullies; and caves. Nest in old hollow eucalypts, live or dead, in a variety of topographic positions, with hollows greater than 40 cm wide and greater than 100 cm deep. Hollow entrances are at least 3 m above ground, in trees of at least 90 cm diameter at breast height. A specialist predator of terrestrial mammals, particularly native rodents. Home range has been estimated as 400-1000 ha according to habitat productivity.	29	Marginal	Low
<i>Tyto tenebricosa</i> Sooty Owl	V		Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	73	Present	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>) or Sugar Glider (<i>Petaurus breviceps</i>). Nests in very large tree-hollows.			
<i>Xenus cinereus</i> Terek Sandpiper	V		In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Generally roosts communally amongst mangroves or dead trees, often with related wader species. Breaks up into smaller flocks or even solitary birds when feeding in open intertidal mudflats. “	1	Marginal	Low
INVERTEBRATES						
<i>Austrocordulia leonardi</i> Sydney Hawk Dragonfly	E		The known distribution of the species includes three locations in a small area south of Sydney, from Audley to Picton. The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages. The type locality is a deep pool above the weir at Heathcote in the Woronora River. Most of the life cycle of this species is spent as an aquatic larva, while adults are present for only a few weeks. This species appears to have specific habitat requirements, including slow-flowing water in rocky rivers with steep sides that provide shady resting areas. All specimens collected came from deep riverine pools with cooler water (along the Woronora River, Kangaroo Creek and Nepean River). Intensive surveys by Theischinger and colleagues (Theischinger, pers. comm.) over the last two years have failed to detect the presence of any of the life stages of <i>Austrocordulia leonardi</i> along the Woronora River and Kangaroo Creek.		Present	Moderate
<i>Menippus darcyi</i> Menippus darcyi population in the Sutherland Shire	E		A small, light green, chrysomelid beetle. The adults are approximately 5 mm in length. Confined to Grays Point Reserves, Grays Point, Sutherland Shire. This species has been recorded from only three locations in Australia: Lord Howe Island, coastal North Queensland and Grays Point Reserve (0.8 h in size), adjacent to Port Hacking in southern Sydney.	1	Marginal	Low
<i>Meridolum corneovirens</i> Cumberland Plain Land Snail	E		Superficially similar to the familiar exotic Garden Snail (<i>Helix aspera</i>). It differs most obviously in its 25 - 30 mm diameter shell. While this shell may be almost any shade of brown, it is always uniform in colour, while that of <i>Helix</i> consists of dark patches on a pale background. A green or yellow tinge may be present. The Cumberland Land Snail also has a more flattened shell that is very thin and fragile, compared with the thick shell of the Garden Snail. The under side of the shell, especially in living individuals, tends to have a	33	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			glossy appearance and is semitransparent, enabling the observer to see the animal colour and some internal organs. The upper side of the shell has a coarse wrinkly appearance. In adult shells the edge of the aperture is reflected, forming a slight lip. This is typically white in colour. However, the feature is absent in both juvenile and sub-adult individuals. The juveniles have a more angular shell and tend to have an open area in the central part of the underside of the shell, known as the umbilicus. Generally, in adults the umbilicus is closed or partially covered. Sometimes there is a reddish brown patch around the umbilical area. Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. known from over 100 different locations, but not all are currently occupied, and they are usually isolated from each other as a result of land use patterns.			
<i>Petalura gigantea</i> Giant Dragonfly	E		The Giant Dragonfly is the third largest dragonfly in Australia and one of the largest dragonflies in the world. Males have an abdomen length of 6 - 7.5 cm, a wingspan up to 11 cm and petal-shaped claspers at the end of the abdomen. Females have an abdomen length of 8 - 9.5 cm and a wingspan up to 12.5 cm, and no claspers. Both sexes have widely-spaced eyes and have a predominantly brownish-black segmented body with light yellow markings along the back and sides. The larvae are also very large, up to 5 cm in length. When the dragonflies emerge from the larvae, they leave behind characteristics shells (exuviae). The Giant Dragonfly is found along the east coast of NSW from the Victorian border to northern NSW. It is not found west of the Great Dividing Range. There are known occurrences in the Blue Mountains and Southern Highlands, in the Clarence River catchment, and on a few coastal swamps from north of Coffs Harbour to Nadgee in the south.	1	Marginal	Low
<i>Synemon plana</i> Golden Sun Moth	E	CE	<i>Synemon plana</i> is found in naturally treeless grassland, and occasionally in secondary grassland, dominated by <i>Danthonia carphoides</i> in the ACT and NSW, and by other <i>Danthonia</i> spp. in Victoria. Adult <i>Synemon plana</i> are active from about mid November to early January. Individuals live only a few days. Males fly rapidly in the heat of the day but females are relatively immobile. They are unable to feed or drink and so must mate and lay eggs rapidly. Eggs are laid between tillers of <i>Danthonia</i> or between tillers and the soil. Larvae feed on underground parts of the <i>Danthonia</i> . The length of the larval stage is unknown but the most likely estimate is about two years. The larvae remain underground and pupate underground after preparing tunnels to the surface, through which the pupae can escape. The pupal stage probably lasts for about 6 weeks.		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<i>Synemon plana</i> is currently known from five sites in Victoria, seven small and one large site in the ACT and a single site in New South Wales.			
MAMMALS						
<i>Cercartetus nanus</i> Eastern Pygmy-possum	V		Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Appear to be mainly solitary, each individual using several nests, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares. Young can be born whenever food sources are available, however most births occur between late spring and early autumn. Agile climbers, but can be caught on the ground in traps, pitfalls or postholes; generally nocturnal. Frequently spends time in torpor especially in winter, with body curled, ears folded and internal temperature close to the surroundings.	89	Present	Moderate
<i>Chalinolobus dwyeri</i> Large-eared Bat	V	V	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Hirundo ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. Found in well-timbered areas containing gullies. This species probably forages for small, flying insects below the forest canopy. Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring.	16	Marginal	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Dasyurus maculatus maculatus</i> Spotted-tailed Quoll	V	E	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground. The home-range of this species is unknown, but estimates are between 800ha and 20km ² . Usually traverse their ranges along densely vegetated creeklines. They need suitable den sites and abundant food, requiring large areas of intact vegetation for foraging. Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; latrine sites can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.	5	Marginal	Low – deemed a rare visitor
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V		The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer.	25	Marginal	Low
<i>Isoodon obesulus obesulus</i> Southern Brown Bandicoot	E	E	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Males have a home range of approximately 5-20 hectares whilst females forage over smaller areas of about 2-3 hectares. Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees <i>Xanthorrhoea</i> sp., blackberry bushes and other shrubs, or in rabbit burrows. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest. Mating occurs any time of the year, usually following heavy rain. Two or three litters of 2-4 young may be produced annually. The gestation period of 11-12 days is the shortest known of any		Marginal	Low – locally extinct (DECCW 2011)

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			marsupial while young remarkably become independent around 60 days after being born.			
<i>Micronomus norfolkensis</i> Eastern Coastal Free-tailed Bat	V		The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane. Freetail-bats are also known as mastiff-bats, having hairless faces with wrinkled lips and triangular ears. They weigh up to 10 grams. The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. They occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.	6	Marginal	Low
<i>Miniopterus australis</i> Little Bent-winged Bat	V		Moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats (<i>M. schreibersii</i>) and appears to depend on the large colony to provide the high temperatures needed to rear its young.	8	Marginal	Low
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	V		This species has recently been renamed to <i>Miniopterus orianae oceanensis</i> or the large bent-winged bat, from <i>Miniopterus schreibersii subsp. oceanensis</i> or the eastern bent-wing bat. The Eastern Bentwing-bat has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. It has a short snout and a high 'domed' head with short round ears. The wing membranes attach to the ankle, not to the base of the toe. The last bone of the third finger is much longer than the other finger-bones giving the "bent wing" appearance. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.	41	Marginal	Low
<i>Myotis macropus</i> Southern Myotis	V		The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found	33	Present	Recorded

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.			
<i>Petauroides volans</i> Greater Glider		V	Found in Eucalypt-dominated low open forests on coast to tall forests in the ranges and low woodland W of Great Dividing Range; not in rainforests. Found along the east coast of Australia.	11	Marginal	Low
<i>Petaurus australis</i> Yellow-bellied Glider	V		The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	1	Marginal	Low
<i>Petaurus norfolcensis</i> Squirrel Glider	V		The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	1	Marginal	Low
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	E	V	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. The species' range is now fragmented, particularly in the south where they are now mostly found as small isolated populations dotted across their former range. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Throughout their range, Brush-tailed Rock-wallabies feed on a wide variety of grasses and shrubs, and have flexible dietary requirements. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha. Live in family groups of 2 – 5 adults and usually one or two juvenile and sub-adult individuals. Dominant males associate and breed with up to four females. Breeding is likely to be continuous, at least in the southern populations, with no apparent seasonal trends in births.	1	Marginal	Low
<i>Phascolarctos cinereus</i>	V	V	Occurs in eastern Australia, from north-eastern Queensland to south-eastern South Australia and to the west of the Great Dividing Range. In NSW it mainly	426	Present	High

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
(combined populations of Qld, NSW and the ACT) Koala			occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of NSW, but now occurs in sparse and possibly disjunct populations. The koala inhabits a range of eucalypt forest and woodland communities, including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains. Examples of important shelter trees are cypress pine and brush box. The quality of forest and woodland communities as habitat for koalas is influenced by a range of factors, such as; species and size of trees present; structural diversity of the vegetation; soil nutrients; climate and rainfall; size and disturbance history of the habitat patch. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Breeding season for the koala peaks between September and February.			
<i>Pseudomys novaehollandiae</i> New Holland Mouse		V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. Lives predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha. Breeding typically occurs between August and January, but can extend into autumn. The species peaks in abundance during early to mid-stages of vegetation succession typically induced by fire. Nocturnal and omnivorous, feeding on seeds, insects, leaves, flowers and fungi, and is therefore likely to play an important role in seed dispersal and fungal spore dispersal.	65	Marginal	Low
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source, often in stands of riparian rainforest, Paperbark or Casuarina forest, and are commonly found in gullies, close to water, or in vegetation with a dense canopy. Forage on the nectar and pollen of native trees, in particular <i>Eucalyptus</i> , <i>Melaleuca</i> and <i>Banksia</i> , and fruits of rainforest trees and vines. Travel up to 50 km to forage. Annual mating commences in January and a single young is born each October or November. Site fidelity to camps is high with some camps being used for over a century. Foraging habitat available in flowering eucalypts of the study area. No camps located within the study area.	312	Present	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheathtail-bat	V		The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	16	Present	Low
<i>Scoteanax rueppellii</i> Greater Broad- nosed Bat	V		The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.	19	Marginal	Low
FLORA						
<i>Acacia baueri subsp. aspera</i>	V		A low growing, well-branched shrub mostly 0.1 - 1 m high with hairy and warty branches. The phyllodes (leaves) are crowded, scattered or in irregular whorls, cylindrical and warty. Flowerheads consisting of 10 - 20 golden yellow flowers occur in the angle between the phyllode and stem. Fruit is a slightly curved pod 1 - 2 cm long. This subspecies differs from <i>A. baueri</i> subsp. <i>baueri</i> which has smoother phyllodes in more regular whorls. Restricted to the Sydney region, occurring on the Kings Tableland in the central Blue Mountains and with sporadic occurrences on the Woronora Plateau in the Royal National Park, Mt. Keira district and at Wedderburn.	1	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			May also occur on the escarpment/Woronora Plateau in the Flat Rock Junction and Stanwell Tops area of the Illawarra.			
<i>Acacia bynoeana</i> Bynoe's Wattle	E	V	This species is confined to the northern portion of the Sydney Basin Bioregion and the southern portion of the north coast Bioregion. Occurs in heath or dry sclerophyll forest on sandy clay soils, often containing ironstone gravels. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Bynoe's Wattle is a semi-prostrate shrub to a metre high. The single flower heads, on short hairy stems, appear anytime from September to March. Its seedpods are mature from September to January. The hairy branchlets distinguish the species from the similar and more common Three-veined Wattle <i>Acacia trinervata</i> . It is more likely to occur in sclerophyllous heath or woodland on Sandstone based substrates in association with <i>Corymbia gummifera</i> , <i>Eucalyptus sclerophylla</i> , <i>Banksia serrata</i> & <i>Angophora bakeri</i> , none of which occur in Cumberland Plain Woodland. It has been recorded in Castlereagh Nature Reserve.	19	Marginal	Low
<i>Acacia pubescens</i> Downy Wattle	V	V	A spreading shrub, 1 - 5 m high with brilliant yellow flowers, bipinnate leaves (divided twice pinnately) and conspicuously hairy branchlets. Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravelly soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. The topography of the habitat of the species is flat to gently undulating, a characteristic of the Cumberland Plain region. The sites of <i>A. pubescens</i> range in altitude from 0 to 650 metres a.s.l. The species often associated with <i>A. pubescens</i> include <i>Melaleuca nodosa</i> , <i>M. styphelioides</i> , <i>Angophora bakeri</i> , <i>Ozothamnus diosmifolius</i> , <i>Acacia parramattensis</i> , <i>Dillwynia sieberi</i> , <i>Pultenaea villosa</i> , <i>Bursaria spinosa</i> , <i>Acacia falcata</i> , <i>Exocarpos cupressiformis</i> , <i>Themeda australis</i> , <i>Lomandra longifolia</i> , <i>Microlaena stipoides</i> , <i>Aristida vagans</i> , <i>Austrodanthonia tenuior</i> , <i>Dianella longifolia</i> , <i>Lepidosperma laterale</i> and other species characteristic of the above plant communities. Stands of <i>A. pubescens</i> have been recorded in open, disturbed. Longevity is unknown, but clonal species have been known to survive for many decades. Flowers from August to October. Pollination of Acacia flowers is usually by insects and birds. The pods mature in October to December. Recruitment is more commonly from vegetative reproduction than from seedlings. The percentage of pod production and seed fall for this species appears to be low. Acacia species generally have	17	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			high seed dormancy and long-lived persistent soil seedbanks. It is thought that the species needs a minimum fire free period of 5 - 7 years to allow an adequate seedbank to develop.			
<i>Allocasuarina diminuta</i> subsp. <i>mimica</i>	E		The endangered population occurs along sandstone ridges and upper hillsides in the region northwest from Heathcote, towards Menai and Holsworthy, in heathy and low open woodland communities. It is restricted to the Local Government Areas listed in this instance (Sutherland and Liverpool). Other occurrences in the Blue Mountains and Southern Highlands (Blackheath to Bundanoon and Taralga), and also in the coastal communities from Kingsford to Little Bay) are not included in the Endangered population listing. Heathy woodland, Heathlands, Low open woodlands.	41	Marginal	Moderate
<i>Allocasuarina glareicola</i>	E	E	An erect, often depauperate she-oak shrub 1-2 m high, with 20 cm branchlets. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with <i>Eucalyptus parramattensis</i> , <i>Eucalyptus fibrosa</i> , <i>Angophora bakeri</i> , <i>Eucalyptus sclerophylla</i> and <i>Melaleuca decora</i> . Common associated understorey species include <i>Melaleuca nodosa</i> , <i>Hakea dactyloides</i> , <i>Hakea sericea</i> , <i>Dillwynia tenuifolia</i> , <i>Micromyrtus minutiflora</i> , <i>Acacia elongata</i> , <i>Acacia brownei</i> , <i>Themeda australis</i> and <i>Xanthorrhoea minor</i> . Not killed outright by fire but resprouts from the rootstock. Spreads by vegetative means, such that clumps of up to 100s of stems may be a single individual. The time taken for the plants to flower and set seed is not known, but only those plants growing in areas unburnt for some time produced substantial numbers of fruit.	1	Marginal	Low
<i>Astrotricha crassifolia</i> Thick-leaf Star-hair	V	V	Occurs in dry sclerophyll woodland on sandstone. Flowers in spring. Resprouter from root suckers or basal stem buds after fire. Seed storage and dispersal ecology and germination requirements are unknown. Not enough data to rank sensitivity to either frequent or infrequent fires.	61	Present	Moderate
<i>Caladenia tessellata</i> Thick lip spider orchid	E	V	The Tessellated Spider Orchid is from a group of orchids characterised by five long spreading petals and sepals around a broad down-curved labellum ('lip'). Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. In NSW current populations occur in Morton NP, Munmorah State Recreation Area, Braidwood (private property), South Pacific Heathland Reserve, Wyrabalong NP, and Porter Creek Wetland Reserve. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The	23	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			single leaf regrows each year. Flowers appear between September and November (but apparently generally late September or early October in extant southern populations).			
<i>Caesia parviflora</i> <i>var. minor</i> Small Pale Grass-lily	E		<ul style="list-style-type: none"> The Small Pale Grass-lily is an inconspicuous herb. The leaves are 2 mm wide and arranged in a rosette at ground level. Several multi-branched flowering shoots spread widely and turn up at the ends. The whole plant is usually much less than 20 cm tall. The small, white starry flowers may be tinged with blue or purple. The little fruits are green and three-lobed. The other two varieties of Pale Grass-lily in NSW, <i>Caesia parviflora</i> <i>var. parviflora</i> and <i>Caesia parviflora</i> <i>var. vittata</i>, are more than 20 cm tall and have broader leaves. This variety occurs uncommonly in Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level. 	1	Present	Low
<i>Callistemon</i> <i>linearifolius</i> Netted Bottle Brush	V		<ul style="list-style-type: none"> This shrub is up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with an sharp tip, thickened margins, and distinct lateral veins. Flowers are clustered into the typical "bottlebrushes" of <i>Callistemon</i> species. The brushes are red and usually 9-10 cm long and approximately 50 mm in diameter. The stem upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter. Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park. 	3	Marginal	Low
<i>Cryptostylis</i> <i>hunteriana</i> Leafless Tongue-orchid	V	V	<ul style="list-style-type: none"> The Leafless Tongue Orchid has no leaf. It produces an upright flower-stem to 45 cm tall, bearing five to 10 flowers between November and February. This species has inconsistent flowering, with individuals not always flowering each season. It has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). In NSW there are Leafless 	1	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Tongue-orchid populations of unknown size in Washpool, Gibraltar Range, Ku-ring-gai Chase, Ben Boyd, Meroo, Morton, Murramarang, Jervis Bay and Lake Conjola National Parks as well as Cambewarra Range and Triplarina Nature Reserves. Brown (2007) indicates that this species is also present in Red Rocks (Yuraygri) National Park and is located on the Red Rocks Plateau in Cambewarra Range Nature Reserve. Also recorded at Nelson Bay, Wyee, Nowendoc State Forest, and two large populations near Bulahdelah. The species occurs mostly in coastal heathlands, margins of coastal swamps and sedgeland, coastal forest, dry woodland, and lowland forest. It prefers open areas in the understorey of forested communities. The soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>). Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site.			
<i>Cynanchum elegans</i> White-flowered Wax Plant		E	<ul style="list-style-type: none"> A climber or twiner with a highly variable form. Mature stems have a fissured corky bark and can grow to 10 metres long and 3.5 cm thick. The leaves are paired (or rarely in threes), ovate to broadly ovate in shape, 1.5 to 10.5 cm long, and 1.5 to 7.5 cm wide. The flowers are white, tubular, and up to 4 mm long and 12 mm wide. The fruit is a dry pointed pod to 8 cm long, which contains up to 45 seeds with long silky hairs attached to one end. The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honey Myrtle <i>Melaleuca armillaris</i> scrub to open scrub. Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. Flowering occurs between August and May, with a peak in November. 		Marginal	Low
<i>Dillwynia tenuifolia</i>	V		A low spreading pea-flower shrub to a metre high. Its leaves are small and narrow (linear-terete, soft, 4-12mm long, with the tip often bent downwards).	2	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			The wide orange-yellow and red pea-flowers are usually single, at or near the tips of the branches. Seed pods are brownish, egg-shaped, 4-5mm long with reticulate seeds. The core distribution is the Cumberland Plain from Windsor and Penrith east to Dean Park near Colebee. Other populations in western Sydney are recorded from Voyager Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Flowering occurs sporadically through the year with a peak from from August to March depending on environmental conditions. Pollinators are unknown. The lifespan is estimated to be 20-30 years. It is thought a minimum of 3-4 years is required before seed is produced. Seeds are hard coated and are persistent in the soil seed bank. Dispersal is likely to be localised and ants are the probable vectors.			
<i>Eucalyptus camfieldii</i> Camfield's Stringybark	V	V	Mostly mallee to 4 m tall though can grow to a straggly tree to 9 m high. Bark is rough, fibrous and stringy, red or dark grey-brown. Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. Occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Grows in coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of <i>E. oblonga</i> Narrow-leaved Stringybark, <i>E. capitellata</i> Brown Stringybark and <i>E. haemastoma</i> Scribbly Gum. Population sizes are difficult to estimate because its extensive lignotubers may be 20 m across. A number of stems arise from these lignotubers giving the impression of individual plants. Flowering period is irregular, flowers recorded throughout the year. Poor response to too frequent fires.	42	Marginal	Low – easy to identify and surveyed for without detection
<i>Genoplesium bauera</i> Bauer's Orchid Midge	V	E	A terrestrial orchid 6-15 cm high, fleshy, brittle, yellowish-green or reddish. The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahrenonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers December to March.	10	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Grammitis stenophylla</i> Narrow-leaf Finger Fern	E		Occurs in eastern Queensland and eastern NSW. In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabri. Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	1	Marginal	Low
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> Small-flower Grevillea	V	V	A low spreading to erect shrub, usually less than a metre high. Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo (and possibly further south to the Moss Vale area). Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Canopy species vary greatly with community type but generally are species that favour soils with a strong lateritic influence including <i>Eucalyptus fibrosa</i> , <i>E. parramattensis</i> , <i>Angophora bakeri</i> and <i>Eucalyptus sclerophylla</i> . Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks. Flowering has been recorded between July to December as well as April to May.	7	Present	Moderate
<i>Hibbertia</i> sp. Bankstown	E	CE	" <i>Hibbertia</i> sp. Bankstown is a prostrate shrub with spreading, hairless, wiry branches up to 40 cm in length. Its leaves are 3 to 6 mm long by 0.8 to 1.4 mm wide, lance shaped and oblong to almost linear. The flowers are yellow with notched petals. Toelken and Miller have described the entity as a subspecies of the (also threatened) <i>H. puberula</i> as <i>H. puberula</i> subsp. <i>glabrescens</i> in 2012 (see reference details at end). That description is copied below: Branches thread-like wiry from short stiff-woody stems. Leaf lamina mainly elliptic-oblong. Outer calyx lobes linear-lanceolate, (5.3–) 5.5–6.1 (–6.3) × 1.6–2.1mm, not beaked and with scarcely recurved margins and faint central ridge towards the apex, glabrescent or sparsely pubescent; inner calyx lobes narrowly oblongovate, (4.6–) 4.8–5.2 (–5.6) × 2.1–2.3 (–2.7) mm, innermost two abruptly constricted into minute terminal mucro continuous with broad membranous margins, glabrous or glabrescent along central ridge. Stamens 12–14; anthers 0.9–1.3 mm long. Flowering: October, November (December). This species is endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown local government area."	1	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Hibbertia puberula</i>	E		Recent work on this species (Toelken & Miller 2012) and its relatives have shown it to be widespread, but never common. It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath (Toelken & Miller 2012). Flowering time is October to December, sometimes into January. Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently (2012) described subspecies also favours upland swamps.	11	Marginal	Low – surveyed extensively and not detected
<i>Hibbertia stricta subsp. furcatula</i>	E		<i>Hibbertia stricta subsp. furcatula</i> (<i>Hibbertia</i> sp. nov. 'Menai') is known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. The Southern Sydney population occurs on both sides of the Woronora River gorge, near Loftus and in Royal National Park. The southern population is mainly in the vicinity of Nowra. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone. Toelken & Miller (2012) note that the species usually grows in 'gravelly loam or clay soil in heath under open woodland'. Habitat of the South Coast population is poorly recorded, but appears to be dry sclerophyll forest or woodland associations in sandy soils over sandstone. <i>Hibbertia</i> sp. nov. 'Menai' flowers in spring and summer ('September to January (February)' in Toelken & Miller (2012) yet also noted as July to about December (in NSW Flora online) and 'winter to summer' (Flora of the Sydney Region). Its longevity, seed biology, and most aspects of its ecology are unknown, although in common with most species of <i>Hibbertia</i> it is probably pollinated primarily by bees. It appears to propagate by seed, with no evidence to date of vegetative reproduction or regeneration.	17	Present	High
<i>Hibbertia woronorana</i>	Not listed	Not listed	Within the <i>H. acicularis</i> group, a new subspecies <i>Hibbertia woronorana</i> has been described. It is not listed under the BC Act, but is restricted to the mid and lower reaches of the Woronora River, New South Wales. Growing on rocky sandstone slopes in sclerophyll forest comprised of <i>Angophora</i>	2	Present	High

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<i>costata</i> , <i>Corymbia gummifera</i> , <i>Eucalyptus punctata</i> and stringybark sp. in association with <i>Allocasuarina littoralis</i> , <i>Doryanthes excelsa</i> , <i>Banksia serrata</i> , <i>Dodonaea triquetra</i> , <i>Platysace linearifolia</i> , <i>Epacris pulchella</i> , <i>Hakea dactyloides</i> , <i>Grevillea buxifolia</i> , <i>Grevillea diffusa</i> , <i>Acacia linifolia</i> , <i>Xanthosia tridentifera</i> . Highly restricted small localised populations within Heathcote National Park though locally common at some sites (R.T.Miller & J.Miller 69/18.iii.2007). The type location is indicated as 'Woronora River at Heathcote Bridge'. Extremely vulnerable to disturbances, rare and possibly endangered downstream of the Needles.			
<i>Leucopogon exolasius</i> Woronora Beard-heath	V	V	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The plant occurs in woodland on sandstone. Flowering occurs in August and September.	14	Present	Moderate
<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	Biconvex Paperbark is a shrub or small tree, usually up to 10 m tall, though occasionally as high as 20 m. The bark is that of a typical paperbark. The leaves are small, to 18 mm long and 4 mm wide; each leaf has a centre-vein in a groove and the leaf blade curves upwards on either side of this centre-vein. Leaf placement is distinctive, with each pair of leaves emerging at right angles from the branch. Each pair is offset at right angles to the previous pair so the branch has a squarish appearance when looked at 'end-on'. This species' white flowers are usually clustered in dense heads and the fruit is urn-shaped and 3 - 5 mm in diameter. Biconvex Paperbark is only found in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October and resprouting occurs following fire.		Marginal	Low
<i>Melaleuca deanei</i> Deane's Paperbark	V	V	A shrub to 3 m high with fibrous, flaky bark. Occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. Locations are known from the following National Parks and Wildlife Service reserves: Berowra Valley Regional Park, Brisbane Water National Park, Ku-ring-gai Chase National Park, Garigal National Park, Lane Cove National Park, Royal National Park, and Heathcote National Park. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone. In southern Sydney, the species is most often found on flat broad ridge tops more than 100 metres wide. The altitudinal range of <i>M. deanei</i> is between 20 and 410 metres above sea level. Strongly associated with sandy loam soils that are low in nutrients, sometimes with	60	Marginal	Moderate

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			ironstone present. Is most often found in Coastal Sandstone Ridgetop Woodland. Flowers appear in summer.			
<i>Persicaria elatior</i> Knotweed		V	Knotweed is known from the North Coast, Central Coast and South Coast Botanical Subdivisions in New South Wales (NSW). Knotweed has been collected from eight sites in NSW including five sites in south-east NSW: Mt Dromedary (an old record), Moruya State Forest (SF), near Turlinjah, the Upper Avon River catchment, north of Robertson, Bermagui (NSW DECCW 2005ov), Picton Lakes. Knotweed normally grows in damp places, including: coastal with swampy areas, along watercourses, streams and lakes, swamp forest, disturbed areas. Associated species include <i>Melaleuca linearifolia</i> , <i>M. quinquenervia</i> , <i>Lophostemon suaveolens</i> , <i>Casuarina glauca</i> , <i>Corymbia maculata</i> , <i>Pseudognaphalium luteoalbum</i> and <i>Polygonum hydropiper</i> . Knotweed appears to be a short-lived herbaceous species, surviving for up to two years (Leiper 2008). Following rain, it germinates readily from seed on bare ground. Knotweed grows rapidly, flowers and sets seed within six months of germinating (Leiper 2008). Flowering mostly occurs in summer.		Marginal	Low
<i>Persoonia hirsuta</i> Hairy Geebung	E	E	Has a scattered distribution around Sydney. The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. <i>Persoonia hirsuta</i> has a large area of occurrence, but occurs in small populations, increasing the species fragmentation in the landscape. The Hairy Geebung has been recorded in the Sydney coastal area (subsp. <i>hirsuta</i> - Gosford to Berowra to Manly to Royal National Park), the Blue Mountains area (subsp. <i>evoluta</i> - Springwood, Lithgow, Putty) and the Southern Highlands (subsp. <i>evoluta</i> - Balmoral, Buxton, Yanderra and Hill Top areas). The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone from near sea level to 600m altitude. It is usually present as isolated individuals or very small populations. It is probably killed by fire (as other <i>Persoonia</i> species are) but will regenerate from seed. Flowering is generally in summer.	11	Marginal	Low
<i>Persoonia nutans</i> Nodding Geebung	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The species has a disjunct distribution, with the majority of populations (and 99% of individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas. Core distribution occurs within the Penrith, and to a lesser extent Hawkesbury, local government areas, with isolated and relatively small populations also	41	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			occurring in the Liverpool, Campbelltown, Bankstown and Blacktown local government areas. The southern and northern populations have distinct habitat differences. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Southern populations also occupy tertiary alluvium, but extend onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest. Peak flowering is from November to March with sporadic flowering all year round. An obligate seed regenerator. Seed germination is promoted by fire and also by physical disturbance. Although listed as a short-lived species much of the ecology is poorly known. Maturity is expected in about 10 years. Plants appear to set abundant fruit. Seed is likely to be dispersed, after consumption of the fruit, by large birds such as currawongs and large mammals such as wallabies, kangaroos and possums. Abundance at a site appears to be related to disturbance history. Sites with higher abundance also appear to be more disturbed.			
<i>Pimelea curviflora</i> <i>var. curviflora</i>		V	A much-branched subshrub or shrub 20 to 120cm high with hairy stems. Flowers are red to yellow, hairy and occur in terminal heads of 4 - 12 flowers. Leaves are 5 - 10 mm long, 2 - 4 mm wide, with a sparsely hairy lower surface. The curved fruit is 2 - 4 mm long. Confined to the coastal area of the Sydney and Illawarra regions. Populations are known between northern Sydney and Maroota in the north-west. New population discovered at Croom Reserve near Albion Park in Shellharbour LGA in August 2011. Formerly recorded around the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly.		Marginal	Low
<i>Pimelea spicata</i> Spiked Rice-flower		E	The Spiked Rice-flower is a shrub to 50 cm tall that may be erect or somewhat spreading in habit. The leaves are opposite and elliptical, to 20 mm long by 8 mm wide, and usually held outwards from the stem. The white, pink-tinged flowers are tubular, to 10 mm long, with four spreading petals. They may appear at any time of the year, but are mostly seen in summer as they are probably related to rainfall. Inflorescences start as dense clusters (like most rice flowers) and then extend along an elongating stem as the inflorescences age (the only species of Pimelea in Greater Sydney to do this). Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Marayong and Prospect Reservoir south to Narellan and Douglas Park) and the Illawarra (Landsdowne to Shellharbour to northern Kiama).		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Pomaderris brunnea</i> Brown Pomaderris	E	V	Brown Pomaderris is a shrub to 3 m tall that has distinctively hairy stems. The stem-hairs comprise long brownish hairs above a thick white hairy under-coat. The leaves are up to 4 cm long and 1.5 cm wide and have toothed margins. The upper leaf surface is hairless; the lower surface is densely hairy like the stem. The leaf veins extend to the margins. The small, yellowish flowers have no petals and form dense clusters at the ends of the branches. Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands. grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines. Flowers Sept - Oct. The species has been found in association with <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Acacia parramattensis</i> , <i>Bursaria spinosa</i> and <i>Kunzea ambigua</i> .	7	Absent	Low
<i>Prostanthera densa</i> Villous Mint-bush	V	V	Villous Mint-bush is an erect mint-smelling shrub to 2 m tall, though in the southern part of its range it is rarely more than 1 m tall. Branches and leaves are covered with long, spreading hairs. The leaves are in pairs and almost triangular in shape, to 15 mm long and 12 mm wide. They are dark green above and paler below, with curled-under edges. The tubular flowers are mauve with orange markings and grow in the angles where the leaves meet the stems. Flowering has been observed throughout the year, but occurs chiefly in spring or from May - December. This species has been recorded from the Currarong area in Jervis Bay, Royal National Park, Cronulla, Garie Beach and Port Stephens (Gan Gan Hill, Nelson Bay). The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla.	3	Marginal	Low
<i>Prostanthera saxicola</i> <i>Prostanthera saxicola</i> population in Sutherland and Liverpool local government areas	E		Primarily in Eucalypt forest, heath and low shrubland, often in damp or moist sites. This population is restricted to the named local government areas (Liverpool and Sutherland) in the southern to south-western parts of Sydney. Recorded occurrences are mainly between Holsworthy station and Sutherland station, north from Lucas Heights and south of the Georges River. However, the population may extend beyond this into the adjacent parts of the relevant LGAs within the region (including the military reserve lands and the Royal and Heathcote National Parks). Eucalypt forest and heath in association with <i>Hakea dactyloides</i> , <i>Brachyloma daphnoides</i> , <i>Banksia spinulosa</i> , <i>Baeckea brevifolia</i> , <i>Epacris pulchella</i> , <i>Acacia myrtifolia</i> and <i>Acacia ulicifolia</i> . <i>Closed heath in association with <i>Allocasuarina nana</i> and <i>Lepidosperma viscidum</i>. Heathy woodland of <i>Angophora hispida</i>, <i>Eucalyptus squamosa</i> and <i>Corymbia gummiifera</i>, as a 'major component of the ground flora'. Rocky ridges and areas of outcrop.</i>	5	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>Pterostylis gibbosa</i> Illawarra Greenhood	E	E	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum <i>Eucalyptus tereticornis</i> , Woollybutt <i>E. longifolia</i> and White Feather Honey-myrtle <i>Melaleuca decora</i> . Near Nowra, the species grows in an open forest of Spotted Gum <i>Corymbia maculata</i> , Forest Red Gum and Grey Ironbark <i>E. paniculata</i> . In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark <i>E. crebra</i> , Forest Red Gum and Black Cypress Pine <i>Callitris endlicheri</i> . The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter. After a spring flowering, the plant begins to die back and seed capsules form (if pollination has taken place).	1	Absent	Low
<i>Pterostylis saxicola</i> Sydney Plains Greenhood	E	E	A cryptic ground orchid with reddish brown and green translucent flowers on a slender stem to 35 cm tall. Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Localities include: Georges River National Park (near Yeramba Lagoon), Ingleburn, Holsworthy, Peter Meadows Creek and St Marys Towers near Douglas Park. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. The time of emergence and withering has not been recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant wither and die following seed dispersal and the plant persists as a tuberoid until the next year.		Marginal	Low
<i>Pultenaea aristata</i> Prickly Bush-pea	V	V	The species occurs in either dry sclerophyll woodland or wet heath on sandstone. Flowering has been recorded in winter and spring. Prickly Bush-pea is restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong.	19	Marginal	Low – study area is outside the northern extent of this species
<i>Pultenaea pedunculata</i> Matted Bush-pea	E		The Matted Bush-pea is a shrub that forms carpets 1 m or more wide, having branches that may be several metres long but usually less than 20cm off the ground. The stems are appressed-pubescent with whitish hairs. Its small leaves are flat and elliptical, to 11 mm long and 2 mm wide, with a darker upper surface, a recurved point at the tip and stipules 2 to 3 mm long. The pea-shaped flowers are small (4-8mm long), and mostly yellow in NSW, though apricot and orange flowered populations are also known. The flowers	1	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			near the ends of the branches, held singly on long stalks (often to 20 mm long), with linear to linear-ovate, hairless bracteoles and a sparsely hairy calyx 3-5mm long with acuminate lobes. The fruit is 5-7mm long, globular to egg-shaped. Matted Bush-pea is widespread in Victoria, Tasmania, and south-eastern South Australia. In NSW however, it is represented by just three disjunct populations, in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). The Cumberland Plain occurrences were more widespread (Yennora, Canley Vale and Cabramatta were lost to development) and is now found at Villawood and Prestons, and north-west of Appin between the Nepean River and Devines Tunnel number 2 (Upper Sydney Water Supply Canal).			
<i>Rhodamnia rubescens</i> Scrub Turpentine	CE		Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	9	Marginal	Low
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E	V	A tree to 15 m tall, but is generally 3–8 m high and shrubby in form. Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. Has been recorded in widely scattered small populations along the NSW coast from Booti (near Forster) in the north to Conjola State Forest (near Jervis Bay) in the south. Found in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas. Rainforests are often remnant stands of littoral or gallery rainforest. Associated species include <i>Alphitonia obliqua</i> , <i>Acmena smithii</i> , <i>Cryptocarya glaucescens</i> , <i>Toona obliqua</i> , <i>Eucalyptus saligna</i> , <i>Ficus fraseri</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Cassine oblique</i> , <i>F. oblique</i> , <i>Glochidion ferdinandi</i> , <i>Endiandra sieberi</i> , <i>Synoum glandulosum</i> , <i>Podocarpus elatus</i> , <i>Notelaea longifolia</i> , <i>Guioa semiglauca</i> and <i>Pittosporum undulatum</i> . Is thought to tolerate wet and dry conditions on sands. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. Flowers December to March, with fruit ripe from March to May, occasionally to September.	3	Absent	Low
<i>Thelymitra kangaloonica</i>		CE	<i>Thelymitra kangaloonica</i> (<i>Thelymitra</i> sp. Kangaloon) is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Kangaloon Sun Orchid			<p>swamps that are above the Kangaloon Aquifer. These swamps are a part of the ecological community "Coastal Upland Swamp" which is listed under the NSW Threatened Species Conservation Act 1995 as an Endangered Ecological Community, also known as "Temperate Highland Peat Swamps on Sandstone" which is listed under the Environment Protection and Biodiversity Conservation Act 1999.</p> <p>The majority of known plants are located on land managed by the Sydney Catchment Authority. One small population is located in Budderoo National Park. It is likely that the number of mature individuals of <i>Thelymitra kangaloonica</i> (<i>Thelymitra</i> sp. Kangaloon) is very low, with less than 250 plants known. It is found in swamps in sedgeland over grey silty grey loam soils</p> <p>It is thought to be a short-lived perennial, flowering in late October and early November</p>			
<i>Thesium austral</i> Austral Toadflax		V	<p>Austral Toadflax occurs in New South Wales, the Australian Capital Territory, Queensland and Victoria. It is also known from eastern Asia (e.g. China). Its current distribution is sporadic but widespread, occurring between the Bunya Mountains in south-east Queensland to north-east Victoria and as far inland as the southern, central and northern tablelands in New South Wales and the Toowoomba region. There is an outlier in Carnarvon National Park on the Consuelo Tableland of the southern Brigalow Belt. It had been recorded once in Tasmania from the Derwent River valley in 1804, but is considered extinct in the state. Many other previously known sites do not have recent records.</p> <p>Austral Toadflax is an inconspicuous plant and is often overlooked (Victorian Workshop 2000 pers. comm.). With survey training, collections increased substantially in northern New South Wales (Copeland 2000 pers. comm.). One expert suggested that there could be hundreds of thousands to a million across Australia.</p> <p>In New South Wales, Austral Toadflax occurs on the coast, tablelands and western slopes (NSW NPWS 2003m). The Atlas of Living Australia (2013) indicates that there were 255 Austral Toadflax herbarium collections between 1990 and 2013 in New South Wales and the Australian Capital Territory. Over 200 of these were in the Nandewar, New England Tablelands and NSW North Coast Bioregions. In northern New South Wales, survey training lead to a significant increase in the discovery of new sites (Copeland 2000 pers. comm.).</p> <p>Sites include Perpendicular Point in Kattang Nature Reserve (1 plant per 1 m²); Look at Me Now Headland at Moonee Creek Nature Reserve (1 plant</p>		Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			per 1 m ²); Old Bar Park (Taree, 1 plant per 100 m ²) (Cohn 2004); Yetman-Wallangra; Linton Nature Reserve; Boambee Head (50–100 plants). Austral Toadflax is semi-parasitic on roots of a range of grass species, notably Kangaroo Grass (<i>Themeda triandra</i>). It occurs in subtropical, temperate and subalpine climates over a wide range of altitudes. It occurs on soils derived from sedimentary, igneous and metamorphic geology on a range of soils including black clay loams to yellow podzolics and peaty loams. It occurs in shrubland, grassland or woodland, often on damp sites. Vegetation types include open grassy heath dominated by Swamp Myrtle (<i>Leptospermum myrtifolium</i>), Small-fruit Hakea (<i>Hakea microcarpa</i>), Alpine Bottlebrush (<i>Callistemon sieberi</i>), Woolly Grevillea (<i>Grevillea lanigera</i>), Coral Heath (<i>Epacris microphylla</i>) and <i>Poa</i> spp.; Kangaroo Grass grassland surrounded by Eucalyptus woodland; and grassland dominated by Barbed-wire Grass (<i>Cymbopogon refractus</i>). At a NSW coastal site, associated plants included Coastal Wattle (<i>Acacia sophorae</i>), Coast Banksia (<i>Banksia integrifolia</i>), <i>Zieria prostrata</i> and Bitou Bush (<i>Chrysanthemoides monilifera</i>)			
THREATENED ECOLOGICAL COMMUNITIES						
<i>Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions BC-EEC</i>	EEC		Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions typically has a dense to open tree canopy, approximately 5 - 20 m tall, depending on exposure and disturbance history. The most common tree species include Bangalay (<i>Eucalyptus botryoides</i>) and Coast Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>), while Blackbutt (<i>Eucalyptus pilularis</i>) and Lilly Pilly (<i>Acmena smithii</i>) may occur in more sheltered situations, and Swamp Oak (<i>Casuarina glauca</i>) may occur on dunes exposed to salt-bearing sea breezes or where Bangalay Sand Forest adjoins Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, as listed under the Threatened Species Conservation Act 1995. The open shrub stratum may be dominated by sclerophyllous species, such as Old Man Banksia (<i>Banksia serrata</i>), Coast Teatree (<i>Leptospermum laevigatum</i>) and Tree Broom-heath (<i>Monotoca elliptica</i>), or mesophyllous, species, such as Coffee Bush (<i>Breynia oblongifolia</i>) and Sweet Pittosporum (<i>Pittosporum undulatum</i>), or a combination of both. Shrubs may vary in height from one to ten metres tall. The groundcover varies from open to dense, and may be sparse where the tree canopy is dense or where there is a thick litter of leaves and branches. Dominant species include Flax-lilies (<i>Dianella</i> spp.), <i>Lepidosperma concavum</i> , Spiny-headed Mat-rush (<i>Lomandra longifolia</i>), Bracken (<i>Pteridium esculentum</i>), and grasses including Blady Grass (<i>Imperata cylindrica</i>), Weeping Grass (<i>Microlaena</i>	N/A	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			stipoides var. stipoides) and Kangaroo Grass (<i>Themeda australis</i>), while herbs, such as Slender Tick-trefoil (<i>Desmodium gunnii</i>), Kidney Weed (<i>Dichondra repens</i>), Whiteroot (<i>Pratia purpurascens</i>) and Ivy-leaved Violet (<i>Viola hederacea</i>), are scattered amongst the larger plants. Vines of <i>Glycine clandestina</i> , False Sarsparilla (<i>Hardenbergia violacea</i>), Running Postman (<i>Kennedia rubicunda</i>), Common Milk Vine (<i>Marsdenia rostrata</i>) and Snake Vine (<i>Stephania japonica</i> var. <i>discolor</i>) scramble through the groundcover and occasionally over shrubs or tree trunks. Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions is currently known from parts of the Local Government Areas of Sutherland, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. It is known to occur within a number of conservation reserves, including Royal, Seven Mile Beach, Conjola, Meroo, Murramarang, Eurobodalla and Biamanga National Parks, though these areas are often exposed to degradation by visitor overuse due to their proximity to popular beaches and camping areas.			
Blue Gum High Forest in the Sydney Basin Bioregion	CEEC	CEEC	A moist, tall open forest community, with dominant canopy trees of Sydney Blue Gum <i>Eucalyptus saligna</i> and Blackbutt <i>E. pilularis</i> . Forest Oak <i>Allocasuarina torulosa</i> and Sydney Red Gum <i>Angophora costata</i> also occur. Species adapted to moist habitat such as Lillypilly <i>Acmena smithii</i> , Sandpaper Fig <i>Ficus coronata</i> , Soft Bracken <i>Calochlaena dubia</i> and Maiden Hair <i>Adiantum aethiopicum</i> may also occur. Contains many more species and other references should be consulted to identify these. Originally restricted to the ridgelines in Sydney's north from Crows Nest to Hornsby, and extending west along the ridges between Castle Hill and Eastwood. In 2000 there was less than 200 ha remaining (about 4.5% of its original extent). It only occurs in small remnants of which the largest is less than 20 ha. The remnants mainly occur in the Lane Cove, Willoughby, Ku-ring-gai, Hornsby, Baulkham Hills, Ryde and Parramatta local government areas. An example of Blue Gum High Forest can be seen at the Dalrymple-Hay Nature Reserve, St Ives. The community also occurs on soils associated with localised volcanic intrusions, 'diatremes'. Occurs only in areas where rainfall is high (above 1100 millimetres per year) and the soils are relatively fertile and derived from Wianamatta shale. In lower rainfall areas, it grades into Sydney Turpentine-Ironbark Forest. The rainforest understorey species rely on birds and mammals to disperse their seeds and are vulnerable to fire. Along the drier ridgelines, fire would have been more frequent and an important factor in maintaining understorey diversity.	N/A	Absent	None
Castlereagh Scribbly Gum	VEC	EEC	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion is dominated by <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> , <i>Angophora</i>	N/A	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Woodland in the Sydney Basin Bioregion			<p><i>bakeri</i> and <i>E. sclerophylla</i>. A small tree stratum of <i>Melaleuca decora</i> is sometimes present, generally in areas with poorer drainage. It has a well-developed shrub stratum consisting of sclerophyllous species such as <i>Banksia spinulosa</i> var. <i>spinulosa</i>, <i>Melaleuca nodosa</i>, <i>Hakea sericea</i> and <i>H. dactyloides</i> (multi-stemmed form). The ground stratum consists of a diverse range of forbs including <i>Themeda australis</i>, <i>Entolasia stricta</i>, <i>Cyathochaeta diandra</i>, <i>Dianella revolute</i> subsp. <i>revoluta</i>, <i>Stylidium graminifolium</i>, <i>Platysace ericoides</i>, <i>Laxmannia gracilis</i> and <i>Aristida warburgii</i> (Tozer 2003). Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium (Tozer 2003). It is most often found on sandy soils and tends to occur on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion (Tozer 2003). The boundary between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion appears to be a function of the interaction of localised drainage conditions and the thickness of the Tertiary alluvium mantle (Tozer 2003). Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion is to occur within the local government areas of Bankstown, Blacktown, Campbelltown, Hawkesbury, Liverpool and Penrith (James 1997), but may occur elsewhere within the Sydney Basin Bioregion. The main occurrence of Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion is in the Castlereagh area of the Cumberland Plain, with small patches occurring at Kemps Creek and Longneck Lagoon. It is also present around Holsworthy, however the floristic composition in this area shows stronger similarities to Castlereagh Ironbark Forest than at other localities (Tozer 2003).</p> <p>Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion corresponds to the community of the same name described by Benson (1992) (Map Unit 14a), NSW NPWS (1997, 2002) and Tozer (2003) (Map Unit 6). It is similar to the Scribbly Gum woodlands found on perched sands in the Mellong Swamp area in Yengo and Wollemi National Parks, however there are distinct geological and floristic differences (James 1997). Occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium. Often adjacent to and on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest in the Sydney Basin Bioregion. The boundary with these units appears to be a function of the localised drainage conditions and the thickness of the tertiary alluvium mantle. The shrub understorey includes a number of listed threatened species including <i>Acacia</i></p>			

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<i>bynoeana</i> , <i>Allocasuarina glareicola</i> , <i>Dillwynia tenuifolia</i> , <i>Grevillea juniperina</i> subsp. <i>juniperina</i> , <i>Micromyrtus minutiflora</i> , <i>Persoonia nutans</i> and <i>Pultenaea parviflora</i> , and may also possibly contain <i>Grevillea parviflora</i> subsp. <i>parviflora</i> . There are periodic fires in Castlereagh Scribbly Gum Woodland and most species are able to regenerate from lignotubers and buds beneath the bark, as well as seed stored in the soil.			
Castlereagh Swamp Woodland Community	EEC		A low woodland, often having dense stands of Paperbark trees <i>Melaleuca decora</i> along with other canopy trees, such as Drooping Red Gum <i>Eucalyptus parramattensis</i> ssp <i>parramattensis</i> . The shrub layer is not well developed and is mostly made up of young paperbark trees <i>Melaleuca</i> sp. The ground layer has a diversity of plants that tolerate waterlogged conditions, such as Swamp Pennywort <i>Centella asiatica</i> , Common Rush <i>Juncus usitatus</i> and <i>Goodenia paniculata</i> . Contains many more species and other references should be consulted to identify these. Occurs in western Sydney in the Castlereagh and Holsworthy areas, on deposits from ancient river systems along today's intermittent creeklines, often in poorly drained depressions. There is now only 616 hectares remaining intact, which mainly occurs in the Hawkesbury, Liverpool and Penrith local government areas. Good examples can be seen at Windsor Downs Nature Reserve and Kemps Creek Nature Reserve. Highly adapted to seasonal fluctuations of wet and dry, with the heavy clay soils cracking during extended dry periods. Intergrades into Ironbark and Scribbly Gum woodland and is subject to periodic fires.	N/A	Marginal	Low
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC	VEC	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans. This community occurs in the intertidal zone along the NSW coast.	N/A	Absent	None
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland ecological community		EEC	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which <i>Casuarina glauca</i> (Swamp Oak) is the dominant species northwards from Bermagui. Other trees including <i>Acmena smithii</i> (Lilly Pilly), <i>Glochidion</i> spp. (Cheese Trees) and <i>Melaleuca</i> spp. (Paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and <i>Melaleuca ericifolia</i> is the only abundant tree in this community south of Bermagui. Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Often fringes treeless floodplain lagoons or wetlands with semi-permanent standing water.			
Coastal Upland Swamp in the Sydney Basin Bioregion	EEC	EEC	The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow to grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community. The total species list is much greater and is likely to exceed 200 species of vascular plants. The Coastal Upland Swamp is endemic to NSW and confined to the Sydney Basin Bioregion. It occurs in the eastern Sydney Basin from the Somersby district in the north to the Robertson district in the south. In the north it occurs on the Somersby-Hornsby plateaux, in the south it occurs on the Woronora plateau. It occurs in elevations from 20 metres to over 600 metres above sea level, with the majority of swamps occurring within 200 and 450 metres elevation. Coastal Upland Swamps occur primarily on impermeable sandstone plateaux with shallow groundwater aquifers in the headwaters and impeded drainage lines of streams, and on sandstone benches with abundant seepage moisture. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow to grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peats with pallid subsoils.	N/A	Marginal	Low
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	EEC	CEEC	Ranges from open forest to low woodland, with a canopy dominated by Broad-leaved Ironbark <i>Eucalyptus fibrosa</i> and Paperbark <i>Melaleuca decora</i> . The canopy may also include other eucalypts such as Woollybutt <i>E. longifolia</i> . The dense shrubby understorey consists of <i>Melaleuca nodosa</i> and Peach Heath <i>Lissanthe strigosa</i> , with a range of 'pea' flower shrubs, such as <i>Dillwynia tenuifolia</i> , <i>Pultenaea villosa</i> and <i>Daviesia ulicifolia</i> (can be locally abundant). The sparse ground layer contains a range of grasses and herbs. Contains many more species and other references should be consulted to identify these. Occurs in western Sydney, and the extent of intact remnants	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			is now reduced to 1011 ha, with the most extensive stands occurring in the Castlereagh and Holsworthy areas. Smaller remnants occur in the Kemps Creek area and in the eastern section of the Cumberland Plain. Good examples can be seen at the Castlereagh and Windsor Downs Nature Reserves, and Cox Creek Nature Reserve. Has a very restricted natural distribution and mainly occurs on clay soils derived from the deposits of ancient river systems (alluvium), or on shale soils of the Wianamatta Shales. Can intergrade into Shale-Gravel Transition Forest (where the alluvium is shallow), Castlereagh Swamp Woodland (in moist depressions) and Castlereagh Scribbly Gum Woodland (on sandier soils).			
Cumberland Plain Woodland in the Sydney Basin Bioregion Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CEEC	CEEC	Grey Box <i>Eucalyptus moluccana</i> and Forest Red Gum <i>E. tereticornis</i> are the dominant canopy trees, with Narrow-leaved Ironbark <i>E. crebra</i> , Spotted Gum <i>Corymbia maculata</i> and Thin-leaved Stringybark <i>E. eugenioides</i> occurring less frequently. The shrub layer is dominated by Blackthorn <i>Bursaria spinosa</i> , and it is common to find abundant grasses such as Kangaroo Grass <i>Themeda australis</i> and Weeping Meadow Grass <i>Microlaena stipoides</i> var <i>stipoides</i> . Contains many more species and other references should be consulted to identify these. Before European settlement, was extensive across the Cumberland Plain, western Sydney. Today, only 9 percent of the original extent remains intact, with the remnants scattered widely across the Cumberland Plain: in an area bounded by Scheyville (north), Penrith (west), Parramatta (east) and Thirlmere (south). Cumberland Plain Woodland occurs in the Auburn, Bankstown, Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly local government areas. Good examples can be seen at Scheyville National Park and Mulgoa Nature Reserve. Occurs on heavy clay soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Well adapted to drought and fire, and the understorey plants often rely on underground tubers or profuse annual seed production to survive adverse conditions.	N/A	Absent	None
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime: Those that lack standing water most of the time are usually dominated by dense grassland	N/A	Absent	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			<p>or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including <i>Paspalum distichum</i> (water couch), <i>Leersia hexandra</i> (swamp rice-grass), <i>Pseudoraphis spinescens</i> (mud grass) and <i>Carex appressa</i> (tussock sedge). Where they are subject to regular inundation and drying the vegetation may include large emergent sedges over 1 metre tall, such as <i>Baumea articulata</i>, <i>Eleocharis equisetina</i> and <i>Lepironia articulata</i>, as well as emergent or floating herbs such as <i>Hydrocharis dubia</i> (frogbit), <i>Philydrum lanuginosum</i> (frogsmouth), <i>Ludwigia peploides</i> subsp. <i>montevidensis</i> (water primrose), <i>Marsilea mutica</i> (nardoo) and <i>Myriophyllum</i> spp. (milfoils). As standing water becomes deeper or more permanent, amphibious and emergent plants become less abundant, while floating and submerged aquatic herbs become more abundant. These latter species include <i>Azolla filiculoides</i> var. <i>rubra</i>, <i>Ceratophyllum demersum</i> (hornwort), <i>Hydrilla verticillata</i> (water thyme), <i>Lemna</i> spp. (duckweeds), <i>Nymphaea gigantea</i> (giant waterlily), <i>Nymphoides indica</i> (water snowflake), <i>Ottelia ovalifolia</i> (swamp lily) and <i>Potamogeton</i> spp. (pondweeds). The threatened aquatic plants, <i>Aldrovanda vesiculosa</i> and <i>Najas marina</i>, also occur within this community. Known from along the majority of the NSW coast. However, it is distinct from Sydney Freshwater Wetlands which are associated with sandplains in the Sydney Basin bioregion. Extensively cleared and modified. In the 1990s the extent remaining were: 3% in the NSW North Coast bioregion, 66% in the lower Hunter – Central coast region, 40% on the Cumberland Plain, 70% in the Sydney – South Coast region, and 30% in the Eden region. There is less than 150 ha remaining on the Tweed lowlands (estimate in 1985); about 10,600 ha on the lower Clarence floodplain (in 1982); about 11,200 ha on the lower Macleay floodplain (in 1983); about 3,500 ha in the lower Hunter – Central Hunter region (in 1990s); less than 2,700 ha on the NSW south coast from Sydney to Moruya (in the mid 1990s), including about 660 ha on the Cumberland Plain (in 1998) and about 100 ha on the Illawarra Plain (in 2001); and less than 1000 ha in the Eden region (in 1990). Poorly reserved, known to occur in Ukerebagh, Tuckean, Tabbimoble Swamp, Hexham Swamp, Pambalong and Pitt Town Nature Reserves and Bungawalbin, Scheyville and Seven Mile Beach National Parks.</p>			
Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion		CEEC	<p>llawarra Subtropical Rainforest (ISR) is a rainforest community that occupies high nutrient soils in the Illawarra region, south of Sydney. Recorded from the local government areas of Wollongong, Shellharbour, Shoalhaven and Kiama, but may occur elsewhere in the Sydney Basin Bioregion. The main occurrences of ISR are located between Albion Park and Gerringong (referred to as the Illawarra Brush in Mills & Jakeman 1995) and on the</p>	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Berkeley Hills north of Lake Illawarra (referred to as the Berkeley Brush in Mills & Jakeman 1995). Outlying occurrences extend south to the Shoalhaven River and west into the Kangaroo Valley. Occupies the Illawarra coastal plain and escarpment foothills, rarely extending onto the upper escarpment slopes. Usually found on Permian volcanic rocks, but can occur on a range of rock types.			
Kurnell Dune Forest in the Sutherland Shire and City of Rockdale	EEC		A low open sclerophyll forest community with a distinctive moist forest component in its flora. The community occupies coastal dune sand and is often found in association with areas of sclerophyll heath and scrub. Characteristic sclerophyll tree and shrub species include <i>Angophora costata</i> , <i>Banksia ericifolia</i> , <i>Banksia serrata</i> , <i>Eucalyptus botryoides</i> , <i>Eucalyptus robusta</i> , <i>Leptospermum laevigatum</i> and <i>Monotoca elliptica</i> . The moist component of the flora is characterised by species including <i>Breynia oblongifolia</i> , <i>Cissus antarctica</i> , <i>Cissus hypoglauca</i> , <i>Clerodendrum tomentosum</i> , <i>Cupaniopsis anacardioides</i> , <i>Elaeocarpus reticulatus</i> , <i>Endiandra sieberi</i> , <i>Glochidion ferdinandi</i> , <i>Maclura cochinchinensis</i> , <i>Notelaea longifolia</i> , <i>Rapanea variabilis</i> and <i>Stephania japonica</i> var. <i>discolor</i> . Occurs within the local government areas (LGAs) of Sutherland and Rockdale. Within Sutherland LGA, major occurrences of the community are found on the Kurnell Peninsula, with other stands near Bundeena. Within Rockdale LGA, the community is recorded from Leo Smith Reserve.	N/A	Absent	None
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	EEC	CEEC	Generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. These features differentiate littoral rainforest from forest or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as <i>Angophora costata</i> , <i>Banksia integrifolia</i> , <i>Eucalyptus botryoides</i> and <i>Eucalyptus tereticornis</i> occur in many stands. Littoral Rainforest occurs only on the coast and is found at locations in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. Littoral Rainforest is very rare and occurs in many small stands. In total, it comprises less than one percent of the total area of rainforest in NSW. The largest known stand occurs in Iluka Nature Reserve, which is about 136 hectares in size. Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Most stands occur within two kilometres of the sea, though are occasionally found further inland within reach of the maritime	N/A	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			influence. A number of species characteristic of Littoral Rainforest in NSW reach their southern limits at various places along the coast; a number of temperate species are restricted to the south coast; the total Littoral Rainforest flora declines from north to south. The species composition (flora and fauna) of a site will be influenced by its geographic location, the size of the site, its degree of exposure and rainfall, its disturbance history (including fire) and, if previously disturbed, the stage of regeneration.			
<i>Posidonia australis</i> seagrass meadows of the Manning-Hawkesbury ecoregion		EEC	The Subtropical and Temperate Coastal Saltmarsh (hereafter Coastal Saltmarsh) ecological community occurs within a relatively narrow margin of the Australian coastline, within the subtropical and temperate climatic zones south of the South-east Queensland IBRA bioregion boundary at 23° 37' latitude along the east coast and south of (and including) Shark Bay at 26° on the west coast. The Coastal Saltmarsh ecological community consists mainly of salt-tolerant vegetation (halophytes) including: grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses generally dominate and vegetation is generally of less than 0.5 m height (with the exception of some reeds and sedges) (Adam, 1990; see also Sainty et al., 2012a, b for pictorial field guide). Many species of non-vascular plants are also found in saltmarsh, including epiphytic algae, diatoms and cyanobacterial mats. Species characteristic of the ecological community, due to their dominance in at least some of its range, may include: <i>Austrostipa stipoides</i> , <i>Gahnia filum</i> , <i>Juncus kraussii</i> , <i>Samolus repens</i> , <i>Sarcocornia quinqueflora</i> , <i>Sporobolus virginicus</i> , <i>Suaeda australis</i> , <i>Tecticornia pergranulata</i> , <i>Tecticornia arbuscular</i> , <i>Triglochin striata</i> , <i>Wilsonia backhousei</i> and <i>Wilsonia rotundifolia</i> .	N/A	Absent	None
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Given its habitat, the community has an important role in maintaining river ecosystems and riverbank stability. Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water.	N/A	Marginal	Low
Shale Gravel Transition Forest	EEC	CEEC	Has an open forest structure with a canopy dominated by Broad-leaved Ironbark <i>Eucalyptus fibrosa</i> , with Grey Box <i>E. moluccana</i> and Forest Red Gum <i>E. tereticornis</i> occurring less frequently. Paperbark <i>Melaleuca decora</i>	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
<i>in the Sydney Basin Bioregion</i>			is common in the small tree layer. A sparse shrub layer is usually present which includes Blackthorn <i>Bursaria spinosa</i> , <i>Daviesia ulicifolia</i> and Peach Heath <i>Lissanthe strigosa</i> . Contains many more species and other references should be consulted to identify these. Mainly found in the northern section of the Cumberland Plain, western Sydney, in the Richmond, Marsden Park and Windsor districts. Also appears in the Liverpool/ Holsworthy area, and there are small occurrences at Bankstown, Yennora and Villawood and the Kemps Creek area. There are 1,721 ha remaining intact. Good examples can be seen at Windsor Downs Nature Reserve and Kemps Creek Nature Reserve.			
Shale/Sandstone Transition Forest in the Sydney Basin Bioregion	EEC	CEEC	Occurs at the edges of the Cumberland Plain, where clay soils from the shale rock intergrade with soils from sandstone, or where shale caps overlay sandstone. The boundaries are indistinct, and the species composition varies depending on the soil influences. The main tree species include Forest Red Gum <i>Eucalyptus tereticornis</i> , Grey Gum <i>E. 131unctate</i> , stringybarks (<i>E. globoidea</i> , <i>E. eugenioides</i>) and ironbarks (<i>E. fibrosa</i> and <i>E. crebra</i>). Areas of low sandstone influence have an understorey that is closer to Cumberland Plain Woodland. Contains many more species and other references should be consulted to identify these. Before European settlement, was extensive around the edges of the Cumberland Plain, western Sydney, particularly the southern half. Today, only 9,950 ha remains intact (22.6% of its original extent) and the bulk of this occurs in the Hawkesbury, Baulkham Hills, Liverpool, Parramatta, Penrith, Campbelltown and Wollondilly local government areas. It occurs in an area bounded by Sackville (north), Mulgoa (west), Wilton (south) and Revesby (east). Good examples can be seen at Gulguer Nature Reserve. High sandstone influence sites have poor rocky soils, some of the shrubs of which rely on nitrogen-fixing root nodules and soil/root fungi to obtain nutrients.	N/A	Absent	None
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	EEC		An open forest dominated by eucalypts with scattered subcanopy trees, a diverse shrub layer and a well-developed groundcover of ferns, forbs, grasses and graminoids. The dominant trees include <i>Angophora costata</i> , <i>Eucalyptus piperita</i> and occasionally <i>Eucalyptus pilularis</i> , particularly around Helensburgh. Associated with occurrences of <i>Eucalyptus pilularis</i> , <i>Acacia binervata</i> , <i>Elaeocarpus reticulatus</i> , <i>Pittosporum undulatum</i> and a relatively dense groundcover of ferns, grasses, rushes, lilies and forbs. The community typically has an open forest structure, although disturbance may result in local manifestations as woodland or scrub. Found within an estimated total extent of less than 45 000 ha, bounded approximately by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. Within this range, the community is currently estimated to occupy an area of approximately 400 - 4 000 ha. The community has been recorded	N/A	Marginal	Low

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			from the local government areas of Campbelltown, Hurstville, Kogarah, Sutherland, Wollondilly and Wollongong within the Sydney Basin Bioregion and may occur elsewhere in the Bioregion. In Hurstville, Kogarah and Sutherland, the community persists as small fragments surrounded by urban development. The community is also present in the upper Hacking River catchment around Helensburgh and in Royal National Park. The terrain is primarily gentle, with slopes not often exceeding 10°, and where sandstone outcrops occur infrequently. The community is typically associated with sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates.			
Subtropical and Temperate Coastal Saltmarsh		VEC	The physical environment for the ecological community is coastal areas under regular or intermittent tidal influence. In southern latitudes saltmarsh is often the main vegetation-type in the intertidal zone and commonly occurs in association with estuaries. It is typically restricted to the upper intertidal environment, occurring in areas within the astronomical tidal limit, often between the elevation of the mean high tide and the mean spring tide. However, exceptions may occur that retain a regular or intermittent tidal connection and these are still considered to be the ecological community. For example, coastal saltmarsh may occur in intermittently open lagoonal estuaries that are only intertidal when the lagoon is opened (which may only be for limited periods, with periods of several years of closure). Such estuaries, known as ICOLLs (intermittently closed and open lakes and lagoons), are common in NSW and also occur in south-western Western Australia. Also, in South Australia there are extensive supratidal. The Coastal Saltmarsh ecological community may also include areas that have groundwater connectivity to tidal water bodies. For example, groundwater hydrology may play a role in the occurrence of species such as the nationally vulnerable <i>Tecticornia flabelliformis</i> which has a preference for water logging. Also, some sabka-related saltmarshes may be reliant on groundwater tidal flows. saltmarsh communities which occur above the reach of astronomical tides, but are inundated by weather assisted tides (i.e. storm surges, e.g. Gulf St Vincent). Thus it occurs at places with at least some tidal connection, including rarely-inundated supratidal areas and intermittently opened or closed lagoons, but not areas receiving only aerosol spray.	N/A	Absent	None
Swamp Oak Floodplain Forest of the New South	EEC	EEC	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which <i>Casuarina glauca</i> (Swamp Oak) is the dominant species northwards from Bermagui. Other trees including <i>Acmena smithii</i>	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Wales North Coast, Sydney Basin and South East Corner Bioregions			(Lilly Pilly), <i>Glochidion</i> spp. (Cheese Trees) and <i>Melaleuca</i> spp. (Paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and <i>Melaleuca ericifolia</i> is the only abundant tree in this community south of Bermagui. Known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers. Small areas of Swamp Oak Floodplain Forest are contained within existing conservation reserves, including Stotts Island, Ukerebagh, Tuckean, Pambalong, Wamberal, Towra Point and Cullendulla Creek Nature Reserves and Bongil Bongil, Myall Lakes and Conjola National Parks. Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees. Often fringes treeless floodplain lagoons or wetlands with semi-permanent standing water.			
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC		Usually an open to closed forest with a shrubby or reedy/ferny understorey. Has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense. For example, stands dominated by <i>Melaleuca ericifolia</i> typically do not exceed 8 m in height. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. The most widespread and abundant dominant trees include <i>Eucalyptus robusta</i> (Swamp Mahogany), <i>Melaleuca quinquenervia</i> (Paperbark) and, south from Sydney, <i>Eucalyptus botryoides</i> (Bangalay) and <i>Eucalyptus longifolia</i> (Woollybut). This community is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. The exact amount of its original extent is unknown but it is much less than 30%. There are less than 350 ha of native vegetation attributable to this community on the Tweed lowlands, less than 2,500 ha on the Clarence floodplain, less than 700 ha on the Macleay floodplain, up to 7,000 ha in the lower Hunter – central coast district, and less than 1,000 ha in the Sydney – South Coast region. Small areas of Swamp Sclerophyll Forest on Coastal Floodplains are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation. The composition of the community is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil, and latitude. The understorey may have a substantial component of exotic grasses, vines and forbs. Often fringes treeless floodplain lagoons or wetlands with semi-permanent standing water.			
<i>Sydney Freshwater Wetlands in the Sydney Basin Bioregion</i>	EEC		Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes. Swampy areas on alluvium with a saline influence do not fall within this community.	N/A	Present	Recorded
<i>Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion</i>	EEC	CEEC	Occurs close to the shale/sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaus. A transitional community, between Cumberland Plain Woodland in drier areas and Blue Gum High Forest on adjacent higher rainfall ridges.	N/A	Marginal	Low
<i>Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney</i>	EEC		The community is found on a range of substrates, although stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary are rarely adamellite headlands on the north coast. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
Basin and South East Corner Bioregions			hectares or tens of hectares occur. Overall, the community therefore has a highly restricted geographic distribution comprising small, but widely scattered patches.			
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion		EEC	The Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion are generally tall open eucalypt forests found on igneous rock (predominately Tertiary basalt and microsyenite) in, or adjacent to, the Sydney Basin Bioregion. The ecological community occurs in areas of high rainfall, generally ranging from 950 to 1600 mm/year. The ecological community typically occurs as an open to tall open forest with a sparse to dense layer of shrubs and vines, and a diverse understorey of native grasses, forbs, twiners and ferns. However, the structure of the ecological community may vary from tall open forest with trees up to and above 30 m tall with a projected foliage cover of 30–70% (e.g. <i>Eucalyptus fastigata</i> forest on basalt near Sassafras in and around Morton National Park) to woodland with trees 10–30 m tall, with a projected foliage cover of 10–30% (e.g. exposed woodland on rocky microsyenite at Mt Jellore) depending on aspect, slope, soil conditions, soil depth, and previous clearing and disturbance. With increasing distance from the coast (and a corresponding decrease in rainfall), the understorey tends to grade from relatively mesic (significant component of rainforest species), to relatively scleric (more drought and fire tolerant shrubs and a more prominent grass layer). Rainforest elements are also present in less coastal remnants with sheltered aspects and topography, and along watercourses. The ecological community may also be affected by cold air drainage and ponding resulting in a more open, grassy forest.	N/A	Marginal	Low
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	EEC	CEEC	A dry vine scrub community of the Cumberland Plain, western Sydney. Canopy trees include Prickly Paperbark <i>Melaleuca styphelioides</i> , Hickory Wattle <i>Acacia implexa</i> and Native Quince <i>Alectryon subcinereus</i> . There are many rainforest species in the shrub layer, such as Mock Olive <i>Notolaea longifolia</i> , Hairy Clerodendrum <i>tomentosum</i> and Yellow Pittosporum <i>Pittosporum revolutum</i> . The shrub layer combines with vines, such as Gum Vine <i>Aphanopetalum resinosum</i> , Wonga Vine <i>Pandorea pandorana</i> and Slender Grape <i>Cayratia clematidea</i> to form dense thickets in sheltered locations. Very restricted and occurs most commonly in the far southern section of the Cumberland Plain, in the Razorback Range near Picton. Outlying occurrences have been recorded at Grose Vale and Cattai. There are 338 hectares remaining intact, the majority of these occurring in the Wollondilly local government area, but occurring to a lesser extent in the Baulkham Hills, Camden, Hawkesbury, Parramatta and Ryde local	N/A	Absent	None

Species	BC Act/ FM Act	EPBC Act	Description of Habitat ¹	BioNet Records	Presence of Habitat	Likelihood of Occurrence
			government areas. A small remnant can be seen in Fairfield City Farm. Vine thickets in Western Sydney Dry Rainforest provide good habitat for birds and mammals. Restricted to hilly country where it occurs on the sheltered lower slopes and gullies. Generally found at higher elevation, in areas receiving higher rainfall than areas of Cumberland Plain Woodland. Occurs on clay soils derived from Wianamatta shale.			

Appendix C – Tests of Significance (BC Act)

Biodiversity Conservation Act 2016 Five-Part Test

The Biodiversity Conservation Act 2016 (BC Act) specifies a set of five factors which must be considered by decision makers in assessing the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. These factors are collectively referred to as the ‘five-part test’ or Test of Significance (ToS). ToS have been undertaken for the following BC Act listed entities:

Threatened Ecological Communities

- Sydney Freshwater Wetlands (Endangered Ecological Community)

Flora

- *Allocasuarina diminuta* subsp. *mimica* population in the Sutherland and Liverpool local government areas (Endangered Population)
- *Thick-leaf Star-hair Astrotricha crassifolia*
- Small-flower *Grevillea Grevillea parviflora* subsp. *parviflora* (Vulnerable)
- Woronora Beard-heath *Leucopogon exolasius* (Vulnerable)
- Deane’s Paperbark *Melaleuca deanei* (Vulnerable)
- *Hibbertia stricta* subsp. *furcatula* (Endangered)

Fauna

- Forest Owls
 - Powerful Owl *Ninox strenua* (Vulnerable)
 - Sooty Owl *Tyto tenebricosa* (Vulnerable)
- Woodland Birds
 - Varied Sittella *Daphoenositta chrysoptera* (Vulnerable)
 - Dusky Woodswallow *Artamus cyanopterus cyanopterus* (Vulnerable)
- Wetland Birds
 - Australian Bittern *Botaurus poiciloptilus* (Endangered)
- Amphibians
 - Giant Burrowing Frog *Heleioporus australiacus* (Vulnerable)
 - Red-crowned Toadlet *Pseudophryne australis* (Vulnerable)
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable)
- Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable)
- Southern Myotis *Myotis macropus* (Vulnerable)
- Koala *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) (Vulnerable)
- Eastern Pygmy Possum *Cercartetus nanus* (Vulnerable)
- Sydney Hawk Dragonfly *Austrocordulia leonardi* (Endangered)
- Broad-headed Snake *Hoplocephalus bungaroides* (Endangered)
- Fish
 - Macquarie Perch
 - Australian Grayling

Threatened Ecological Communities: Sydney Freshwater Wetlands

<p>a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>N/A</p>
<p>b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <ul style="list-style-type: none"> i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction. ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
<p>PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner comprises approximately 0.04 ha of the vegetation within the proposal site. This PCT is consistent with the EEC ‘Sydney Freshwater Wetlands’. This vegetation includes pockets of aquatic macrophytes observed in the Woronora River which traverses the proposal site and provides important habitat resources for other threatened species. Up to 0.05 ha of this EEC will be impacted as a result of the proposed works. Given the fact that this vegetation is present both upstream and downstream of Heathcote Bridge, the proposed works are not likely to have an adverse effect on the extent of this EEC such that its local occurrence is likely to be placed at risk of extinction. Similarly, the composition of the local occurrence is unlikely to be altered to a point where it would no longer qualify as Sydney Freshwater Wetlands in accordance with the final determination for the community.</p>
<p>c) In relation to the habitat of a threatened species or ecological community:</p> <ul style="list-style-type: none"> i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.
<ul style="list-style-type: none"> i. The proposal would impact/remove 0.05 ha of habitat for Sydney Freshwater Wetlands, comprised of PCT 781. This is 83% of the community within the proposal area, however extensive areas of similar condition PCT occur immediately adjacent to and beyond the proposal area. ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. Similar habitat to that being removed is present upstream and downstream from the bridge. iii. The extent of Sydney Freshwater Wetlands and habitat that would be removed for the proposal is not considered important to the long-term survival of the community as it is part of a larger local occurrence.
<p>d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).</p>
<p>The study area does not contain a declared area of outstanding biodiversity value.</p>

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

The proposal is part of, or may contribute to, the following key threatening processes relevant to Sydney Freshwater Wetlands:

- Clearing of native vegetation
- Invasion of plant communities by exotic perennial grasses
- Invasion and establishment of exotic vines and scramblers.
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

Clearing of native vegetation is a direct impact to Sydney Freshwater Wetlands that would result from the proposal. 0.05 ha of the local occurrence would be removed, however this is considered unlikely to place it at risk of extinction given the local context.

The remaining key threatening processes concern indirect impacts. Those regarding invasion of exotic plants are already in effect to some degree within the study area. No evidence of pathogens was observed during the site surveys. The mitigation measure outlined in this BA will aid to minimise the potential risks of these indirect impacts.

Conclusion

The proposal would result in the reduction of the local occurrence of Sydney Freshwater Wetlands by 0.05 ha. This reduction would occur in areas of vegetation beneath Heathcote Bridge.

These direct impacts are not considered likely to adversely affect the extent or composition of the local occurrence such that it would be placed to risk of extinction.

Indirect impacts, such as weed and pathogen invasion, are processes that may already be present in the study area. The mitigation measures outlined in the BA will minimise the risk of the proposal exacerbating these processes.

Considering the above, the proposal is considered unlikely to generate a significant impact to the local occurrence of Sydney Freshwater Wetlands.

Flora

- ***Allocasuarina diminuta subsp. mimica* population in the Sutherland and Liverpool local government areas**
- **Small-flower *Grevillea parviflora subsp. parviflora***
- **Woronora Beard-heath *Leucopogon exolasius***
- **Thick-leaf Star-hair *Astrotricha crassifolia***
- **Deane's Paperbark *Melaleuca deanei***
- ***Hibbertia woronorana***
- ***Hibbertia stricta subsp. furcatula***

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

Allocasuarina diminuta subsp. mimica

This endangered population occurs along sandstone ridges and upper hillsides and is restricted to the Sutherland and Liverpool Local Government Areas. There are two records of this species within 2 km of the proposal area. The nearest record is approximately 280 m from the proposal area.

The species was not observed during site surveys. Therefore, no known records would be removed and the proposed action is not considered likely to place the local viable population at risk of extinction.

Thick-leaf Star-hair

Thick-leaf Star-hair occurs in dry sclerophyll woodland on sandstone near Patonga, in the Royal National Park and on the Woronorana Plateau.

The species was not observed during site surveys. There are many Bionet records of this species south of the site near Lake Woronorana but no records within 2 km of the proposal area, therefore no known records would be removed by the proposal actions. The action proposed is not considered likely to place the local viable population at risk of extinction.

Hibbertia stricta subsp. furcatula

Hibbertia stricta subsp. furcatula (*Hibbertia* sp. nov. 'Menai') is known to occur in two populations, one in the southern outskirts of Sydney, and one near Nowra on the mid-South Coast of NSW. The Southern Sydney population occurs on both sides of the Woronora River gorge, near Loftus and in Royal National Park. Habitat of the Southern Sydney population is broadly dry eucalypt forest and woodland. This population appears to occur mainly on upper slopes and above the Woronora River gorge escarpment, at or near the interface between the Lucas Heights soil landscape and Hawkesbury sandstone.

The species was not observed during site surveys. There are 17 Bionet records of this species within 10 km of the site with some of the records along Heathcote Rd 5 km north of the proposal area. Approximately, 2.53 ha of potential habitat would be removed under the current proposal. Given that no individuals were recorded during the surveys and the small area to be impacted is unlikely that the habitat to be removed will significantly impact the survival of the species such that it would be placed at risk of extinction.

Hibbertia woronorana

Within the *H. acicularis* group, a new subspecies has been described. It is not listed under the BC Act, but is restricted to the mid and lower reaches of the Woronora River, New South Wales. Growing on rocky sandstone slopes in sclerophyll forest comprised of *Angophora costata*, *Corymbia gummifera*, *Eucalyptus punctata* and *stringybark* sp. in association with *Allocasuarina littoralis*, *Doryanthes excelsa*, *Banksia serrata*, *Dodonaea triquetra*, *Platysace linearifolia*, *Epacris pulchella*, *Hakea dactyloides*, *Grevillea buxifolia*, *Grevillea diffusa*, *Acacia linifolia*, *Xanthosia tridentifera*. Highly restricted small localised populations within Heathcote National Park though locally common at some sites (R.T.Miller & J.Miller 69/18.iii.2007). Extremely vulnerable to disturbances, rare and possibly endangered downstream of the Needles.

The species was not observed during site surveys, however it has a very high likelihood of occurring given its type location as Woronora River at Heathcote Bridge. There is a high possibility that the proposal would have an adverse effect on the life cycle of a viable local population, given the restricted distribution of this species.

Small-flower Grevillea

Small-flower Grevillea is distributed sporadically throughout the Sydney Basin region. It prefers sandy or light clay soils over thin shales, and grows in a variety of vegetation types, including slightly disturbed areas.

The species was not observed during site surveys, and there are no BioNet records within 2 km of the proposal area, therefore no known records would be removed by the proposal actions. The action proposed is not considered likely to place the local viable population at risk of extinction.

Woronora Beard-heath

Woronora Beard-heath is known to occur along the upper Georges River area and Heathcote National Park, in woodland on sandstone.

There are three BioNet records of this species within 2 km of the proposal site, the nearest 425 m from the proposal area boundary. While this species was not observed during site surveys, it is known to occur in Heathcote National Park which is directly adjacent to the proposal area.

Provided no individuals are identified on site, the action proposed is not considered likely to place the local viable population at risk of extinction.

Deane's Paperbark

Deane's Paperbark occurs mainly in ridgetop woodland, with around 5% of sites in heath on sandstone.

There is one BioNet record of Deane's Paperbark within 2 km of the proposal site, approximately 1.6 km from the impact area, within Heathcote National Park. A distinctive shrub growing up to 3 m high, this species was not observed during site visit and therefore unlikely to be present in the area. The action proposed is not considered likely to place the local viable population at risk of extinction.

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

- i. **Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. **Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. **The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. **Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. **The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

Allocasuarina diminuta subsp. mimica

- i. The proposal would remove up to approximately 3.03 ha of potential habitat for *Allocasuarina diminuta subsp. mimica*.
- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge. There are no known records within this area.

- iii. The habitat proposed to be removed is not considered integral to the long-term survival of the *Allocasuarina diminuta subsp. mimic*. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

Thick-leaf Star-hair

- i. The proposal would remove approximately 2.53 ha of potential habitat for Thick-leaf Star-hair.
- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge, and is unlikely to be the preferred habitat for this species.

The habitat proposed to be removed is not considered integral to the long-term survival of the Thick-leaf Star-hair. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

Hibbertia stricta subsp. furcatula

- i. The proposal would remove up to approximately 3.03 ha of potential habitat for *Hibbertia stricta subsp. furcatula*.
- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge, and is unlikely to be the preferred habitat for this species.

The habitat proposed to be removed is not considered integral to the long-term survival of the *Hibbertia stricta subsp. furcatula*. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

Hibbertia woronorana

- i. The proposal would remove up to approximately 3.03 ha of potential habitat for *Hibbertia woronorana*.
- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge.
- iii. Given the limited distribution of this newly described species, the habitat proposed to be removed may be important to the long-term survival of the *Hibbertia woronorana*.

Small-flower Grevillea

- iii. The proposal would remove up to approximately 3.03 ha of potential habitat for Small-flower Grevillea.
- iv. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge, and is unlikely to be the preferred habitat for this species.
- v. The habitat proposed to be removed is not considered integral to the long-term survival of the Small-flower Grevillea. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

Woronora Beard-heath

- i. The proposal would remove approximately 2.53 ha of potential habitat for Woronora Beard-heath.

- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge. The species is known in the area, however not observed during site surveys.
- iii. The habitat proposed to be removed is not considered integral to the long-term survival of the Woronora Beard-heath. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

Deane's Paperbark

- i. The proposal would remove up to approximately 3.03 ha of potential habitat for Deane's Paperbark.
- ii. The area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed consists of a small area of vegetation surrounding Heathcote Bridge, and is unlikely to be the preferred habitat for this species.
- iii. The habitat proposed to be removed is not considered integral to the long-term survival of the Deane's Paperbark. This species is not known to be present. The area of vegetation to be impacted is small given the local context.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The following key threatening process is relevant to the threatened flora species:

- Clearing of native vegetation

The clearing of native vegetation and construction of associated infrastructure for urban development is known to directly and indirectly impact on the lifecycle of threatened flora species.

Up to 3.03 ha of habitat would be removed, which will increase the impact of the above key threatening process.

The mitigation measures outlined in this BA would minimise potential risks to potential viable local populations including a targeted search to ensure that potentially overlooked individuals within the study area, are accounted for, prior to clearing works.

Conclusion

Allocasuarina diminuta subsp. *mimica*, Thick-leaf Star-hair, *Hibbertia stricta* subsp. *furcatula*, Small-flower Grevillea, Woronora Beard-heath or Deane's Paperbark:

While the size of potential viable local population of the threatened flora species is unknown, it is assumed that this population is viable and may extend into the study area. None of the species were observed during site surveys and there are no records from within the proposal area.

Up to 3.03 ha of potential habitat, some of which is sub-optimal, would be removed amongst a much larger area of habitat in the region, including the high-quality habitat throughout Heathcote National Park and Holsworthy Military Reserve.

Considering the above, the proposal is considered unlikely to generate a significant impact to populations of *Allocasuarina diminuta subsp. mimica*, Thick-leaf Star-hair, *Hibbertia stricta subsp. furcatula*, Small-flower Grevillea, Woronora Beard-heath or Deane's Paperbark.

Hibbertia woronorana:

Given that this species is restricted to the lower reaches of the Woronora River, and that its type locality is from Heathcote Bridge, there is a high likelihood that this species may be impacted by the proposal. While not currently listed as a threatened species, advice should be sought from the Department of Planning, Industry and Environment and relevant experts prior to commencement of works to identify location of known individuals.

Forest Owls

- **Powerful Owl *Ninox strenua***
- **Sooty Owl *Tyto tenebricosa***

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

Within the study locality there are considered to be viable local populations of Powerful Owl and Sooty Owl.

These species, though not recorded during the assessment, may utilise the resources (primarily foraging but also roosting and shelter habitat) within the study area or traverse the study area on occasion. There are seven records of Sooty Owl within 2 km of the proposal area. The nearest record is 313 m from the proposal site. Key habitat features include eucalypt woodland with hollow-bearing trees. A dense midstorey is also present which is a preference of Sooty Owl. Similarly, dense mesic riparian vegetation would constitute suitable roosting habitat for the Powerful Owl.

These owls nest in large tree hollows. Powerful Owl requires a hollow greater than 45 cm diameter; Sooty Owl greater than 40 cm (DECC 2006).

21 hollow-bearing trees were present within the proposal area and up to 16 will be removed. Up to five contain hollows greater than 20 cm.

The study area is subject to anthropogenic disturbance, which is likely to deter nesting, particularly for the Powerful Owl. Given these trees are located on the fringe of habitat directly adjacent to the road, the chance of these tree hollows being used as nesting sites is of a low likelihood. Higher quality habitat is present in the region including Heathcote National Park and Holsworthy Military Reserve.

The proposed action will remove a small amount of foraging habitat (up to 3.12 ha) which is not considered likely to place these species at risk of extinction given the local context. The study area is subject to anthropogenic disturbance, which is likely to deter nesting, particularly for the Powerful Owl. Given these trees are located on the fringe of habitat directly adjacent to the road, the chance of these tree hollows being used as nesting sites is of a low likelihood. Higher quality habitat is present in the region including Heathcote National Park and Holsworthy Military Reserve.

The proposed action will remove a small amount of foraging habitat (up to 3.12 ha) which is not considered likely to place these species at risk of extinction given the local context.

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

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which is potential foraging habitat for these species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local forest owl populations, as similar, higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening processes relevant to forest owls:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to forest owls that would result from the proposal due to the loss of foraging habitat.

Conclusion

The proposal would result in the removal of up to 3.12 ha of foraging habitat for Powerful Owl and Sooty Owl. This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road and are not of high quality in the context of the surrounding habitat. These direct impacts are not considered likely to adversely affect the viable local populations of these species.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened forest owls.

Woodland Birds

- Varied Sittella *Daphoenositta chrysoptera*
- Dusky Woodswallow *Artamus cyanopterus cyanopterus*

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

Within the study locality there are considered to be viable local populations of Varied Sittella and Dusky Woodswallow.

Varied Sittella and Dusky Woodswallow have broad habitat preferences which are met by the proposal area vegetation. These species, not recorded during the assessment, may utilise the resources (primarily for foraging, but also nesting) within the study area or traverse the study area on occasion.

Varied Sittella inhabits eucalypt, mallee and Acacia woodland. It has a preference for areas with rough barked trees, and is generally sedentary. Dusky Woodswallow inhabits a large variety of habitats including forests, woodlands, paddocks, coastal/sub-inland scrubs, and urban environments.

There is one BioNet record of Dusky Woodswallow with 2 km of the proposal area (2.8 km), and no records of the Varied Sittella.

The proposed action will remove a small amount of (primarily) foraging habitat (up to 3.12 ha) for Varied Sittella and Dusky Woodswallow. As this habitat is located on the fringe of habitat directly adjacent to the road, and higher quality habitat is present nearby, this is not considered likely to place these species at risk of extinction.

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

- i. **Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. **Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. **The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. **Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. **The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides nesting and foraging habitat for these species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local woodland bird populations as similar, higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening processes relevant to woodland birds:

- Clearing of native vegetation
- Removal of dead wood and dead trees

Clearing of native vegetation is a direct impact to woodland birds that would result from the proposal due to the loss of foraging habitat. Up to 3.12 ha of the native vegetation would be removed.

Removal of dead wood and dead trees would be limited and is unlikely to impact local woodland bird populations markedly.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat for Varied Sittella and Dusky Woodswallow.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road and are not of high quality in the context of the surrounding habitat. These direct impacts are not considered likely to adversely affect the viable local populations of these species.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened woodland birds.

Wetland Birds

- **Australian Bittern *Botaurus poiciloptilus***

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

Within the study locality there are considered to be viable local populations of Australian Bittern.

Australian Bittern inhabits edges of pools and waterways with tall dense vegetation such as sedges, rushes and reeds. Pockets of aquatic macrophytes were observed in the study area, as part of PCT 781 Coastal Freshwater Lagoons. These provide potential shelter and foraging habitat for Australian Bittern.

There are no BioNet records of Australian Bittern with 2 km of the proposal area.

The proposed action will remove a small amount of potential habitat (up to 0.05 ha of freshwater wetland habitat, PCT 781) for Australian Bittern. As this this habitat is located on the fringe of habitat directly adjacent to the road, and additional higher quality habitat is present nearby, this is not considered likely to place these species at risk of extinction.

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

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 0.05 ha of freshwater wetland habitat would be removed/impacted, which provides shelter and foraging habitat for this species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of Australian Bittern as similar habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening processes relevant to wetland birds:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to wetland birds that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed, including up to 0.05 ha of freshwater wetland habitat.

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 0.05 ha of habitat for Australian Bittern.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of this species.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Australian Bittern.

Amphibians

- **Giant Burrowing Frog *Heleioporus australiacus***
- **Red-crowned Toadlet *Pseudophryne australis***

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

Within the study locality there are considered to be viable local populations of Giant Burrowing Frog and Red-crowned Toadlet.

The Giant Burrowing Frog is found in heath, woodland and open dry sclerophyll forest, and spends more than 95% of its life in non-breeding habitat up to 300 m away, where it burrows beneath soil and leaf litter. Home ranges can be up to 0.04 ha in size. Breeding habitat includes soaks or pools within first and second order streams.

Red-crowned toadlet inhabits open forests, periodically wet drainage lines, and shelters under rocks or in dense vegetation and leaf litter. Breeding habitat includes ephemeral creeks and gutters. Red-crowned Toadlet has not been recorded breeding in waters that are even mildly polluted. They are not usually found outside the immediate vicinity of breeding habitat.

The Woronora River is considered unlikely to provide habitat for these species, however habitat adjacent to the river provides potential habitat. Rock pools adjacent to the river may provide suitable breeding habitat for Giant Burrowing Frog.

There are no BioNet records of these species within 2 km of the proposal area.

The proposed action will remove a small amount of primarily non-breeding habitat (up to 3.12 ha) for Giant Burrowing Frog and Red-crowned Toadlet. As similar and higher quality habitat is present along the length of the Woronora River, and there are no records from within 2 km, the proposal is not considered likely to place these species at risk of extinction.

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

- Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides primarily non-breeding habitat for these species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local amphibian species as similar, higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to amphibians:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to amphibians that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed.

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat for Giant Burrowing Frog and Red-crowned Toadlet.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road and are not of high quality in the context of the surrounding habitat. These direct impacts are not considered likely to adversely affect the viable local populations of these species, given there are no records within 2 km of the proposal area.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened amphibians.

Broad-headed Snake *Hoplocephalus bungaroides*

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

Within the study locality there are considered to be viable local populations of Broad-headed Snake. The Royal, Heathcote and Garawarra reserve complex are considered a regional 'hotspot' for broad-headed snake (Schulz & Magarey 2012). Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in crevices or hollows in large trees within 500 m of escarpments in summer. Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally. Females produce four to 12 live young from January to March, which is a relatively low level of fecundity. The proposal site is only likely to provide summer breeding habitat in the form of tree hollows. Literature suggests that they prefer dead trees with a large DBH, and hence large hollows (Croak *et al.* 2013). The proposal will remove up to 16 hollow-bearing trees. Of these, up to five are large (>20 cm). Given the extent of available habitat in the surrounding landscape, the removal of 3.12 ha of potential habitat is unlikely to place a viable local population at risk of extinction.

- b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**
- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
 - ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

- c) In relation to the habitat of a threatened species or ecological community:**
- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
 - ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
 - iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation and up to five large hollow-bearing trees would be removed, which provides primarily breeding and summer refuge habitat for this species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of the Broad-headed Snake, as higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening processes relevant to the Broad-headed Snake:

- Clearing of native vegetation
- Loss of Hollow-bearing Trees
- Bushrock removal.

Clearing of native vegetation is a direct impact to this species that would result from the proposal due to the loss of summer refuge habitat. Up to 3.12 ha of the native vegetation would be removed.

One large hollow-bearing tree that may provide suitable breeding habitat would be removed as a result of the proposal.

Bushrock removal is a significant threat to this species, which is most likely to utilise bushrock habitat at the top of the escarpment during autumn, winter and spring. The construction program will involve rock disturbance over an approximate 22 month period. Impacts to this species will be mitigated by actions in accordance with *Guide 4: Clearing of vegetation and removal of bush rock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011)

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat and up to five suitable hollow-bearing trees for Broad-headed Snake.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road and are not of high quality in the context of the surrounding habitat. These direct impacts are not considered likely to adversely affect the viable local populations of this species.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Broad-headed Snake.

Grey-headed Flying-fox *Pteropus poliocephalus*

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

Within the study locality there are considered to be viable local populations of Grey-headed Flying-fox.

This species inhabits subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps, urban gardens and cultivated fruit crops. Roosting camps are generally found within 20 km of a regular food source, commonly in gullies, close to water with a dense canopy. Grey-headed Flying-fox can travel up to 50 km from their camps to forage.

The are 13 BioNet records within 2 km of the proposal area, with the nearest record 320 m away. The nearest known camp is approximately 10.5 km from the proposal area, near Yowie Bay (National Flying-fox monitoring viewer, DoE 2019).

The proposal area provides suitable foraging habitat as it contains preferred food tree species including *Eucalyptus* and *Banksia*, and is within 50 km from a known camp.

The proposed action will remove a small amount of foraging habitat (up to 3.12 ha), which is not considered likely to place these species at risk of extinction given that similar foraging habitat resources are present in the surrounding landscape, and the large foraging range of this species.

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

- i. **Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. **Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. **The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. **Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. **The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides foraging habitat for this species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of Grey-headed Flying-fox as similar, higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to Grey-headed Flying-fox:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to this species that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed.

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of foraging habitat for Grey-headed Flying-fox.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of these species, given there are no camps within the proposal area, the species has a large foraging range, and alternative foraging habitat is plentiful in the region.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Grey-headed Flying-fox.

Large-eared Pied Bat *Miniopterus orianae oceanensis*

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

Within the study locality there are viable local populations of Large-eared Pied Bat.

Large-eared Pied Bat inhabits well-timbered areas containing gullies in dry open forest. They roost in caves, cliff crevices, old mine workings and disused Fairy Martin mud nests.

There are no BioNet records of this species within 2 km of the proposal area. The habitat within the proposal area is not considered suitable for roosting or nesting, but does provide foraging habitat.

The proposed action will remove a small amount of foraging habitat (up to 3.12 ha), which is not considered likely to place these species at risk of extinction given that similar foraging habitat resources are present in the surrounding landscape.

- b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**
- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
 - ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides foraging habitat for this species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of Large-eared Pied Bat as similar, higher quality habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to Large-eared Pied Bat

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to this species that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed.

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of foraging habitat for Large-eared Pied Bat.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of these species, given there are no records within 2 km of the proposal area and alternative foraging habitat is available.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Large-eared Pied Bat.

Southern Myotis *Myotis macropus*

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

Within the study locality there are considered to be viable local populations of Southern Myotis.

Southern Myotis roosts in groups up to 15 individuals close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage over streams and pools.

While there are no BioNet records of this species within 2 km of the proposal area, the species was identified utilising scuppers within the bridge. Up to five individuals were detected during the targeted survey.

All scuppers within the bridge will be removed for the purpose of widening. As such, the removal of all roosting and breeding habitat within the structure is assumed. Additionally, up to 16 hollow-bearing trees will be impacted by the works. The proposal involves the creation of new scuppers, and the installation of bat roosting structures, which have successfully provided habitat for the species post-construction on other projects.

Additionally, the proposed action will remove a small amount of foraging habitat (up to 3.12 ha) for Southern Myotis.

While breeding habitat will be impacted for the duration of the works, the availability of habitat will be maintained and enhanced in the future. As such the proposal is not considered likely to place the species at risk of extinction given similar resources are present in the surrounding landscape and potential roosting structures will remain in the long-term.

- b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

- c) In relation to the habitat of a threatened species or ecological community:**

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides potential habitat for Southern Myotis. The scuppers would be removed for the duration of the works however additional habitat would be created as a result of the works, leading to a net increase in the availability of roosting and potential breeding habitat for the species.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.

iii.	The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local Southern Myotis populations as similar habitat would remain in the surrounding landscape that is contiguous with the study area, and the total area of habitat would increase as a result of the proposal.
d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).	
The study area does not contain a declared area of outstanding biodiversity value.	
e) Whether the proposed development or activity is part of a key threatening process or is likely to increase the impact of a key threatening process.	
<p>The proposal is part of, or may contribute to, the following key threatening process relevant to Southern Myotis:</p> <ul style="list-style-type: none"> • Clearing of native vegetation <p>Clearing of native vegetation is a direct impact to Southern Myotis that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed.</p> <p>Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.</p>	
Conclusion	
<p>The proposal would result in the removal up to 3.12 ha of habitat for Southern Myotis.</p> <p>A microbat management plan would be prepared as part of the proposal to manage direct impacts to individuals roosting within the bridge, and the bridge design would incorporate habitat for the species leading to a net increase in the habitat area for the species in the long-term.</p> <p>The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.</p> <p>Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Southern Myotis.</p>	

Koala *Phascolarctos cinereus*

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	
<p>Within the study locality there is considered to be a viable local population of Koala. The proposal area is mapped within the Sutherland LGA which is not covered by the 'Koala Development Application Map' and therefore the SEPP (Koala Habitat Protection) 2019 does not apply. (DPIE 2020). The proposal area provides connectivity to areas of koala habitat within the Campbelltown LGA which contains a key population. Lunney et al. (2010) found that Koalas at Heathcote (and therefore within the proposal area) are genetically indistinguishable from the Campbelltown Koala population, which means that they should be considered part of a single population connected by the Holsworthy Army Range. This same report identifies that high-quality Koala habitat is maintained throughout the region as protected area (i.e. national park, Sydney Catchment Authority land).</p>	

The proposal area falls within the Bungonia ARKS, which is identified as being of regional significance for Koala (DPIE 2020b).

DECCW (2011) found that Heathcote and Royal National Parks do not contribute significantly to the regional conservation of Koala, as sightings are infrequent, sparse and generally relate to either rehabilitate and released individuals or wide-ranging individuals from the core Campbelltown population. Their vertebrate fauna study concluded that the occurrence of Koala in the general proposal area is likely to be uncommon and relate to a non-breeding population.

Within the 10 km Study area, there are 186 Koala records stretching back to 1934 and including 13 records to date in 2020 (BioNet, accessed 21st October 2020). There are 18 BioNet records within 2 km of the proposal area, including a 2010 live sighting and two roadkill records from Heathcote Road at the proposal site (in 2018, carcasses found together). This indicates that the study area does provide habitat and is a corridor for movement.

The existence of suitable shelter and movement habitat, along with numerous records from the area, means that Koala are likely to be present or traverse through the study area.

No key feed tree species identified for the Wollondilly koala population were recorded during the survey and it is unlikely that the proposal will result in removal of any feed trees. The proposed action will remove a small amount of habitat (up to 3.12 ha), which is not considered likely to place the local population at risk of extinction, given the lack of preferred Koala feed trees and the adjacent intact, protected habitat (i.e. Heathcote and Royal National Parks).

The Koala population in the broader area is considered to have a 'moderate' resilience to threats within the landscape; within 'moderate to high' functional habitat. This suggests that the Koala has a moderate likelihood of future persistence, considering current and future threats. High threats to Koala in this ARKS are wildfire, vehicle strike and dog attack (DPIE 2020b).

Heathcote Road already represents a barrier to Koala, evidenced by roadkill records within the proposal area. The proposed widening is unlikely to significantly increase this threat. During construction, connectivity below the bridge may be temporarily reduced, however it is not considered likely that Koala use this access currently, given the exposed and compacted nature of ground.

The proposal provides an opportunity to decrease this barrier and improve movement opportunity for Koala. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas under the bridge, and specific Koala crossing infrastructure and targeted restoration to facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit to the Koala. Bridges with a dry fauna passage underneath are proven to successfully facilitate fauna crossing, including for Koala (Department of Transport and Main Roads [TMR] 2010). Monitoring for the Bonville Pacific Highway Upgrade recorded 11 successful crossings by Koala at such a bridge (as at 2014; Roads and Maritime 2019).

Bridge design principles relevant to the current proposal should include:

- Natural substrate
- Unimpeded riparian vegetation
- Minimum width of 3 m between the toe of scour protection and the top of bank (where possible), with refuge areas (i.e. logs, fauna furniture).

Fencing should consider relevant guidelines (i.e. TMR 2010), guide animals towards the crossing point, exclude fauna from the road but allow them to escape back from the road.

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

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i.** Up to 3.12 ha of native vegetation would be removed, which provides potential foraging and shelter habitat for Koala. No feed trees are likely to be removed.
- ii.** An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of core habitat and would already be subject to edge effects.
- iii.** The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local Koala populations, as higher quality habitat would remain intact and protected in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to Koala:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to Koala that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed, which does not include Koala feed trees.

Given the local context, this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat for Koala, which does not include Koala feed trees and is not considered to support a breeding population (DECCW 2011).

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high existing disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of this species, given the presence of similar habitat in the area.

Vehicle strike along Heathcote Road is already a recognized threat to Koala. The proposal provides an opportunity to decrease this barrier and improve movement opportunity for Koala. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas under the bridge, and specific Koala crossing infrastructure and targeted restoration to facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit to the Koala.

Other mitigation measures outlined in the report above will minimise the severity of any direct and indirect impacts on Koala which may be generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the threatened Koala.

Eastern Pygmy Possum *Cercartetus nanus*

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

Within the study locality there are considered to be viable local populations of Eastern Pygmy Possum.

These species, while not recorded during the assessment, may utilise the resources within the study area or traverse the study area. There are no BioNet records of this species within 2 km of the proposal area however this species can be difficult to detect, especially in winter where time is spent in torpor.

Eastern Pygmy Possums inhabit a broad range of habitats, with preference from woodlands and heath. They feed on nectar, pollen, and soft fruits. Tree hollows, rotten stumps, holes, abandoned nests, possum dreys, vegetation thickets and built nests are used for shelter.

Suitable foraging habitat exists in the study area including *Banksias* and flowering gums, as well as hollow bearing trees for shelter.

Up to 16 hollow-bearing trees would be removed by the proposal.

The proposed action will remove a small amount of habitat (up to 3.12 ha) for Eastern Pygmy Possum, which is not considered likely to place the species at risk of extinction given similar resources are present in the surrounding landscape and potential nesting structures will remain.

- b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**
- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
 - ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- iv. **The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- v. **Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- vi. **The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 3.12 ha of native vegetation would be removed, which provides potential foraging and shelter habitat for Eastern Pygmy Possum.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. The habitat to be removed is located at the edge of a much larger patch of habitat.
- iii. The extent of habitat that would be removed for the proposal is not considered important to the long-term survival of local Eastern Pygmy Possum populations as similar habitat would remain in the surrounding landscape that is contiguous with the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to Eastern Pygmy Possum:

- Clearing of native vegetation

Clearing of native vegetation is a direct impact to Eastern Pygmy Possum that would result from the proposal due to the loss of habitat. Up to 3.12 ha of the native vegetation would be removed.

Given the local context this vegetation removal is considered unlikely to significantly contribute to this key threatening process.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat for Eastern Pygmy Possum.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of this species, given the presence of similar habitat in the area.

The mitigation measures outlined in the BA will minimise the severity of the direct and indirect impacts generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Eastern Pygmy Possum.

Sydney Hawk Dragonfly

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

Potential habitat for the Sydney Hawk Dragonfly is present at the proposal site. Targeted surveys for this species in accordance with the survey guidelines were undertaken and did not record its presence. The type locality for the Sydney Hawk Dragonfly is a deep pool above the weir at Heathcote in the Woronora River. Preferred habitat includes slow-flowing water in rocky rivers with steep sides that provide shady resting areas. A very rare species, all specimens collected have come from deep riverine pools with cooler water (along the Woronora River, Kangaroo Creek and Nepean River). Intensive surveys by Theischinger and colleagues (Theischinger, pers. comm.) have failed to detect the presence of any of the life stages of *Austrocordulia leonardi* along the Woronora River and Kangaroo Creek since the removal of the weir in the Woronora River at Heathcote in 1986 (Hawking & Theischinger, 2004). The Sydney Hawk Dragonfly spends most of its life underwater as an aquatic larva, before metamorphosing and emerging from the water as an adult. Adults are thought to only live for several weeks or a few months.

It is unlikely that a local viable population exists at the site given the results of targeted surveys, including those by Theischinger and colleagues. If a population did occur along the Woronora River, impacts to the river would be temporary in nature and as such, the proposal is unlikely to have an adverse effect on the life cycle of this species and place it at risk of extinction.

- b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:**

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

- c) In relation to the habitat of a threatened species or ecological community:**

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 0.05 ha of native vegetation would be removed constituting suitable habitat for the species, which provides potential breeding and foraging habitat for the Sydney Hawk Dragonfly.
- ii. An area of habitat is unlikely to become fragmented or isolated as a result of the proposal. Impacts to the river would be temporary, and flow would be maintained.
- iii. The extent of habitat that would be impacted by the proposal is not considered important to the long-term survival of a Sydney Hawk Dragonfly population, as history suggests that this species is unlikely to occur within the study area.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to the Sydney Hawk Dragonfly:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The creation of a temporary water crossing at the proposal site would alter the natural flow regime of the Woronora River, however post-construction it would return to normal.

Conclusion

The proposal would result in the temporary modification of up to 0.05 ha of potential habitat for Sydney Hawk Dragonfly.

The creation of a temporary vehicle crossing across Woronora River would temporarily impact the flow rate of the river, however it would be done in consultation with DPI (Fisheries), and given the existing evidence that the Sydney Hawk Dragonfly no longer occurs within the study area, it is unlikely that the proposal would adversely affect a viable local population of this species.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Sydney Hawk Dragonfly.

Australian Grayling

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

The Australian Grayling is a diadromous species that spends its larval stages in marine water and its adult life mainly in freshwater (Backhouse et al. 2008b). Australian Grayling migrate to brackish waters to spawn and larvae are swept into marine waters, where they spend approximately six months or reach ~45–65 mm long before returning to freshwater (Backhouse et al. 2008b; NSW DPI 2015a). Spawning typically occurs from late summer to winter, however this period varies with location and local environmental factors such as varying water temperatures, water flow events and other variables (McDowall 1976; Backhouse et al. 2008b; DAWE 2019). The Australian Grayling potentially occurs in the wider Woronora estuary (WBM 2008), however the Heathcote River has not been identified as habitat for this species on the NSW Fisheries Spatial Data Portal. The closest important population within the Sydney Basin Bioregion occurs on the Shoalhaven River (DAWE 2020). Artificial barriers which restrict movement of the Australian Grayling include in-stream dams, weirs, and culverts or anything that impedes this migration. The Needles which is located downstream of the proposal area is likely to be a barrier to movement for this species. As such, the proposal is unlikely to have an adverse effect on the lifecycle of this species, as it is currently unlikely to occur at the proposal site and barriers to movement already exist downstream.

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

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 0.05 ha of potential aquatic habitat would be temporarily impacted by the proposal
- ii. A temporary water crossing would create a barrier to movement along the Woronora River, however given that it is temporary, post-construction the proposal area would not be fragmented or isolated
- iii. The extent of habitat that would be temporarily impacted by the proposal is not considered important to the long-term survival of the Australian Grayling, given that a review of the literature suggests that this species is unlikely to occur here.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to the Australian Grayling:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Clearing of native vegetation

The creation of a temporary water crossing at the proposal site would alter the natural flow regime of the Woronora River, however post-construction it would return to normal. The clearing of riparian vegetation can lead to poor water quality and sedimentation.

Conclusion

The proposal would result in the temporary modification of up to 0.05 ha of potential habitat for Australian Grayling.

The creation of a temporary vehicle crossing across Woronora River would temporarily impact the flow rate of the river, however it would be done in consultation with DPI (Fisheries), and given the existing evidence that the closest important population of the Australian Grayling occurs along the Shoalhaven River, it is unlikely that the proposal would adversely affect a viable local population of this species.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Australian Grayling.

Macquarie Perch

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

Macquarie perch lay eggs which settle into interstitial spaces between rocks and pebbles (Cadwallader & Rogan 1977; Cadwallader 1978; Tonkin et al., 2010), and low silt coarse spawning substrates are critical for egg development. Potential habitat for Macquarie Perch (*Macquaria australasica*) (FM-V) occurs within the proposal area, however extensive surveys conducted in 2001 as well as an examination of historical records, suggests that there is unlikely to be a population of Macquarie Perch within the Woronora River system (NSW Fisheries 2001). Given that there is unlikely to be a viable local population within the study area, the proposal is unlikely to place this species at risk of extinction.

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

- i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

N/A

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

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.**

- i. Up to 0.05 ha of potential aquatic habitat would be temporarily impacted by the proposal
- ii. A temporary water crossing would create a barrier to movement along the Woronora River, however post-construction the proposal area would not be fragmented or isolated
- iii. The extent of habitat that would be temporarily impacted by the proposal is not considered important to the long-term survival of the Macquarie Perch, given that a review of the literature suggests that this species is unlikely to occur here.

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

The study area does not contain a declared area of outstanding biodiversity value.

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

The proposal is part of, or may contribute to, the following key threatening process relevant to the Macquarie Perch:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Clearing of native vegetation

The creation of a temporary water crossing at the proposal site would alter the natural flow regime of the Woronora River, however post-construction it would return to normal. The clearing of riparian vegetation could lead to poor water quality and sedimentation.

Conclusion

The proposal would result in the temporary modification of up to 0.05 ha of potential habitat for Macquarie Perch.

The creation of a temporary vehicle crossing across Woronora River would temporarily impact the flow rate of the river, however it would be done in consultation with DPI (Fisheries), and given the existing evidence that there is unlikely to be a population of Macquarie Perch within the Woronora River system (NSW Fisheries 2001), it is unlikely that the proposal would adversely affect a viable local population of this species.

Considering the above, the proposal is considered unlikely to generate a significant impact to the assessed threatened Macquarie Perch.

Appendix D – Assessments of Significance (EPBC Act)

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) protects the environment, particularly Matters of National Environmental Significance (Protected matters). It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places. The Matters of National Environmental Significance are:

- World heritage properties;
- National heritage properties;
- Wetlands of international importance;
- Listed threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas;
- The Great Barrier Marine Park;
- Nuclear actions; and
- Water resources, in relation to coal seam gas development and large coal mining development.

An action will require approval if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- Extinct in the wild;
- Critically endangered;
- Endangered; or
- Vulnerable.

The factors required to be addressed vary depending on the conservation status of the listed entity in question. The Assessments of Significance (AoS) commencing overleaf reflect this variability. AoS have been undertaken for the following EPBC Act listed entities:

Flora

- Thick-leaf Star-hair *Astrotricha crassifolia* (Vulnerable)
- Small-flower *Grevillea Grevillea parviflora subsp. parviflora* (Vulnerable)
- Woronora Beard-heath *Leucopogon exolasius* (Vulnerable)
- Deane's Paperbark *Melaleuca deanei* (Vulnerable)

Fauna

- Broad-headed Snake *Hoplocephalus bungaroides* (Vulnerable)
- Mammals
 - Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable)
 - Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable)
 - Koala *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) (Vulnerable)
- Wetland Birds
 - Australian Bittern *Botaurus poiciloptilus* (Endangered)
- Migratory Birds
 - Rufous Fantail *Rhipidura rufifrons* (Migratory)

- Black-faced Monarch *Monarcha melanopsis* (Migratory)

Flora

- **Small-flower Grevillea** *Grevillea parviflora subsp. parviflora*
- **Woronora Beard-heath** *Leucopogon exolasius*
- **Deane's Paperbark** *Melaleuca deanei*
- **Thick-leaf Star-hair** *Astrotricha crassifolia*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population of a species**

Small-flower Grevillea

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area. Up to 3.03 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

Woronora Beard-heath

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area. Up to 3.03 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

Deane's Paperbark

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area. Up to 3.03 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

Thick-leaf Star-hair

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area. Up to 3.03 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

- **reduce the area of occupancy of an important population**

Small-flower Grevillea

There are no known important populations in the proposal area, therefore the proposal would not reduce the area of occupancy of an important population.

Woronora Beard-heath

There are no known important populations in the proposal area, therefore the proposal would not reduce the area of occupancy of an important population.

Deane's Paperbark

There are no known important populations in the proposal area, therefore the proposal would not reduce the area of occupancy of an important population.

Thick-leaf Star-hair

There are no known important populations in the proposal area, therefore the proposal would not reduce the area of occupancy of an important population.

- **fragment an existing important population into two or more populations**

Small-flower Grevillea

There are no known important populations in or directly adjacent to the proposal area, therefore the proposal would not fragment an existing important population into two or more populations.

Woronora Beard-heath

There are no known important populations in or directly adjacent to the proposal area, therefore the proposal would not fragment an existing important population into two or more populations.

Deane's Paperbark

There are no known important populations in or directly adjacent to the proposal area, therefore the proposal would not fragment an existing important population into two or more populations.

Thick-leaf Star-hair

There are no known important populations in or directly adjacent to the proposal area, therefore the proposal would not fragment an existing important population into two or more populations.

- **adversely affect habitat critical to the survival of a species**

Small-flower Grevillea

No critical habitat for this species has been declared. The proposal would remove up to 3.03 ha of potential habitat for Small-flower Grevillea, however similar habitat is present throughout the locality. This impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species.

Woronora Beard-heath

No critical habitat for this species has been declared. The proposal would remove up to 3.03 ha of potential habitat for Woronora Beard-heath, however similar habitat is present throughout the locality. This impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species.

Deane's Paperbark

The Recovery Plan for this species (DECC 2010) states habitat critical to the survival of this species includes: *the area of occupancy of populations, areas of similar habitat surrounding and linking populations, additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations.*

Therefore the proposal area habitat could be considered critical to Deane's Paperbark. The proposal would remove up to 3.03 ha of potential habitat for Deane's Paperbark, however similar habitat is present throughout the locality. This impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species

Thick-leaf Star-hair

No critical habitat for this species has been declared. The proposal would remove up to 3.03 ha of potential habitat for Thick-leaf Star-hair, however similar habitat is present throughout the locality. This impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species.

- **disrupt the breeding cycle of an important population**

Small-flower Grevillea

No individuals would be lost, however up to 3.03 ha potential habitat would be removed. This is considered unlikely to disrupt the breeding cycle of any populations nearby. Mature individuals will still be able to provide viable seed which can germinate and recruit where conditions are favorable.

Woronora Beard-heath

No individuals would be lost, however up to 3.03 ha potential habitat would be removed. This is considered unlikely to disrupt the breeding cycle of any populations nearby. Mature individuals will still be able to provide viable seed which can germinate and recruit where conditions are favorable.

Deane's Paperbark

No individuals would be lost, however up to 3.03ha potential habitat would be removed. This is considered unlikely to disrupt the breeding cycle of any populations nearby. Mature individuals will still be able to provide viable seed which can germinate and recruit where conditions are favorable.

Thick-leaf Star-hair

No individuals would be lost, however up to 3.03 ha potential habitat would be removed. This is considered unlikely to disrupt the breeding cycle of any populations nearby. Mature individuals will still be able to provide viable seed which can germinate and recruit where conditions are favorable.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

Small-flower Grevillea

The proposal would result in the removal of up to 3.03 ha of potential habitat, and no individuals. Similar habitat exists in the study area. No areas of habitat will become isolated as a result of the proposal.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Woronora Beard-heath

The proposal would result in the removal of up to 3.03 ha of potential habitat, and no individuals. Similar habitat exists in the study area. No areas of habitat will become isolated as a result of the proposal.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Deane's Paperbark

The proposal would result in the removal of up to 3.03 ha of potential habitat, and no individuals. Similar habitat exists in the study area. No areas of habitat will become isolated as a result of the proposal.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Thick-leaf Star-hair

The proposal would result in the removal of up to 3.03 ha of potential habitat, and no individuals. Similar habitat exists in the study area. No areas of habitat will become isolated as a result of the proposal.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is unlikely to result in the establishment of invasive species in this habitat provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing new diseases to the proposal area can be mitigated via the hygiene protocols outlined in the BA.

- **interfere substantially with the recovery of the species.**

Small-flower Grevillea

No Recovery Plan has been developed for this species. The Species Profile and Threats Database (2020) collates a number of recovery actions from various government documents. While proposal will involve the removal of up to 3.03 ha of potential habitat, it is not likely to interfere substantially with these actions or the recovery of the species.

Woronora Beard-heath

No Recovery Plan has been developed for this species. The Approved Conservation Advice for *Leucopogon exolasius* (EPBC 2008) lists a number of priority actions for the recovery of this species at a regional and local level. While proposal will involve the removal of up to 3.03 ha of potential habitat, it is not likely to interfere substantially with these actions or the recovery of the species.

Deane's Paperbark

The National Recovery Plan for *Melaleuca deanei* (Deane's Paperbark) (DECCW 2010) lists the following objectives for the recovery of the species:

- Coordinate the recovery of *M.deanei*
- Protect known occurrences of *M.deanei* using land-use and conservation planning mechanisms
- Identify and minimize the threats operating at *M.deanei* sites

While proposal will involve the removal of up to 3.03 ha of potential habitat, it is not likely to interfere substantially with these objectives or the recovery of the species.

Thick-leaf Star-hair

No Recovery Plan has been developed for this species. The Approved Conservation Advice for *Astroticha crassifolia* (Thick-leaf Star-hair) (EPBC 2008) lists a number of priority actions for the recovery of this species at a regional and local level. While proposal will involve the removal of up to 3.03 ha of potential habitat, it is not likely to interfere substantially with these actions or the recovery of the species.

Conclusion

No individuals of an important population would be removed, however up to 3.03 ha of habitat would be removed.

This action is not considered likely to place important populations at risk of extinction or interfere substantially with the recovery of these species. Indirect impacts, including the introduction and/or spread exotic flora and pathogens, will be abated through the application of standard safeguards and mitigation measures as outlined in the BA.

The proposal is considered unlikely to generate a significant impact to Small-flower Grevillea, Woronora Beard-heath, Deane's Paperbark or Thick-leaf Star-hair.

Broad-headed Snake *Hoplocephalus bungaroides*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population of a species**

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The locality is known as a 'hotspot' for this species. The proposal site may contain summer breeding habitat in the form of hollow-bearing trees (up to five sufficiently sized ones) and some rock crevices. This species is likely to be higher up the escarpment during autumn, winter and spring.

Up to 3.12 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

- **reduce the area of occupancy of an important population**

There are no identified important populations in the proposal area, however the vegetation and bushrock removal at the proposal site has the potential to reduce the area of occupancy of any local population if it occurs.

- **fragment an existing important population into two or more populations**

There are no known important populations in the proposal area. Therefore the vegetation removal that would result from the proposal would not fragment an existing important population into two or more populations. The proposal will not fragment potential habitat for this species.

- **adversely affect habitat critical to the survival of a species**

Habitat critical to the survival of this species is sandstone rock in bushland on escarpment areas and large hollow-bearing trees in adjacent woodland areas.

The habitat within the proposal area contains up to five large hollow-bearing trees that provides potential summer breeding habitat, and areas of bushrock.

Up to 3.12 ha of vegetation including bushrock would be removed, however given the local context the habitat removal proposed is not considered likely to adversely affect habitat critical to the survival of a species. The bushrock typically used by this species does not occur on cliffs.

- **disrupt the breeding cycle of an important population**

One large hollow-bearing tree provides potential breeding habitat for the broad-headed snake in the proposal area.

Up to 3.12 ha of potential movement and foraging habitat (summer only) would be impacted.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of 3.12 ha of potential habitat. Habitat adjacent to the proposal area may also be subject to edge effects such as weed invasion, increased light and exposure to the elements. However, such factors are already in effect in the area. No areas of habitat will become isolated from other areas of habitat.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is unlikely to exacerbate the pressure of invasive species provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing diseases to the proposal area can be mitigated via the hygiene protocols outlined in the BA.

- **interfere substantially with the recovery of the species.**

Recovery activities that are relevant to the proposal include:

- Retain sandstone rock in bushland on escarpment areas; implement LEPs, DCPs with suitable restrictions on the removal of bushrock.

- Retain woodland adjacent to sandstone escarpments, particularly large hollow-bearing trees.
- Restore rocky habitat to escarpments that have been disturbed.

The proposed works are unlikely to interfere substantially with these objectives.

Conclusion

No individuals of this species were recorded in the study area. Up to 3.12 ha of potential habitat will be impacted by the proposal. This action is not considered likely to place the species at risk of extinction or interfere substantially with the recovery of the species. Potential impacts will be abated through the application of standard safeguards and mitigation measures as outlined in the BA.

The proposal is considered unlikely to generate a significant impact to the Broad-headed Snake.

Large-eared Pied Bat *Chalinolobus dwyeri*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population of a species**

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area and no BioNet records within 2 km of the proposal area.

Up to 3.12 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

- **reduce the area of occupancy of an important population**

There are no known important populations in the proposal area. Therefore the vegetation removal that would result from the proposal would not reduce the area of occupancy of an important population. The proposal will not significantly reduce the area of occupancy for this species.

- **fragment an existing important population into two or more populations**

There are no known important populations in the proposal area. Therefore the vegetation removal that would result from the proposal would not fragment an existing important population into two or more populations. The proposal will not fragment potential habitat for this species.

- **adversely affect habitat critical to the survival of a species**

The National Recovery Plan for the large-eared pied bat *Chalinolobus dwyeri* (DERM 2011) states that habitat critical to the survival of the species includes: diurnal roosts (disused mine shafts, caves, overhangs, and abandoned fairy martin nests) and maternity roosts (arch caves with dome roofs). Foraging habitat includes fertile valleys and plains, treed water courses and canopied habitat. The Recovery Plan also lists sandstone cliffs and fertile wooded valley habitat within close proximity of each other as critical habitat.

The habitat within the proposal area is unlikely to be considered critical habitat.

Up to 3.12 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to adversely affect habitat critical to the survival of a species.

- **disrupt the breeding cycle of an important population**

No breeding habitat has been observed in the proposal area. There are no known important populations and no individuals would be lost.

Up to 3.12 ha of potential foraging habitat would be impacted. This is considered unlikely to disrupt the breeding cycle of the population.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of 3.12 ha of potential habitat. Habitat adjacent to the proposal area may also be subject to edge effects such as weed invasion, increased light and exposure to the elements. However, such factors are already in effect in the area. No areas of habitat will become isolated from other areas of habitat.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is unlikely to exacerbate the pressure of invasive species provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing diseases to the proposal area can be mitigated via the hygiene protocols outlined in the BA.

- **interfere substantially with the recovery of the species.**

The National Recovery Plan (DERM 2011) for this species lists the following specific objectives for species recovery:

- Identify priority roost and maternity sites protection
- Implement conservation and management strategies for priority sites
- Educate the community and industry to understand and participate in the conservation of the large-eared pied bat
- Research the large-eared pied bat to augment biological and ecological data to enable conservation management

- Determine the meta-population dynamics throughout the distribution of the large-eared pied bat

The proposed works will not interfere with any of these objectives.

Conclusion

No known individuals of this species occur in the study area. Up to 3.12 ha of potential habitat will be impacted by the proposal. This action is not considered likely to place the species at risk of extinction or interfere substantially with the recovery of the species. Indirect impacts, including the introduction and/or spread exotic flora and pathogens, will be abated through the application of standard safeguards and mitigation measures as outlined in the BA.

The proposal is considered unlikely to generate a significant impact to the Large-eared Pied Bat.

Grey-headed Flying-fox *Pteropus poliocephalus*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population of a species**

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There are no known important populations in the proposal area. BioNet returned 13 records within 2 km of the proposal area, with the nearest record 320 m away. The nearest known camp is approximately 10.5 km from the proposal area, near Yowie Bay (National Flying-fox monitoring viewer, DoE 2019). Grey-headed Flying-fox can travel up to 50 km from their camps to forage.

Up to 3.12 ha of potential foraging habitat would be removed, however given the local context the habitat removal proposed is not considered likely to lead to a long-term decrease of any populations of this species.

- **reduce the area of occupancy of an important population**

The vegetation removal that would result from the proposal would slightly reduce foraging habitat for this species, however there are no known important populations, and effects would be temporary.

- **fragment an existing important population into two or more populations**

There are no known existing important populations in the proposal area, therefore no important populations will be fragmented. Suitable patches of habitat will not become fragmented or isolated as a result of the vegetation clearance.

- **adversely affect habitat critical to the survival of a species**

No critical habitat for this species has been declared.

Up to 3.12 ha of vegetation would be removed, however given the local context the habitat removal proposed is not considered likely to adversely affect habitat critical to the survival of a species.

This impact is unlikely decrease the functionality of the surrounding habitat and its importance to the survival of the species.

- **disrupt the breeding cycle of an important population**

This species breeds in roosting camps. The nearest known camp is approximately 10.5 km away from the proposal area.

Only 3.12 ha potential foraging habitat would be impacted by this proposal. This is considered unlikely to disrupt the breeding cycle of the population as similar foraging habitat is present throughout the locality.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of 3.12 ha of potential habitat. Habitat adjacent to the proposal area may also be subject to edge effects such as weed invasion, increased light and exposure to the elements. However, such factors are already in effect in the area. No areas of habitat will become isolated from other areas of habitat.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is unlikely to exacerbate the pressure of invasive species provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing diseases to the proposal area can be mitigated via the hygiene protocols outlined in the BA.

- **interfere substantially with the recovery of the species.**

There is no Recovery Plan or Approved Conservation Advice for this species. The Action Plan for Australian Bats (Duncan et al.1999) is referenced on the Australia Government SPRAT profile as having the following recovery objectives:

- Stabilise the population at its 1999 level.
- Define patterns of landscape use, and identify and protect essential habitat.
- Develop non-destructive methods for crop protection.
- Develop non-destructive methods for management of camps in problem areas.
- Ensure consistent management of the species across relevant States (Queensland, NSW and Victoria).

The proposed works will not interfere with any of these objectives.

Conclusion

There are records of this species near the proposal area. These records would be of foraging individuals. Up to 3.12 ha of potential foraging habitat will be impacted by the proposal. This action is not considered likely to place the species at risk of extinction or interfere substantially with the recovery of the species. Indirect impacts, including the introduction and/or spread exotic flora and pathogens, will be abated through the application of standard safeguards and mitigation measures as outlined in the BA.

The proposal is considered unlikely to generate a significant impact to the Grey-headed Flying-fox.

Koala *Phascolarctos cinereus*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of an important population of a species**

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Within the 10 km Study area, there are 186 Koala records stretching back to 1934 and including 13 records to date in 2020 (BioNet, accessed 21st October 2020). There are 18 BioNet records within 2 km of the proposal area, including a 2010 live sighting and two roadkill records from Heathcote Road at the proposal site (in 2018, carcasses found together). This indicates that the study area does provide habitat and is a corridor for movement.

The existence of suitable shelter and movement habitat, along with numerous records from the area, means that Koala are likely to be present or traverse through the study area.

No key feed tree species identified for the Wollondilly koala population were recorded during the survey and it is unlikely that the proposal will result in removal of any feed trees. The proposed action will remove a small amount of habitat (up to 3.12 ha), which is not considered likely to place the local population at risk of extinction, given the lack of preferred Koala feed trees and the adjacent intact, protected habitat (i.e. Heathcote and Royal National Parks).

The Koala population in the broader area is considered to have a 'moderate' resilience to threats within the landscape; within 'moderate to high' functional habitat. This suggests that the Koala has a moderate likelihood of future persistence, considering current and future threats. High threats to Koala in this ARKS are wildfire, vehicle strike and dog attack (DPIE 2020b).

Heathcote Road already represents a barrier to Koala, evidenced by roadkill records within the proposal area. The proposed widening is unlikely to significantly increase this threat. During construction, connectivity below the bridge may be temporarily reduced.

The proposal provides an opportunity to decrease this barrier and improve movement opportunity for Koala. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas under the bridge, and specific Koala crossing infrastructure and targeted restoration to facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit to the Koala.

Bridges with a dry fauna passage underneath are proven to successfully facilitate fauna crossing, including for Koala (Department of Transport and Main Roads [TMR] 2010). Monitoring for the Bonville Pacific Highway Upgrade recorded 11 successful crossings by Koala at such a bridge (as at 2014; Roads and Maritime 2019).

- **reduce the area of occupancy of an important population**

The vegetation removal that would result from the proposal would not reduce the area of occupancy of an important population.

- **fragment an existing important population into two or more populations**

A population of Koala would not be fragmented into two or more populations. The habitat to be removed is located at the edge of a much larger patch of core habitat and would already be subject to edge effects.

Habitat similar to the area to be disturbed is present throughout the locality, which is of higher quality and is already protected (i.e. Heathcote and Royal National Parks).

Heathcote Road already represents a barrier to Koala, evidenced by roadkill records within the proposal area. The proposed widening is unlikely to significantly increase this threat. During construction, connectivity below the bridge may be temporarily reduced, however it is not considered likely that Koala use this access currently, given the exposed and compacted nature of ground.

- **adversely affect habitat critical to the survival of a species**

No critical habitat for this species has been declared and the habitat within the proposal area is not considered critical. Within the study locality there is considered to be a viable local population of Koala. The proposal area is mapped within the Sutherland LGA which is not covered by the 'Koala Development Application Map' and therefore the SEPP (Koala Habitat Protection) 2019 does not apply. (DPIE 2020). The proposal area provides connectivity to areas of koala habitat within the Campbelltown LGA which contains a key population. Lunney et al. (2010) found that Koalas at Heathcote (and therefore within the proposal area) are genetically indistinguishable from the Campbelltown Koala population, which means that they should be considered part of a single population connected by the Holsworthy Army Range. This same report identifies that high-quality Koala habitat is maintained throughout the region as protected area (i.e. national park, Sydney Catchment Authority land)

The proposal would remove up to 3.12 ha of potential habitat. This impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species.

- **disrupt the breeding cycle of an important population**

DECCW (2011) study findings suggest that Heathcote and Royal National Parks do not contribute significantly to the regional conservation of Koala, as sightings are infrequent, sparse and generally relate to either rehabilitate and released individuals or wide-ranging individuals from the core Campbelltown population. Their vertebrate fauna study concluded that the occurrence of Koala in the general proposal area is likely to be uncommon and relate to a non-breeding population.

The proposed clearance of up to 3.12 ha of potential habitat is unlikely to interfere with the breeding cycle of this species. Koalas are unlikely to be on site during construction works. If present, the TfNSW stop works procedure would be implemented as per the RMS Biodiversity Guidelines.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of 3.12 ha of potential habitat. Habitat adjacent to the proposal area may also be subject to edge effects such as weed invasion, increased light and exposure to the elements. However, such factors are already in effect in the area. No areas of habitat will become isolated from other areas of habitat.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

The proposal is unlikely to exacerbate the pressure of invasive species provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing diseases to the proposal area can be mitigated via the hygiene protocols outlined in the BA.

- **interfere substantially with the recovery of the species.**

The NSW Recovery plan for the Koala (*Phascolarctos cinereus*) (DECC 2010) lists the overall objective as 'to reverse the decline of the Koala in New South Wales, to ensure adequate protection, management and restoration of koala habitat, and to maintain healthy breeding populations of koalas throughout their current range'.

The proposed works will not interfere substantially with these objectives.

Conclusion

The proposal would result in the removal up to 3.12 ha of habitat for Koala, which does not include Koala feed trees.

This reduction would occur in vegetation surrounding Heathcote Bridge in areas prone to edge effects, with high existing disturbance from the adjacent road. These direct impacts are not considered likely to adversely affect the viable local populations of this species, given the presence of similar habitat in the area.

Vehicle strike along Heathcote Road is already a recognized threat to Koala. The proposal provides an opportunity to decrease this barrier and improve movement opportunity for Koala. Mitigation associated with the bridge upgrade will include the installation of fauna fencing to funnel Koalas under the bridge, and specific Koala crossing infrastructure and targeted restoration to facilitate movement under the bridge and adjacent to Woronora River. This is expected to result in a net benefit to the Koala.

Other mitigation measures outlined in the report above will minimise the severity of any direct and indirect impacts on Koala which may be generated by the proposal.

Considering the above, the proposal is considered unlikely to generate a significant impact to the threatened Koala.

Australian Bittern *Botaurus poiciloptilus*

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- **lead to a long-term decrease in the size of a population of a species**

The Significant Impact Guidelines 1.1 define an important population of a vulnerable species as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Australian Bittern inhabits edges of pools and waterways with tall dense vegetation such as sedges, rushes and reeds. Pockets of aquatic macrophytes were observed in the study area, as part of PCT 781 Coastal Freshwater Lagoons. These provide potential shelter and foraging habitat for Australian Bittern.

There are no BioNet records of Australian Bittern with 2 km of the proposal area.

The proposed action will remove a small amount of potential habitat (up to 0.05 ha of freshwater wetland habitat, PCT 781) for Australian Bittern. As this this habitat is located on the fringe of habitat directly adjacent to the road, and additional habitat is present nearby, this is not considered likely to lead to a long-term decrease in the size of any populations of this species.

- **reduce the area of occupancy of the species**

Only 0.05 ha of freshwater wetland habitat for Australian Bittern will be removed. There is similar habitat present near the proposal area. Vegetation such as sedges, rushes and reeds are expected to recolonise the area and provide suitable habitat in the future. The proposed works are considered unlikely to reduce the area of occupancy of the species.

- **fragment an existing population into two or more populations**

There are no known populations within the proposal area. The proposed works are considered unlikely to fragment an existing population into two or more populations.

- **adversely affect habitat critical to the survival of a species**

The Conservation Advice for Australian Bittern (ACT DEE 2019) states that any natural habitat where Australian Bittern is known or likely to occur should be considered critical to the survival of the species.

Therefore the proposal would result in the removal of up to 0.05 ha of critical habitat.

However, this impact is unlikely to decrease the functionality of the surrounding habitat and its importance to the survival of the species.

- **disrupt the breeding cycle of a population**

Australian Bittern breeds from October to February in solitary pairs. Sometimes nests are places in close proximity to each other. The species nests adjacent to densely vegetation freshwater swamps and pools. Some pools will remain undisturbed by the proposal. No nests were observed during site visits. The species is capable of moving between habits.

The proposed works are not considered likely to disrupt the breeding cycle of a population.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

The proposal would result in the removal of 0.05 ha of potential habitat. Habitat adjacent to the proposal area may also be subject to edge effects such as weed invasion, increased light and exposure to the elements. However, such factors are already in effect in the area.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

- **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat**

The pressure of weed invasion is present within the proposal area. The proposed works are unlikely to exacerbate this pressure provided the mitigation measures outlined in the BA are adhered to.

- **introduce disease that may cause the species to decline**

The risk of introducing diseases to these species can be mitigated via the hygiene protocols outlined in the BA.

- **interfere with the recovery of the species.**

The Conservation Advice for Australian Bittern (ACT DEE 2019) lists the following key strategies to achieve the overall objective to 'provide guidance for actions that will expand the range and the number of Australian Bitterns in Australia':

- Identify the key sites where Australasian Bitterns occur throughout their range and establish a baseline measure of abundance. This baseline will then be used to track change overtime.
- Manage key sites to ensure habitat is suitable for Australasian Bitterns. This will require measures that primarily target adequate water flow and quality, and measures to ensure weed species and grazing animals do not compromise wetland structure and function.
- Improve understanding of foraging and breeding behaviour, in order to better design recovery actions.
- Engage community and stakeholders in Australasian Bittern conservation.

The proposed works are not expected to interfere with these actions or the recovery of this species.

Conclusion

Up to 0.05 ha of habitat will be impacted by the proposal. This action is not considered likely to place the species at risk of extinction or interfere substantially with the recovery of the species. Indirect impacts, including the introduction and/or spread exotic flora and pathogens, will be abated through the application of standard safeguards and mitigation measures as outlined in the BA. The proposal is considered unlikely to generate a significant impact to the Australian Bittern.

Migratory

- **Rufous Fantail** *Rhipidura rufifrons*
- **Black-faced Monarch** *Monarcha melanopsis*

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **substantially modify (including by fragmenting, alerting fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?**

Rufous Fantail

Rufous Fantail is found in coastal and near coastal districts of northern and eastern Australia. In NSW, breeding populations are present on and east of the Great Divide, and north to the NSW-Queensland border. The species winters in north Queensland, Torres Strait and southern Papua New Guinea. This species is also widespread in Mariana Islands, south through Yap (Caroline Islands), to Sulawesi, the Moluccas and Lesser Sundas, east through southern Papua New Guinea, Louisiade Archipelago and Santa Cruz, to the Solomon Islands and Micronesia.

Rufous Fantail is considered a common and secure species. In eastern Australia, it inhabits wet sclerophyll forests, subtropical and temperate rainforests and when on passage drier forests and woodlands, parks and gardens.

There are no BioNet records of this species within 2 km of the proposal area, however the Rufous Fantail was recorded (as road kill) along the eastern end of Heathcote Road during an ecological survey conducted by NGH for the Heathcote Road slope stabilisation project in April 2017.

The proposed works expected to only cause a minor level of vegetation impact, up to 3.12 ha vegetation. This is a small amount of potentially suitable habitat in the local context. The proposal will not substantially modify, destroy or isolate any areas that may be important habitat for this species.

Black-faced Monarch

Black-faced Monarch is eastern Australia, including NSW, QLD, Torres Strait, Cape York Peninsula, south along the coasts and the eastern slopes of the Great Divide, to the NSW border. It is also present in other states. Internationally, it has also been recorded in Papua New Guinea, and is a vagrant to the Aru Island and New Zealand.

Black-faced Monarch inhabits a variety of rainforest systems, and sometimes open eucalypt forests, softwood scrub, coastal scrub and mangroves.

There are no BioNet records of this species within 2 km of the proposal area, however suitable habitat is present in the proposal area.

The proposed works expected to only cause a minor level of vegetation impact, up to 3.12 ha vegetation. This is a small amount of potentially suitable habitat in the local context. The proposal will not substantially modify, destroy or isolate any areas that may be important habitat for this species.

- **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?**

A number of invasive flora species, including some priority weeds are present within the development area. The proposal has the potential to contribute to the spread of invasive species in the development area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal would therefore be unlikely to result in invasive species that are harmful to these species becoming established in their potential habitat.

- **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?**

Rufous Fantail

The main threat as listed on the Australia Government SPRAT profile is fragmentation and loss of core moist forest breeding habitat through land clearing and urbanisation.

Rufous Fantail generally breeds from September to February in a small cup-shaped nest, which are made in a wide variety of plant species. No nests were observed on site. Similar habitat to that in the proposal area is present in the locality.

The proposal will not disrupt the lifecycle of an ecologically significant proportion of the population of this species.

Black-faced Monarch

Threats listed on the Australia Government SPRAT profile include collision with windows and lighthouses. The proposal would not exacerbate these threats.

Black-faced Monarch breeds in rainforest, and nests at the top of trees with large leaves, in the tops of small saplings or in lower shrubs. Species used as nest sites present in the proposal area include *Acacia*. Breeding usually occurs between October to March. NSW populations are migratory, wintering in southern and eastern Papua New Guinea.

The proposal will not disrupt the lifecycle of an ecologically significant proportion of the population of this species.

Conclusion

The impacts of the proposal on the assessed migratory species listed under the EPBC Act are considered to be manageable. A significant impact is considered unlikely as no important habitat will be substantially modified, destroyed, or isolated, the risk of invasive species establishment can be mitigated, and no serious disruptions to the lifecycle of these migratory species is anticipated.

Appendix E – Database Search Results

