Species Impact Statement

PMHC Rawdon Island Bridge – Stage 2 Repairs

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Prepared for: Port Macquarie – Hastings Council

Certification

	Name	Signature	Date
Prepared by	Troy Jennings		29/03/2022
Reviewed by	David Andrighetto		29/03/2022

UPR	Description	Issued By	Date Issued
4203-1005	Version 1 (draft)	David Andrighetto	29/03/2022
4203-1005	Version 2 (draft)	David Andrighetto	31/03/2022
4203-1013	Version 3	David Andrighetto	05/04/2022
4203-1017	Version 4	David Andrighetto	08/04/2022

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Definitions

Term	Definition
Abundance	A quantification of the population of the species or community.
Action	Means the proposed activity
Activity	Has the same meaning as the EP&A Act
Affected species	Subject species likely to be affected by the Activity.
Conservation status	The degree of representation of a species or community in formal conservation reserves.
Department	Means the Department of Planning and Environment
Direct impacts	Impacts that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat.
Ecologist	A licenced (National Parks and Wildlife Service Scientific Licence and Animal Care and Ethics Committee approval) ecologist engaged to advise on/undertake ecological management throughout the proposal. Has minimum three years' experience working as an ecologist with extensive microbat experience and has current Lyssavirus vaccinations.
Environment Agency Head	Means the Secretary of the Department of Planning and Environment (or delegate)
Habitat	The area occupied, or periodically or occasionally occupied, by any threatened species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different Stages of their life cycles.
Indirect impacts	Occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas.
Life cycle	The series or stages of reproduction, growth, development, ageing and death of an organism.
Likely	A real chance or possibility (DEC 2004).
Local occurrence	Occur within the study area. However the local occurrence may include adjacent areas if the ecological community or threatened species in the study area forms part of a larger contiguous area of that ecological community/habitat and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
Local population	The population that occurs in the study area.
	The local population of a threatened *plant* species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
	The local population of *resident fauna species* comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
	The local population of *migratory or nomadic fauna* species comprises those individuals that are likely to occur in the study area from time to time.
Locality	The area within a 10km radius of the Subject site.
Proposal	The development, activity or action proposed. In this case it involves repair and restoration works of the existing bridge Rawdon Island Bridge – specifically works associated with Pier 6.

Region	For the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation. If the bioregion occurs partly within and partly outside NSW, the region consists only of so much of the bioregion as occurs within NSW. The region for this project is defined as the North Coast Bioregion. The North Coast Bioregion runs up the east coast of NSW from just north of Newcastle to just inside the QLD border.
Risk of extinction	The likelihood that the local population would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the viability of that population.
Study area	Is the Subject site plus a buffer which includes areas that may be affected by the proposal, either directly or indirectly.
Subject site	The area which is subject to direct impacts inclusive of permanent and temporary works.
Subject species	Those threatened and significant species, populations and ecological communities which are known or considered likely to occur in the study area.
Viable	The capacity to successfully complete each stage of the life cycle under normal conditions.

Acronyms

Acronym	Meaning
AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method 2020
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	Biodiversity Conservation Regulation 2017
BCD	Biodiversity Conservation Division
DPE	Department of Planning and Environment
EAH	Environment Agency Head
EEC	Endangered Ecological Community
EES	Environment, Energy and Science
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation for Australia
KTP	Key Threatening Process
LGA	Local Government Area
MMP	Microbat Management Plan
NSW	New South Wales
OEH	Office of Environment and Heritage
PCT	Plant Community Type
PMHC	Port Macquarie – Hastings Council
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community listed under the BC Act and/or EPBC Act
VI	Vegetation Integrity
VIS	Vegetation Information System

Executive Summary

This Species Impact Statement (SIS) has been prepared by GeoLINK for Port Macquarie – Hastings Council (PMHC) for proposed Stage 2 bridge repair works at Rawdon Island Bridge. Rawdon Island Bridge is located on the Hasting River within the PMHC Local Government Area (LGA) in the NSW North Coast region.

The Stage 2 Review of Environmental Factors (REF) for the proposed Stage 2 repair works was prepared by PMHC (PMHC, 2022) and an impact assessment for the works concluded there is potential for significant impact on the Southern Myotis (*Myotis macropus*) which is listed under the *Biodiversity Conservation Act 2016* (BC Act). An SIS was the selected approval pathway. PMHC therefore requested Environment Agency Head (EAH) requirements for an SIS. GeoLINK has been commissioned to prepare this SIS for the proposal in accordance with the EAH requirements (ref: DOC22/57622) issued by the Department of Planning and Environment (DPE) on 3 March 2022.

The scope of works comprises repair works at Pier 6 (Stage 2). Other Rawdon Island Bridge repair works (Stage 1) are not part of this assessment and have been subject to separate assessment and approval (determination).

The potential occurrence and likely impact of each of the subject threatened species and ecological communities in the EAH requirements and identified in BioNet wildlife atlas search with 10km radius were assessed. The assessment has considered previous records in the study area and locality and the results of previous biodiversity surveys associated with Rawdon Island Bridge. The review of affected subject species concluded that three threatened fauna species being the Little Bent-winged Bat, Large Bent-winged Bat and Southern Myotis would be affected by the proposal and would require further assessment in the SIS. These species are listed as Vulnerable under the BC Act.

Rawdon Island Bridge supports an important Southern Myotis breeding colony, with population estimates ranging between 120 and 199 individuals. There are no other known roosting colonies in close proximity (i.e. 5km) to the Rawdon Island Bridge. Rawdon Island Bridge is not likely to comprise significant roosting habitat (breeding or important overwintering habitat) for the Little Bent-winged Bat or Large Bent-winged Bat.

The main impacts of the proposal include temporary exclusion of the Southern Myotis colony and roost habitat loss/modification.

A Stage 2 Microbat Management Plan (MMP) has been prepared which describes ameliorative measures of the proposal. Key components of the MMP include:

- provision of alternative microbat roosting habitat prior to works at Pier 6 and associated microbat exclusion
- staged microbat exclusion outside the Southern Myotis breeding season prior to the repair works at Pier 6 that may disturb microbats
- maintaining permanent microbat roosting habitat at completion of the repair works on Rawdon Island Bridge within Pier 2, 5 and 6.

Monitoring will include:

- baseline data from existing and ongoing population monitoring prior to exclusion (including microbat data collected as part of the Stage 1 repair works)
- exclusion phase monitoring
- post exclusion monitoring for one year.

Potential adaptive measures include:

- reviewing and modifying the exclusion method (e.g. reducing the rate of exclusion)
- modifying the permanent roosting habitat (i.e. Piers 2, 5 and 6) to maintain habitat values
- installing additional or modifying compensatory roosting habitat
- extending monitoring.

With implementation of the Stage 2 MMP ameliorative measures, it is expected that the majority of the subject Southern Myotis population impacted by the proposal would:

- remain at Rawdon Island Bridge occupying the alternative roosting habitats provided during the works
- continue to use the Rawdon Island Bridge as a permanent breeding population post completion of the works.

Flexibility and adaptive management will be required throughout the Stage 2 MMP implementation to avoid conflicts with the Stage 1 works and to accommodate microbat behaviour and responses (particularly during the exclusion phase).

Overall the existing habitat values of Rawdon Island Bridge for the subject Southern Myotis population and other subject species are likely to be maintained upon completion of the works and the risk of a significant impact is substantially reduce through implementation of the provisions of the MMP. If a significant impact is however identified during the works and microbat monitoring, PMHC would consult with DPE and implement appropriate contingency measures.

1. Introduction

1.1 Background information

Rawdon Island Bridge is located within Port Macquarie – Hastings Council (PMHC) LGA, and spans from the suburbs of Sancrox and Rawdon Island (**Illustration 2.1**). The bridge is a beam and slab concrete bridge spanning the Hastings River. It is approximately 164m long and 6.5m wide, has seven piers and was constructed in 1961. The deck is approximately 6m above the high tide water level, with the top of the blade wall approximately 1.6m beneath the deck. The bridge is a significant asset in the PMHC LGA providing a critical link between Rawdon Island and the mainland, and is utilised by residents, businesses and primary producers located on the island. The bridge provides the only access to the community of Rawdon Island and there is no other access on or off the Island.

Rawdon Island Bridge was inspected above-water level in 2019 by ARRB Pty Ltd and found to be in poor condition overall. Underwater dive inspections were completed by Aus Coast Diving Pty Ltd following the March 2021 floods to determine the extent of damage related to this event. During these underwater inspections, severe structural damage was identified on the piles of Rawdon Island Bridge on 16th June 2021. Structural assessments identified an 80-90% structure loss at one pile location, and 3 or 4 other similarly affected piles. PMHC determined this as a high risk to public safety and as a result Rawdon Island Bridge was closed to traffic in July 2021. Urgent repair and maintenance works were required for the bridge and were approved via a Review of Environmental Factors (REF) – Stage 1 works, determined in October 2021 (PMHC, 2021). Investigations associated with the Stage 1 REF, identified a 'local population' of Southern Myotis (*Myotis macropus*) roosting on Rawdon Island Bridge within the Pier 6 bridge expansion joint. The Stage 1 scope excluded works which may alter the roosting habitat of Southern Myotis at Pier 6 and works considered likely to have a high level of disturbance to the Southern Myotis colony. This environmental assessment approach allowed for very high priority works to commence to allow the bridge to return to safe operation, while not significantly impacting the microbat population in Pier 6 through the implementation of the Stage 1 Microbat Management Plan (MMP) (Echo Ecology and Surveying, 2021c). The Stage 1 MMP followed a process of behavioural monitoring, staged repair works and adaptive management to guide the Stage 1 works. Activities that modify the roost or are likely to cause a high level of disturbance to roosting bats are excluded from the Stage 1 Assessment of Significance (AoS) and Stage 1 MMP due to their potential to be a significant impact. Such activities (considered to be disturbing activities) are covered under a separate scope of works termed 'Stage 2 repair works' and include the following works at Pier 6: joint replacement; concrete repairs immediately adjacent to the joint at headstock, diaphragms, deck joint and pier blade wall; and installation of cathodic protection system to extend the life of the bridge structure.

A Stage 2 REF for the proposed repair works at Pier 6 was prepared by PMHC (2022) and an AoS for the works concluded there is potential for significant impact on the Southern Myotis (*Myotis macropus*) which is listed under the *Biodiversity Conservation Act 2016* (BC Act). A Species Impact Statement (SIS) was identified by PMHC as the preferred approval pathway. PMHC therefore requested Environment Agency Head (EAH) requirements for a SIS. GeoLINK has been commissioned to prepare a SIS (this report) for the proposal in accordance with the EAH requirements (ref: DOC22/57622) issued by the Department of Planning and Environment (DPE) on 3 March 2022.

1.2 Compliance with EAH requirements

The Environment Agency Head (EAH) requirements were received on 3 March 2022 (document ref. DOC22/57622). The specific requirements of the EAH and the sections within which they are addressed in this SIS are outlined in **Table 1.1**.

Table 1.1 EAH requirement compliance

EAH Section	EAH Heading	SIS Section	SIS Heading
1	Form of the Species Impact Statement	1.3	■ Declaration
2	Contextual Information	2	■ Contextual Information
2.1	Description of activity and study area	2.1 2.2	■ Study area and Subject site ■ Description of proposal
2.2	Relevant plans and maps	2.2 3.1	■ Illustration 2.1 ■ Illustration 2.2 ■ Illustration 3.1
2.3	Vegetation	3.2	■ Vegetation ■ Illustration 3.2
3	Initial assessment	4	■ Initial assessment
3.1	Identifying candidate species	4.2	■ Identifying candidate species
3.2	Identify subject species	4.3 – 4.5	■ Identify subject species ■ Habitat Assessment ■ Habitat suitability for candidate species ■ Targeted surveys ■ Final list of subject species
4	Assessment of likely impacts on threatened species	5	■ Assessment of likely impacts on threatened species
4.1	Assessment of species likely to be affected	5.1	■ Assessment of species likely to be affected
4.2	Discussion of conservation status	5.2	■ Discussion of conservation status
4.3	Discussion of local and regional abundance and distribution	5.3	■ Discussion of local and regional abundance and distribution
4.4	Assessment of habitat	5.4	■ Assessment of habitat
4.5	Discussion of likely effect of the activity at local and regional scales	5.5	■ Discussion of likely effect of the activity at local and regional scales
4.6	Description of feasible alternatives	5.6	■ Description of feasible alternatives
5	Assessment of likely impacts on threatened ecological communities	6.1	■ Assessment of ecological communities
5.1	Assessment of ecological communities (both endangered and critically endangered) likely to be affected		
5.2	Discussion of conservation status		
5.3	Assessment of habitat		
5.4	Description of feasible alternatives		
6	Ameliorative measures	7	■ Ameliorative measures

EAH Section	EAH Heading	SIS Section	SIS Heading
6.1	Description of ameliorative measures	7.1 7.1.1	■ Description of ameliorative measures ■ Biodiversity impact amelioration strategies
7	Statement of long-term viability	7.1.2	■ Statement of long-term viability
8	Additional information	9	■ Additional information
8.1	Qualifications and experience	9.1	■ Qualifications and experience
8.2	Other approvals required for the development or activity	9.2	■ Other approvals required
8.3	Licensing matters relating to the survey	9.3	■ Licences

1.3 Declaration

I, Blayne West, of Port Macquarie – Hastings Council at 17 Burrawan Street Port Macquarie NSW being the proponent for the Rawdon Island Bridge repairs, Rawdon Island Road, Port Macquarie – Hastings Local Government Area, NSW; have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the proposal.

Proponent	
Name	Blayne West
Position	Group Manager – Community Infrastructure Planning and Design
Organisation	Port Macquarie-Hastings Council
Signature	
Date	

I, David Andrighetto, of GeoLINK Pty Ltd, being the principal author, have prepared the SIS in accordance with the EAH's requirements issued on 3/03/2022.

SIS Principal Author	
Name	David Andrighetto
Position	Senior Ecologist
Organisation	GeoLINK Pty Ltd
Signature	
Date	12/04/2022

2. Contextual information

2.1 Study area and Subject site

The Rawdon Island Bridge occurs over the Hastings River on Rawdon Island Road (known as B159 Rawdon Island Bridge) north-east of Wauchope. The existing bridge is an 8-span concrete bridge structure with an approximate length of 164 m. The bridge was constructed in 1961. The bridge is a significant asset in the PMHC LGA providing a critical link between Rawdon Island and the mainland, and is utilised by residents, businesses and primary producers located on the island. The bridge provides the only road access to the community of Rawdon Island and there is no other access on or off the island.

Plate 2.1 – Rawdon Island Bridge

Plate 2.2 – Rawdon Island Bridge (Pier 6)

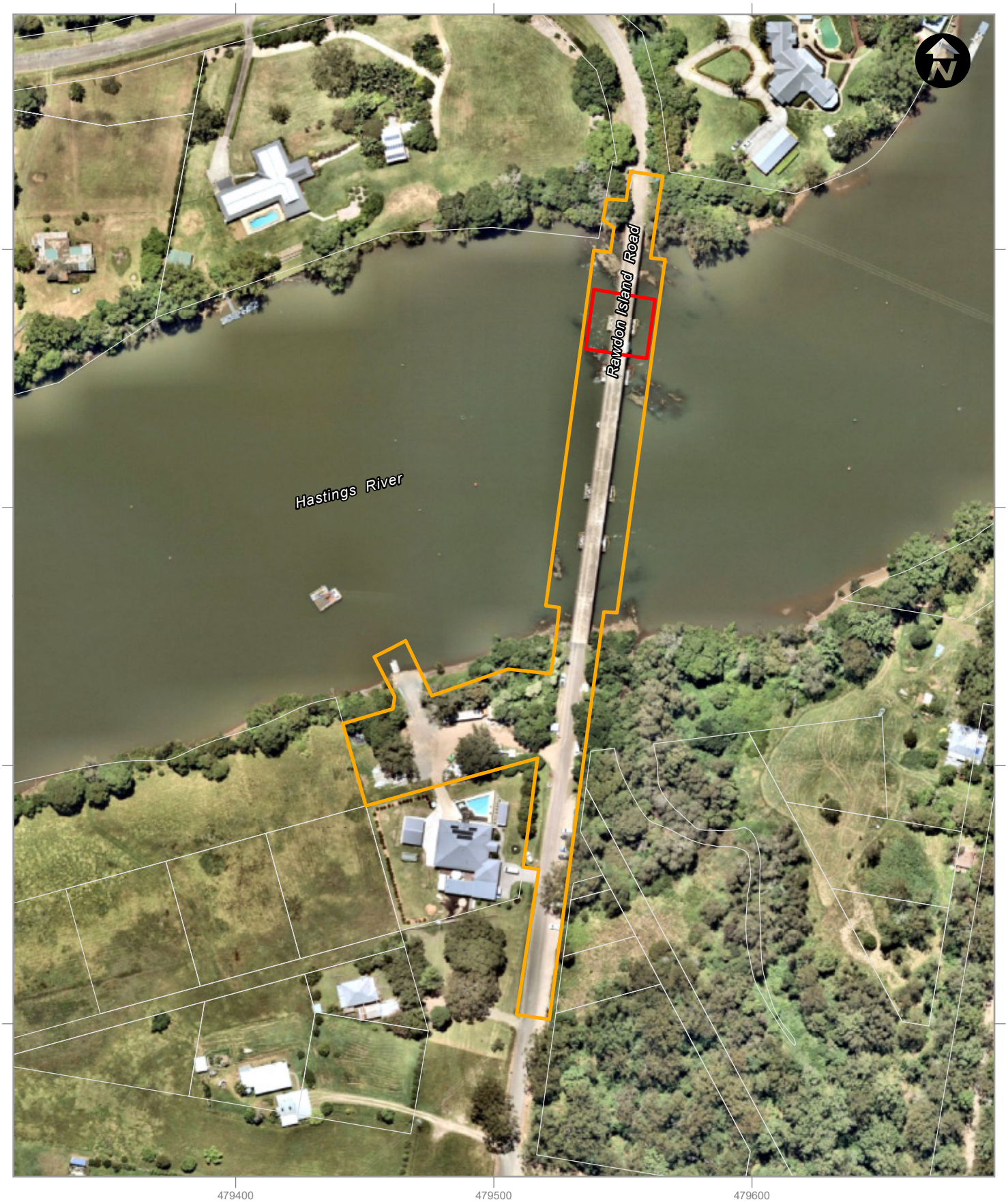
The following terms are discussed throughout this report and are defined as:

- **Study area**: as defined in the Stage 2 REF and includes the buffer area surrounding Subject site works and other areas associated with construction/ repairs works with Rawdon Island bridge (**Illustration 2.2**)
- **Subject site**: The proposed construction footprint for works at Pier 6 that are defined below (**Section 2.2**) (**Illustration 2.2**)
- **Locality**: the area within 10km of the Subject site.

0 2 km

Site Locality - Illustration 2.1

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TJC
Source of base data: OpenStreetMap
Date: 09/12/2021



LEGEND

- Subject site
- Study area
- Cadastre

0 40 Meters

The Site - Illustration 2.2

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 24/03/2022

2.2 Description of proposal

The scope of work and activities associated with the Stage 2 repair works and which are to occur in the Subject site, are as follows:

1. Pier 6 bridge joint rehabilitation – This work involves removal of the existing rubber compression seal, concrete break back utilising saw cutters and handheld jackhammers to remove deteriorated or poor quality concrete, cleaning and reinstating reinforcing, pouring a new epoxy shoulder to support the new joint sealant, and installing a pourable joint sealant to prevent water draining through to the substructure. This work primarily impacts the bridge decking and joint above the diaphragm beams and girders.
2. Pier 6 Diaphragm Beam Repairs – Concrete repairs to existing concrete diaphragm beams directly below the joint due to severe corrosion and delamination of concrete. This would involve saw cutting the edge of damaged concrete area, concrete break-back to remove damaged materials and expose reinforcement, cleaning and reinstating reinforcement, and concrete repairs using hand packable or pourable proprietary grout materials. No works on the inside face of the diaphragm beams are proposed.
3. Pier 6 Headstock Repairs - Concrete repairs to existing headstock directly below the joint due to severe corrosion and delamination of concrete, due to poor construction cover. This would involve saw cutting the edge of damaged concrete area; concrete break-back to removal damaged materials and expose reinforcement; cleaning and reinstating reinforcement; concrete repairs using hand packable or pourable proprietary grout materials; and provision of a protective coating over the full extent of the headstock.
4. Pier 6 Blade Wall Repairs and Protection – The existing pier blade walls between headstock and top of pile foundations have localised deterioration throughout due to chloride ingress and carbonation. Repairs involve saw cutting the edge of damaged concrete area; concrete break-back to removal damaged materials and expose reinforcement; cleaning and reinstating reinforcement; concrete repairs using hand packable or pourable proprietary grout materials; and provision of a protective coating over the full extent of the blade wall. Installation of an Impressed Current Cathodic Protection (ICCP) system in the bottom 2m of the blade wall is also included, which includes saw-cutting and grinding strips in the surface of the concrete to install zinc anodes around the full perimeter of the pier and connection to a solar powered TRU to provide current to the system (located at Abutment A).

Specific areas associated with Stage 2 works on Pier 6 are shown in **Figure 2.1**.

Bridge repair activities are being carried out or are approved to be carried out on other parts of the bridge under the separate Stage 1 REF approval. The specific Stage 1 program (i.e. timing of activities) is subject to change due to weather impacts and progressive bridge condition assessments affecting location specific repair requirements.

Suspended scaffold will be hung around the perimeter of Pier 6 during the repair works. The scaffold would take 2-3 days to assemble nearby, then floated into position around the pier and hung from the bridge kerb. It would remain in place for the duration of works, estimated at 10-12 weeks for the works, plus 2-4 additional weeks to enable microbat inspection and management (refer to **Section 7**).

Bridge works are scheduled for the following work hours:

- Monday to Friday – 06:00 am to 08:00 pm
- Saturday – 06:00 am to 08:00 pm
- Sunday – 08:00 am to 02.00 pm.

The Stage 2 repair works would be undertaken following the Stage 2 MMP to minimise impacts on threatened microbats. Key actions include:

- induction of personnel
- install alternative compensatory microbat roosting habitat
- microbat baseline surveys (including microbat data collected as part of the Stage 1 repair works)
- install temporary microbat exclusion (estimated 12 week duration)
- post exclusion inspections
- maintenance and restoration of pre-existing roosting habitat (expansion joints)
- monitoring.

Flexibility and adaptive management will be required throughout the Stage 2 MMP implementation to avoid conflicts with the Stage 1 works and to accommodate microbat behaviour and responses (particularly during the exclusion phase).

Further information of proposed actions and ameliorative strategies are outlined in **Section 7** and Stage 2 MMP (Appendix **C**). Some out of hours work would be required as part of microbat management (refer to **Section 7**).

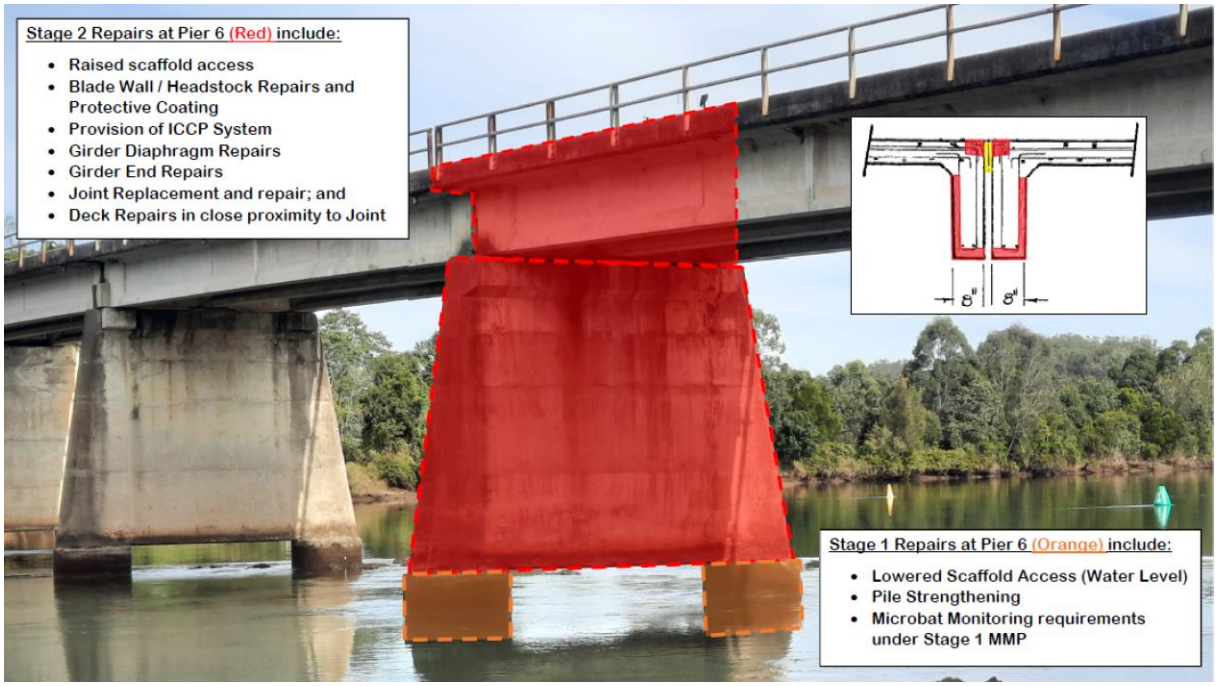


Figure 2.1 Staged works on Pier 6 Rawdon Island Bridge – Stage 2 works (this proposal) shown in red (source: PMHC)

2.3 Background searches and assessment of information

The following data and resources were used or consulted in this report:

- BioNet Vegetation Classification (Environment Energy and Science, 2022b)
- BioNet Threatened Biodiversity Data Collection (TBDC)(Environment Energy and Science, 2022c)
- BioNet Threatened Species Profiles
- NSW Department of Finance and Services (via Six Maps)
- IBRA Regions and Subregions (Thackway and Cresswell, 1995)
- NSW (Mitchell) Landscapes - Version 3.1 (Planning Industry and Environment, 2016)
- EPBC Act Protected Matters Search Tool (Department of Agriculture Water and the Environment, 2022a)
- Directory of Important Wetlands in Australia (Department of the Environment and Energy).

The aim of the background research was to identify threatened species, populations and ecological communities, Australian Government listed migratory species or critical habitat recorded previously or predicted to occur in the locality of the Subject site.

This allowed for known habitat characteristics to be compared with those present in the Subject site to determine the habitat suitability of each species or population.

Table 2.1 Database searches

Database	Search date	Area searched	Reference
BioNet Atlas of NSW Wildlife search tool	11/03/2022	10km x 10km centred on the Subject site	(Environment Energy and Science, 2022a)
EPBC Act Protected Matters Search Tool (PMST)	11/03/2022	10km x 10km centred on the Subject site	(Department of Agriculture Water and the Environment, 2022a)

In addition to database searches the review and utilisation of previous ecological investigations associated with the proposed works associated with Rawdon Island Bridge have been considered and used where required. The following previous ecological investigations were considered in this report:

- Stage 1 Rawdon Island Bridge Repairs Works:
  - Ecological Assessment for Rawdon Island Bridge Repairs (Wolfpeak, 2021)
  - Rawdon Island Bridge – Microbat Management Plan (Echo Ecology and Surveying, 2021c)
  - Rawdon Island Review of Environmental Factors (DOC2021/291331) – Stage 1 works (Port Macquarie - Hastings Council, 2021)
  - Rawdon Island Bridge Repair – Local Area Bat Roost Search (Echo Ecology and Surveying, 2021a)
  - Rawdon Island Bridge – Microbat Assessments of Significance (Echo Ecology and Surveying, 2021b)
  - Rawdon Island Bridge – Pre-construction Microbat Monitoring Outcomes Report (Echo Ecology and Surveying, 2021d)
  - Rawdon Island Bridge – Construction Microbat Monitoring Outcomes Report 1 (Echo Ecology and Surveying, 2022).
- Stage 2 Rawdon Island Bridge Repair Works:
  - Rawdon Island Review of Environmental Factors – Stage 2 works (Pier 6) (Port Macquarie - Hastings Council, 2022).

Existing findings and data from the ecological investigations (September – November 2021) and construction phase monitoring associated with the approved Stage 1 works were used to inform this report.

3. Existing Environment

3.1 Landscape features

Table 3.1 Summary of the Subject site landscape features

Landscape feature	Occurrence in Subject site
IBRA bioregion	NSW North Coast
IBRA subregion	Macleay Hastings
NSW landscape regions (Mitchell landscapes)	The Subject site occurs within Manning - Macleay Coastal Alluvial Plains and immediately adjacent to Wauchope Coastal Foothills
Local Government Area (LGA)	Port Macquarie – Hastings Council
Local Land Service (LLS) region	North Coast
Botanical subregion	North Coast (NNC)
Rivers, streams and estuaries	Rawdon Island Bridge spans the Hastings River
Important and local wetlands	No listed important wetlands were identified in the locality or proximity to the Subject site.
Areas containing karst, caves, crevices, cliffs, rocks or other geological features of significance	No areas containing karst, caves, crevices, cliffs, rocks or other geological features of significance occur within the Subject site
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared within the Subject site.

LEGEND

Subject site

Study area

Mitchell Landscape

Manning - Macleay Coastal Alluvial Plains

Wauchope Coastal Foothills

0 100 Meters

Landscape Features - Illustration 3.1

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 24/03/2022

LEGEND

- Subject site
- Study area
- Native vegetation extent
- Watercourse

0 100 Meters

Native Vegetation Extent - Illustration 3.2

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 24/03/2022

3.2 Vegetation

Under the approved Stage 1 REF (PMHC, 2021) for repair works associated with Rawdon Island Bridge, ecological investigations which included vegetation surveys within the study area were undertaken in September 2021 (Wolfpeak, 2021). Vegetation surrounding Rawdon Island bridge occurred on the southern and northern banks of the Hastings River. Ground truthing of vegetation within the study area was undertaken and vegetation was described and classified under the NSW Plant Community Type (PCT) classification where possible (Wolfpeak, 2021). All identified PCTs were assessed to determine if any identified PCT corresponded to a listed BC or EPBC Act listed threatened ecological communities (TEC). The following vegetation communities within the study area were identified:

- PCT 916: Mangrove - Grey Mangrove low closed forest of the NSW Coastal Bioregion
- PCT 1068: Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion
- Miscellaneous ecosystem – exotic grassland
- Miscellaneous ecosystem – weeds and ornamental plantings.

Vegetation mapping within the study area is showed in **Illustration 3.3**.

3.2.1 Threatened ecological communities

One vegetation community, PCT 1068: Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion, corresponded to the threatened ecological community – *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* under the BC Act (**Illustration 3.3**).

An assessment of PCT 1068 against EPBC Act criteria outlined in *Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia* (Department of Sustainability Environment Water Population and Communities, 2011) was undertaken in the *Ecological Assessment for Rawdon Island Bridge Repairs* (Wolfpeak, 2021). The assessment concluded that the occurrence of PCT 1068 within the study area does not meet the EPBC listing criteria for *Lowland Rainforest of Subtropical Australia*.

LEGEND

- Subject site
- Study area
- Cadastre
- PCT 1068: Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion
- Miscellaneous ecosystem - weeds and ornamental plantings
- Miscellaneous ecosystem - exotic grassland
- Lowland Rainforest on Floodplain of the NSW North Coast Bioregion (BC Act TEC)

0 30 Meters

Vegetation Communities Within Study Area - Illustration 3.3

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 24/03/2022

4. Initial assessment

A literature review of information pertaining to the study area and searches of the following databases were carried out to identify potential subject species, populations and/or ecological communities. Key sources of information reviewed include:

- BioNet Vegetation Classification (Environment Energy and Science, 2022b)
- BioNet Threatened Biodiversity Data Collection (TBDC)(Environment Energy and Science, 2022c)
- EPBC Act Protected Matters Search Tool (Department of Agriculture Water and the Environment, 2022a).

4.1 Previous ecological assessments

The following previous ecological investigations and reporting were considered in this report:

- Stage 1 Rawdon Island Bridge repair works:
  - Ecological Assessment for Rawdon Island Bridge Repairs (Wolfpeak, 2021)
  - Rawdon Island Bridge – Microbat Management Plan (Echo Ecology and Surveying, 2021c)
  - Rawdon Island Review of Environmental Factors (DOC2021/291331) – Stage 1 works (Port Macquarie - Hastings Council, 2021)
  - Rawdon Island Bridge Repair – Local Area Bat Roost Search (Echo Ecology and Surveying, 2021a)
  - Rawdon Island Bridge – Microbat Assessments of Significance (Echo Ecology and Surveying, 2021b)
  - Rawdon Island Bridge – Pre-construction Microbat Monitoring Outcomes Report (Echo Ecology and Surveying, 2021d)
  - Rawdon Island Bridge – Construction Microbat Monitoring Outcomes Report 1 (Echo Ecology and Surveying, 2022).
- Stage 2 Rawdon Island Bridge repair works:
  - Rawdon Island Review of Environmental Factors – Stage 2 works (Port Macquarie - Hastings Council, 2022).

Existing findings and data from the ecological investigations (September – November 2021) and construction phase monitoring (November 2021 – March 2022) associated with the approved Stage 1 Rawdon Island Bridge repair works were used to inform this report.

4.2 Identifying candidate species

Background searches were undertaken to assess the likelihood of occurrence of threatened species, populations and communities (threatened biodiversity) identified within the locality of the Subject site and those which are considered candidate species. All threatened biodiversity identified in background searches (**Table 2.1**) were considered in this assessment with the consideration of previous ecological surveys and based on the habitat profiles and other habitat information in the TBDC and the *Species Profile and Threats Database* (Department of Agriculture Water and the Environment, 2022b). The assessment also included consideration of the dates and locations of nearby records and information about species populations in the locality.

For this assessment, the likelihood of occurrence of threatened species and populations was determined based on the criteria shown in **Appendix B** and specifically based on the habitat that

occurs within the existing Rawdon Island Bridge and the species likely to utilise it and potential be impacted by the proposal.

Background searches identified 59 threatened fauna species and 23 threatened flora species either recorded or predicted to occur within the locality of the Subject site. Based on previous surveys and the habitat that occurs within the existing Rawdon Island Bridge the following species were identified to be candidate species:

- Little Bent-winged Bat (*Miniopterus australis*) listed as Vulnerable under the BC Act
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) listed as Vulnerable under the BC Act
- Southern Myotis (*Myotis macropus*) listed as Vulnerable under the BC Act.

Background searches identified four threatened ecological communities that have either been recorded or have the potential to occur within the locality. Based on previous ecological surveys only one threatened ecological community was confirmed within the study area, this being:

- *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* listed as Endangered under the BC Act.

No EPBC listed entities were identified occurring within the site or with a moderate to high likelihood or occurrence within the Subject site. As a result, no EPBC Act listed entities are considered further.

4.3 Identify subject species

All identified candidate species were further assessed to determine which threatened entities are likely to be affected by the proposal based on habitat identified in the Subject site. Further assessment of these entities and habitat is provided below.

4.3.1 Habitat assessment

Ecological assessments including habitat assessments were undertaken in September 2021 (Wolfpeak, 2021). The study area which consists of Rawdon Island Bridge and parts of Hastings River riparian habitat (**Illustration 3.3**). Vegetation within the study area occurred on the southern and northern banks of the river. The vegetation consisted of disturbed condition of lowland rainforest (PCT 1068), mangrove forest (PCT 916), exotic grassland and planted ornamentals and weed species.

The following habitat values within the study area were noted (Wolfpeak, 2021):

- no large logs with hollows present
- no hollow present (in the form of hollow-bearing trees)
- small presence of flowering natives and sap producing plants (i.e. wattles, Corymbia spp.) for nectar/ sap feeding fauna
- no primary Koala feed trees
- no Allocasuarinas for seed feeding species (i.e Glossy Black-cockatoos)
- small presence of fruiting species (i.e. Lilly Pilly)
- presence of artificial roosting habitat in the form of Rawdon Island Bridge, underside of bridge contains open gaps and roosting habitat for microbat species. Targeted surveys identified roosting microbats within these structures (i.e. Pier 6)
- riparian habitat provides connectivity for terrestrial fauna species.

Works within the study area including works directly impacting vegetation were approved under the Stage 1 REF (PMHC, 2021). Works not approved under the Stage 1 REF are Stage 2 repair works associated with Pier 6 (the Subject site; refer to **Section 2.2**). Specifically identifying habitat values

within the Subject site are associated with artificial habitats in the form of concrete openings within Rawdon Island Bridge Pier 6 which provided microbat roosting habitat (refer to **Figure 2.1**). Due to the lack of suitable habitat, the majority of fauna and flora species identified in the locality are unlikely to utilise the Subject site and are not considered as candidate species for further assessment. Based on the presence of only artificial roosting habitat within the Subject site, only the following threatened species are known or considered likely to utilise the Subject site:

- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Southern Myotis (*Myotis macropus*).

Works within the study area including works directly impacting vegetation, specifically the listed TEC - *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* was assessed and approved under the Stage 1 REF (Port Macquarie - Hastings Council, 2021). An Assessment of Significance for *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* concluded that the proposed action would not result in a significant impact on this ecological community (Wolfpeak, 2021).

4.3.2 Habitat suitability for candidate species

Below outlines the habitat suitability within the Subject site for each candidate species based on the information in the TBDC (Environment Energy and Science, 2022c).

Little Bent-winged Bat (*Miniopterus australis*)

The Little Bent-winged Bat occurs along the east coast and adjacent ranges of Australia from Cape York in QLD to Wollongong in NSW. The species is known to utilise a variety of habitat including; moist eucalypt forest, rainforest, wet and dry sclerophyll, melaleuca swamps, and dense coastal forests and heathland. The species prefers to roost in caves, tunnels, tree hollows, mines and artificial habitats (i.e. stormwater drains, culverts, bridges and buildings). The species is known to breed in maternity cave colonies, of which, only five nursery/ maternity roost sites are known in Australia. The following habitat features based on the information in the TBDC include:

- **Habitat constraint:** Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding with numbers of individuals >500 or known from scientific literature
- **Buffer area around habitat or breeding features:** All breeding habitat including caves, or other features, used for breeding and the area immediately surrounding this feature should have a 100m radius buffer around the location centred on the cave/feature entrance.

Rawdon Island Bridge is a beam and slab concrete bridge, approximately 164m long and 6.5m wide, with seven piers. Previous ecological assessments of the entire bridge identified several small open cavities within the bridge that provide habitat for cave-dwelling microbat species (Wolfpeak, 2021). The highest potential roosting habitat was identified in deck expansion joints above Pier 2 and Pier 6 (Echo Ecology and Surveying, 2021b, 2021c; Wolfpeak, 2021). The deck expansion joint above Pier 5 provides structurally similar habitat but without a seal. The Pier 5 expansion join is being repaired as part of the Stage 1 works and may provide potential habitat upon completion. The main roosting habitat, which has been seen utilised by microbats (both Little Bent-winged Bat and Southern Myotis) occurs within Pier 6 (**Plate 4.1**) (Echo Ecology and Surveying, 2021c, 2021b). Regarding Little Bent-winged Bat, it is likely that Rawdon Island Bridge only provides roosting habitat for individuals whilst foraging in the locality and unlikely to act as a breeding site. Only a small number of Little Bent-winged Bats (<10) have previously been recorded at the bridge (Dr Anna McConville, pers. comms, March 2022). Little Bent-winged Bats are known to prefer breeding in maternity colonies associated with cave systems that maintain certain stable temperatures, of which only five nursery/maternity colonies are known in Australia (Environment Energy and Science, 2022c). Significant over-wintering

sites in artificial structures are typically dark voids (David Andrighetto. pers. obs.) and differ to the potential roosting habitat on the Subject site which has some light exposure.

Large Bent-winged Bat (*Miniopterus orianae oceanensis*)

The Large Bent-winged Bat occurs along the east and north-west coast of Australia. The species utilises a variety of well timbered forests, often foraging above tree tops for flying insects. The species prefers to roost in caves but is also recorded roosting in artificial habitats such as derelict mines, stormwater tunnels, buildings and culverts. Populations are often centred on maternity caves in which during the non-breeding season individuals have been recorded dispersing 300km from these caves. The following habitat features based on the information in the TBDC include:

- **Habitat constraints:** Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding.
- **Breeding features**: Potential breeding habitat is caves, tunnels, mines or other structures known or suspected to be used by *M. schreibersii oceanensis* with numbers of individuals >500 or known from scientific literature
- **Buffer area around habitat or breeding features:** All breeding habitat including caves, or other features, used for breeding and the area immediately surrounding this feature should have a 100m radius buffer around the location centred on the cave/feature entrance.

As stated above, previous ecological assessments of the entire bridge identified several small open cavities within the bridge that provide habitat for cave-dwelling microbat species. The highest potential roosting habitat was identified in deck expansion joints above Pier 2 and Pier 6 (Echo Ecology and Surveying, 2021b, 2021c; Wolfpeak, 2021). The deck expansion joint above Pier 5 provides structurally similar habitat but without a seal. The Pier 5 expansion join is being repaired as part of the Stage 1 works and may provide potential habitat upon completion. Similar to Little Bent-winged Bat, these identified habitat areas have the potential to provide roosting habitat for the Large Bent-winged Bat. Whilst no Large Bent-winged Bats have been identified in previous ecological assessments and monitoring events, the species is known to sometimes seen roosting with other Bent-winged Bat species such as the Little Bent-winged Bat. Like the Little Bent-winged Bat, it is likely that Rawdon Island Bridge only provides roosting habitat for Large Bent-winged Bats whilst individuals forage in the locality, it is unlikely to act as a breeding site. Large Bent-winged Bats appear to prefer breeding in large maternity colonies associated with cave systems that maintain certain stable temperatures (Environment Energy and Science, 2022c). Significant over-wintering sites in artificial structures are typically dark voids (David Andrighetto. pers. obs.) and differ to the potential roosting habitat on the Subject site which has some light exposure.

Southern Myotis (*Myotis macropus*)

Southern Myotis occurs along coastal areas from north-west Australia, the top-end and around to western parts of Victoria. The species can also be found inland along major rivers with permanent water. Southern Myotis specialises in foraging over waterbodies catching insects and small fish by raking their feet across the water surface. The species roosts in caves, mines, hollow-bearing trees, stormwater channels and artificial structures (i.e. culverts, bridges) often in close to water sources and dense foliage. The following habitat features based on the information in the TBDC include:

- **Habitat constraints** Bridges, caves or artificial structures within 200m of riparian zone. Hollow-bearing trees within 200m of riparian zones. Waterbodies including rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site
- **Breeding features**: Bridges, caves or artificial structures within 200m of riparian zone. Hollow-bearing trees within 200m of riparian zones.
- **Buffer area around habitat or breeding features:** Buffers should align with PCTs on the subject land to which the species is associated and are within 200m of waterbodies mapped.

Rawdon Island Bridge provides the highest value habitat opportunities for Southern Myotis. As stated previously, the bridge provides several small open cavities, of which, Pier 6 expansion joint is known to provide roosting for approximately 120-199 individuals (Echo Ecology and Surveying, 2021b, 2021c; Wolfpeak, 2021; Dr Anna McConville, pers. comms, March 2022) (**Plate 4.2**, **Plate 4.4** and **Plate 4.5**). Previous ecological surveys across entire bridge only identified Pier 6 being utilised by the species, with some potential/ similar habitat values identified in Pier 2. The deck expansion joint above Pier 5 provides structurally similar habitat but without a seal. The Pier 5 expansion join is being repaired as part of the Stage 1 works and may provide potential habitat upon completion. Given the presence of a relatively large colony roosting within Pier 6 expansion joint and evidence of long-term use, it is likely that the roosting habitat is also used for breeding by the species.

4.4 Targeted surveys

Due to the ecological investigations (September – November 2021) associated with the approved Stage 1 Rawdon Island bridge repair works, the existing targeted survey results and data are still valid and were used to inform this report (PMHC, 2021; Wolfpeak, 2021). Additionally, ongoing monitoring of the existing bridge structure undertaken by Echo Ecology and Surveying is continuing to provide up-to-date data and information on species utilising the existing bridge habitat (Echo Ecology and Surveying, 2021d, 2022).

The targeted surveys were undertaken from September – November, majority of the microbat monitoring surveys were undertaken from November – March during optimal survey periods for candidate species (Environment Energy and Science, 2022c). An outline of these surveys and associated survey effort undertaken are shown in **Table 4.1**.

Table 4.1 Previous ecological surveys and methods

Previous ecological survey	Date	Survey methods
Ecological Assessment for Rawdon Island Bridge Repairs (Wolfpeak, 2021)	September 2021	■ Targeted threatened flora surveys ■ Vegetation surveys ■ Fauna habitat assessment and hollow-bearing tree survey ■ Targeted threatened fauna survey – microbat roost searches.
Rawdon Island Bridge Repair – Local Area Bat Roost Search (Echo Ecology and Surveying, 2021a)	September 2021	■ Targeted microbat roost searches within 5km of Subject site.
Rawdon Island Bridge – Pre-construction Microbat Monitoring (Echo Ecology and Surveying, 2021b)	November 2021	Targeted microbat surveys: ■ Infrared video camera monitoring (**Plate 4.3**) ■ Daily roost inspections ■ Flyout counts ■ Noise monitoring.
Rawdon Island Bridge – Construction Microbat Monitoring Outcomes Report 1 (Echo Ecology and Surveying, 2022)	March 2022	Targeted microbat surveys: ■ Infrared video camera monitoring (**Plate 4.3**) ■ Daily roost inspections ■ Flyout counts ■ Noise monitoring.

Plate 4.1 – Rawdon Island Bridge (Pier 6)

Plate 4.2 – Pier 6 bat guano below roosting habitat (photo: Will Steggall)

Plate 4.3 – Pier 6 monitoring cameras

Plate 4.4 – Pier 6 Southern Myotis roosting (photo: Will Steggall)

Plate 4.5 – Pier 6 roosting habitat in concrete expansion gap (photo: Will Steggall)

4.5 Final list of subject species

Based on the habitat within the Subject site and results from targeted surveys, the following species are considered as subject species:

- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Southern Myotis (*Myotis macropus*).

Assessment of impacts of the proposal on the subject species is provided below.

5. Assessment of impacts on threatened species

5.1 Assessment of species likely to be affected

Assessment of potential impacts of the proposal on subject species, include:

- Little Bent-winged Bat (*Miniopterus australis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Southern Myotis (*Myotis macropus*).

Assessment of impacts are provided in **Table 5.1**. Potential impacts are divided into 'direct impacts' (activities directly affecting habitat and individuals) and 'indirect impacts' (activities affect habitat and individuals in a manner other than direct loss). The key impacts to subject species include roosting habitat modification and disruption to roosting habitat which have the potential to have a significant impact on subject species and potential mortality/ injury during bridge repair works should no mitigation measures be undertaken.

Safeguards and management measures to alleviate the identified potential impacts are detailed in the Stage 2 Microbat Management Plan (MMP; **Appendix C**) and outlined in **Section 7**. The Stage 2 MMP aims to:

- provide advice for construction personnel on how to manage microbat conflicts during repair work
- guide microbat exclusion installation process
- reduce potential for microbat injury or mortality
- avoid disturbances to breeding microbats
- maintain breeding roosting habitat for the Southern Myotis at Rawdon Island Bridge upon completion of the repair works.

Table 5.1 Assessment of impacts on subject species

Potential impact (risk)	Significance of impact
Direct impacts	
Habitat modification (high): The proposal would involve modifying (repairing) the bridge/expansion joint at Pier 6, resulting in the following roosting habitat changes: ■ potential change to roosting habitat at top of the expansion joint from the bridge joint repairs which involve removal of the existing rubber compression seal, concrete break back utilising saw cutters and handheld jackhammers to remove deteriorated or poor quality concrete, cleaning and reinstating reinforcing, pouring a new epoxy shoulder and installing a new joint sealant. ■ preventing water creeping into the roost (i.e. modifying the micro-climate) during rainfall periods ■ diaphragm beam repairs below the expansion joint, which comprises the main microbat access to the roost. Most of the internal concrete surfaces associated with the roost would not be modified. The Pier 6 bridge expansion joint roost habitat changes have potential to reduce the roost habitat value of the Pier 6 expansion joint for microbats. The Stage 2 MMP proposes microbat exclusion for an estimated 12 week period. Exclusion will begin outside the breeding season (Southern Myotis), however, once established may persist at the start of the following breeding season (October), pending weather.	**Potentially significant** – The roosting colony's response is unknown but may include adoption of alternative roosting habitat within the existing bridge structure or other habitat in the locality, either as a single unit or fragmented into smaller groups. Alternative roosting habitat (similar to existing bridge habitat) locally is mainly provided by culverts and bridges. A total of 11 structures within the locality have a moderate to high roosting potential for microbats (Echo Ecology and Surveying, 2021a), in which, the subject species may relocate if disturbed and no other alternative habitat is provided. Regarding the subject Bent-winged Bat species, both species are known to travel reasonably large distances from roost sites for foraging purposes (70-300km) (G. Hoye and Spence, 2004). Bent-winged Bat roosts were also identified within 5km of Rawdon Island Bridge (Echo Ecology and Surveying, 2021a) and there is potential if disturbed and habitat removed individuals may relocate to these locations. However, numbers of Bent-winged Bats within Rawdon Island Bridge were identified as low (<10 individuals), and it is considered that habitat removal for both species is likely to be of low significance. For the Southern Myotis, this species has been recorded travelling 3 – 10km from roost sites where connectivity was available (Gonsalves and Law, 2017a). Roost searches within 5km radius did not record any Southern Myotis roosting within artificial structures, and the species has not been observed switching roost locations within the existing Rawdon Island Bridge structure (Echo Ecology and Surveying, 2021a). This suggests that, without provision of alternative habitat within the existing bridge structure that the species may be significantly impacted by the modification and disturbance of habitat associated with the proposal. The proposed Stage 2 MMP measures, including exclusion of the existing roost, will directly impact the colony. Exclusion works are temporary in nature and aim to be up for a maximum of 12 weeks. Exclusion installation will be undertaken outside the breeding season and will be managed utilising alternative microbat roosting habitat provided to alleviate this impact. Proposed ameliorative strategies to alleviate the risk of habitat modification and exclusion impacts are outlined in **Section 7**.
Disruption to breeding cycles (high): The proposal poses a high risk of disruption to the breeding cycle through the disturbance and potential modification of habitat within existing bridge structure.	**Potentially significant** – Rawdon Island Bridge supports a relatively large breeding colony (120-199 individuals) of Southern Myotis. Depending on the response to disturbance/ modification of habitat, breeding may not occur within the local area. Loss of a local breeding site for a viable local population would be a significant impact. Exclusion works are temporary in

Potential impact (risk)	Significance of impact
The Stage 2 MMP proposes microbat exclusion for an estimated 12 week period. Exclusion will begin outside the breeding season (Southern Myotis), however, once established may persist at the start of the following breeding season (October), pending weather.	nature and aim to be up for a maximum of 12 weeks. Exclusion will be installed outside of the breeding season utilising alternative roosting habitat provided on Rawdon Island Bridge to avoid direct disruptions during the breeding season. Proposed ameliorative strategies to alleviate the risk of breeding impacts are outlined in **Section 7**. In regard to the subject Bent-winged Bat species, both species are unlikely to breed within the existing bridge structures. Both species are known to prefer to breed in large maternity colonies associated with cave systems that maintain certain stable temperatures. The nearest known maternity colony is the Willi Willi cave system to the west of Kempsey. It is unlikely that the proposal would disrupt the breeding cycles of either Bent-winged Bat species.
Mortality or injury during bridge repairs (high): The proposal poses a high risk of mortality or injury to microbats roosting at the bridge during repair works.	**Potentially significant** – The proposed works requires direct construction activities at and within proximity to the known roosting habitat within Rawdon Island Bridge at Pier 6. Without mitigation measures (such as temporary exclusion), there is a particular risk that works will encounter microbats and potentially injure or cause mortality to subject species. Additionally, there is a risk to juvenile microbats if the removal or exclusion work were scheduled during the Southern Myotis breeding season or when juveniles are flightless and dependent. Microbats displaced during the day are also vulnerable to predation. Proposed ameliorative strategies to alleviate the risk of mortality or injury are outlined in **Section 7**.
Noise and vibrations (high): The proposal would require the use of machinery and power tools which are likely to cause short term noise and vibration impacts at the existing roost if not mitigated.	**Potentially significant** – Potential impacts associated with short-term construction phase noise and vibration may disturb or harm roosting microbats, particularly if undertaken during the Southern Myotis breeding season or microbats vacate the roost during the day. No post construction noise impacts are expected. The Stage 2 MMP aims to alleviate noise impacts by excluding microbats from the Pier 6 roost and provide alternative habitat on Rawdon Island Bridge while Pier 6 construction works are being undertaken (refer to **Section 7**).
Indirect impacts	
Foraging habitat degradation: No forest/woodland or foraging habitats would be affected. Stage 2 REF mitigation measures would be implemented to alleviate potential water quality impacts.	**Non–significant** – vegetation clearing, and disturbance are not anticipated to be impacted as a result of the proposal. Impacts to vegetation communities and foraging habitat associated with microbats were assessed under the approved Stage 1 works (Port Macquarie - Hastings Council, 2021). Stage 2 works (this proposal) only incorporates works associated with the Pier 6 bridge structure and associated microbat roosting habitat. No foraging habitat is expected to be impacted as a result of the proposal.

Potential impact (risk)	Significance of impact
Flyways (low): The proposal is unlikely to block or limit access to roosting habitat within the existing bridge structure.	**Non-significant** – The proposed repair works will not impose or reduce regular commuting routes used by microbats (flyways). Post works will ensure that access to roosting habitat will still be available from below the bridge decking.
Reduction in habitat connectivity: no severing or fragmentation of habitat is proposed to occur.	**Non–significant** – the proposal would not involve severing or removal of habitats resulting in a loss in connectivity. Microbats are a highly mobile species, and the proposal would not exacerbate connectivity links than what already occurs within the study area.

5.2 Discussion of conservation status

This section outlines the details of each subject species regarding its conservation status, key threatening processes, distribution, habitat requirements and recovery strategies.

5.2.1 Little Bent-winged Bat

5.2.1.1 Conservation status

The Little Bent-winged Bat does not have any statutory conservation status locally or regionally. State-wide in NSW, Little Bent-winged Bat is listed as 'Vulnerable' under the BC Act for the following reasons:

- the species is facing a high risk of extinction in the medium-term future
- the species has had a moderate reduction in population size and geographic distribution
- the species is restricted to a small number of locations where breeding occurs, such that the species is prone to the effects of human activities or stochastic events – i.e. disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic.

5.2.1.2 Key threatening processes

There are currently 39 Key Threatening Processes (KTP) listed under the BC Act. Those relevant to Little Bent-winged Bat include:

- clearing of native vegetation
- predation by feral cats.

The NSW threatened species profile (Environment Energy and Science, 2022c) lists the following threats to Little Bent-winged Bat:

- disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic
- destruction of caves that provide seasonal or potential roosting sites
- changes to habitat, especially surrounding maternity/nursery caves and winter roosts
- pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals
- predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- introduction of exotic pathogens such as the White-nosed fungus
- hazard reduction and wildfire fires during the breeding season
- large scale wildfire or hazard reduction can impact on foraging resources
- poor knowledge of reproductive success and population dynamics.

5.2.1.3 Distribution and habitat requirements

The Little Bent-winged Bat occurs along the east coast and adjacent ranges of Australia from Cape York in QLD to Wollongong in NSW. The species is known to utilise a variety of habitat including; moist eucalypt forest, rainforest, wet and dry sclerophyll, melaleuca swamps, and dense coastal forests and heathland. The species prefers to roost in caves, tunnels, tree hollows, mines and artificial habitats (i.e. stormwater drains, culverts, bridges and buildings). The species is known to breed in maternity cave colonies, of which, only five nursery/ maternity roost sites are known in Australia.

The Little Bent-winged Bat population at the Subject site is not at the limit of the species known distribution or limited by its known habitat requirements. No breeding colonies or known breeding caves occur within the Subject site.

5.2.1.4 Applicable recovery plans/ recovery actions

No approved or draft recovery plans have been undertaken for this species. The following recovery actions have been proposed for the species (Office of Environment and Heritage, 2022):

- protect known roosting and nursery sites and surrounding forest from disturbance by restricting and/or monitoring access
- retain stands of native vegetation, particularly within 10km of roosts
- reduce use of pesticides within breeding and foraging habitat
- undertake non-chemical weed control to prevent obstruction of maternity cave and other roost entrances
- exclude fire from 100m of maternity cave, winter roost or other significant roost entrances and ensure smoke/flames do not enter these roosts
- control foxes, feral cats and goats around maternity caves, winter roosts and other significant roost sites
- ensure any fencing and gating of roosts is done in a bat friendly manner allowing adequate entrance and exit space for all species using the roost
- check with OEH before undertaking recreational caving activities
- ensure adequate foraging habitat is retained when undertaking hazard reduction activities, particularly during the breeding/reproduction season
- ensure appropriate hygiene protocols are implemented when undertaking research and survey work.

5.2.1.5 Reservation within conservation reserves

Approximately 23% of the species current known distribution occurs within NSW reserves (i.e. NSW National Parks and associated estates) (Office of Environment and Heritage, 2022). Little Bent-winged Bat has been assigned to the Landscape species management stream under the Saving our Species (SoS) program. Species that are labelled under landscape species management are species that are highly mobile or affected by landscape-scale threats. One key management site has been identified for this species, which includes:

- Willi Willi Cave – Willi Willi National Park, Kempsey, NSW

Key sites such as Willi Willi Cave are known breeding sites for the species and important for conservation of the species and preservation of breeding cycles for the species. No listed priority management sites occur within the Subject site, nor will any be impacted as a result of the proposal.

5.2.2 Large Bent-winged Bat

5.2.2.1 Conservation status

The Large Bent-winged Bat does not have any statutory conservation status locally or regionally. State-wide in NSW, Large Bent-winged Bat is listed as ‘Vulnerable’ under the BC Act for the following reasons:

- the species is facing a high risk of extinction in the medium-term future
- the species has had a moderate reduction in population size and geographic distribution

- the species is restricted to a small number of locations where breeding occurs, such that the species is prone to the effects of human activities or stochastic events – i.e. disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic.

5.2.2.2 Key threatening processes

There are currently 39 Key Threatening Processes (KTP) listed under the BC Act. Those relevant to Large Bent-winged Bat include:

- clearing of native vegetation
- predation by feral cats

The NSW threatened species profile (Environment Energy and Science, 2022c) lists the following threats to Little Bent-winged Bat:

- disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding
- loss of high productivity foraging habitat
- introduction of exotic pathogens, particularly white-nose fungus
- cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances
- hazard reduction and wildfire fires during the breeding season
- predation by feral cats.

5.2.2.3 Distribution and habitat requirements

The Large Bent-winged Bat occurs along the east and north-west coast of Australia. The species utilises a variety of well timbered forests, often foraging above tree tops for flying insects. The species prefers to roost in caves, but is also recorded roosting in artificial habitats such as derelict mines, stormwater tunnels, buildings and culverts. Populations are often centred on maternity caves in which during the non-breeding season individuals have been recorded dispersing 300km from these caves.

The Large Bent-winged Bat population at the Subject site is not at the limit of the species known distribution or limited by its known habitat requirements. No breeding colonies or known breeding caves occur within the Subject site.

5.2.2.4 Applicable recovery plans/ recovery actions

No approved or draft recovery plans have been undertaken for this species. The following recovery actions have been proposed for the species (Office of Environment and Heritage, 2022):

- control foxes and feral cats around roosting sites, particularly maternity caves
- retain native vegetation around roost sites, particularly within 300m of maternity caves
- minimise the use of pesticides in foraging areas
- protect roosting sites from damage or disturbance.

5.2.2.5 Reservation within conservation reserves

The adequacy of representation of Large Bent-winged Bat within conservation reserves in the region is generally unknown. However, the species is assigned to the Site-managed species management stream under the SoS program. Species that are labelled under site-managed species management are species that can be secured by projects at specific sites. Regarding Large Bent-winged Bat there are a number of site specific management sites that are important sites, these include:

- Kwiamble – Inverell
- Mount Kaputar – Narrabri
- Willi Willi Cave – Kempsey
- Yessabah – Kempsey
- Church Cave – Yass Valley
- Drum Cave – Bungonia State Conservation Area
- Dip Cave – Wee Jasper Nature Reserve.

No listed priority management sites occur within the Subject site, nor will any be impacted as a result of the proposal.

5.2.3 Southern Myotis

5.2.3.1 Conservation status

Southern Myotis does not have any statutory conservation status locally or regionally. State-wide in NSW, Southern Myotis is listed as 'Vulnerable' under the BC Act for the following reasons:

- its population and distribution are suspected to be reduced
- it faces severe threatening processes
- it is an ecological specialist (it depends on particular types of diet or habitat) and associated habitats are severe pressure.

5.2.3.2 Key threatening processes

There are currently 39 Key Threatening Processes (KTP) listed under the BC Act. Those relevant to Southern Myotis include:

- alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
- clearing of native vegetation
- loss of hollow-bearing trees.

The NSW threatened species profile (Environment Energy and Science, 2022c) lists the following threats to Southern Myotis:

- loss or disturbance of roosting sites
- clearing adjacent to foraging areas
- application of pesticides in or adjacent to foraging areas
- reduction in stream water quality affecting food resources.

5.2.3.3 Distribution and habitat requirements

The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. The species is also found inland along major rivers with permanent water. Southern Myotis specialises in foraging over waterbodies catching insects and small fish by raking their feet across the water surface. The species roosts in caves, mines, hollow-bearing trees, stormwater channels and artificial structures (i.e. culverts, bridges) often in close to water sources and dense foliage.

The Southern Myotis population at the Subject site is not at the limit of the species known distribution or limited by its known habitat requirements.

5.2.3.4 Applicable recovery plans/ recovery actions

No approved or draft recovery plans have been undertaken for this species. The following recovery actions have been proposed for the species (Office of Environment and Heritage, 2022):

- retain native vegetation along streams and rivers and around other waterbodies
- minimise the use of pesticides adjacent to foraging areas
- protect roosts from damage or disturbance.

5.2.3.5 Reservation within conservation reserves

Approximately 20% of the species current known distribution occurs within NSW reserves (i.e. NSW National Parks and associated estates) (Office of Environment and Heritage, 2022). Southern Myotis has been assigned to the Landscape species management stream under the SoS program. Species that are labelled under landscape species management are species that are highly mobile or affected by landscape-scale threats.

No listed priority management sites occur within the Subject site, and no listed sites will be impacted as a result of the proposal.

5.3 Discussion of local and regional abundance and distribution

This section discusses the local and regional abundance and distribution of each subject species.

5.3.1 Discussion of other known local populations

5.3.1.1 Little Bent-winged Bat

Definitive populations numbers are lacking for this species, population numbers of the species regionally and locally can only be derived from past research and local roost searches from previous ecological assessments.

Studies of Willi Willi cave system located 62km northwest from the Subject site is likely to act as the main maternity colony for Little Bent-winged bats within the region. Whilst no recent population accounts have been made for this roosting site, population numbers by Dwyer (1968), estimated Little Bent-winged Bat numbers peaking around 6850 individuals (Dwyer, 1968).

Local roost searches (within 5km of the Subject site) were undertaken by Echo Ecology and Surveying (Echo Ecology and Surveying, 2021a). A total of 23 structures were assessed for roosting habitat, of which, Little Bent-winged Bats were identified in two. Recorded numbers of Little Bent-winged Bats were approximately <260 individuals (Echo Ecology and Surveying, 2021a). It is likely that the local population of Little Bent-winged Bats fluctuates based on a variety of environmental factors including habitat availability and food resources. Ultimately the Willi Willi maternity cave would be a key source population and roosting site whereby individuals would likely disperse outside breeding seasons into smaller colonies within local culverts and bridges as seen in the Subject site.

Within the existing Rawdon Island Bridge, the numbers of Little Bent-winged Bats were identified as low (<10 individuals), and it is considered that the roost within Rawdon Island Bridge is unlikely to be a site which supports significant numbers of Little Bent-winged Bats and would not be considered to be a breeding site, therefore the roost is likely to be of low significance.

5.3.1.2 Large Bent-winged Bat

Similarly, to Little Bent-winged Bats, recent population numbers for Large Bent-winged Bats are limited. However, numbers of regionally significant roosts by Dwyer (1966) estimated numbers within the Willi Willi Cave system averaging around 25,650 individuals (Dwyer, 1966). Willi Willi cave system is located 62km northwest from the Subject site is likely to act as the main maternity colony for bent-winged bats within the region and is known to accommodate a much larger colony of Large Bent-winged Bats than Little Bent-winged Bats (Dwyer, 1968). Maternity sites are utilised yearly during breeding and are significant sites for Bent-winged species, acting as a source population and dispersal point. Large Bent-winged Bats are known to move 70km between roost sites (G. Hoye and Spence, 2004) and there is possibility that individuals could travel from Willi Willi Cave to the Subject site.

Local roost searches (within 5km of the Subject site) undertaken by Echo Ecology and Surveying (Echo Ecology and Surveying, 2021a) identified two roosts with =/<10 Large Bent-winged Bat individuals. Similar to Little Bent-winged Bats, it is likely that the local population of Large Bent-winged Bats fluctuates based on a variety of environmental factors including habitat availability and food resources. The Willi Willi maternity cave would be a key source population and roosting site whereby individuals would likely disperse outside breeding seasons into smaller colonies within local culverts and bridges. Within the existing Rawdon Island Bridge, no Large Bent-winged Bats have been identified to date, however, it is likely that individuals would roost within the existing structure. Similar to the conclusions of Little Bent-winged Bats, it is considered that the roost within Rawdon Island Bridge is unlikely to be a site which supports significant numbers of Large Bent-winged Bats and therefore the roost is likely to be of low significance.

5.3.1.3 Southern Myotis

Southern Myotis roosts in colonies of 10-15 individuals and occasionally of several hundred (Richards et al., 2008) relatively stable residential populations (Law et al., 2020). Within breeding colonies, it occurs in relatively small clusters, where each male establishes a territory, excludes other males and forms a harem of females during the breeding season (Dwyer, 1970). When not breeding, males either roost alone or form bachelor groups of up to 20 males (Dwyer, 1970). Large breeding colonies (>50 to >500 individuals) have been recorded in artificial structures such as culverts and bridges in the NSW Northern Rivers, Mid-Coast and Hunter regions (e.g. Sportsmans Creek Bridge, Marom Creek culvert, Barrington Bridge, Briner Bridge, Binna Burra culvert, Glebe Bridge, Clarence Town Bridge, Shark Creek Bridge, Tabulam Clarence River Overflow and McFarlane Bridge (GeoLINK, 2017, 2016, 2018; David Andrighetto, pers. obs.).

Southern Myotis are known to regularly travel approximately 5-10km from roost sites to forage which indicates that bats roosting within 5-10km range are likely to be part of the same population (Gonsalves and Law, 2017a). Southern Myotis have been observed to maintain high site fidelity and appear to maintain permanent roosting sites with some roost swaps within nearby areas (Gonsalves and Law, 2017b, 2017a).

Local roost searches (within 5km of the Subject site) were undertaken by Echo Ecology and Surveying (Echo Ecology and Surveying, 2021a). A total of 23 structures (14 culverts and 9 bridges) were assessed for Southern Myotis roosting presence and habitat suitability. Eleven of these structures were found to have a moderate to high potential for Southern Myotis utilisation, however, on inspection no Southern Myotis were recorded within these structures (refer to **Table 5.2**) Echo Ecology and Surveying, 2021a).

BioNet searches of Southern Myotis roosts within the PMHC LGA identified records of only four known roosts all within bridge and culvert structures; including two located within the locality of the Subject

site (refer to **Table 5.2**). Hollow-bearing trees in proximity of the Hastings River and associated tributaries may also provide roosting habitat, however such trees are not common within the locality.

The presence of alternative potential and known Southern Myotis roosting habitat within 10km of the site suggesting potential for individuals to utilises these roosting habitats if required. However no evidence of roost swapping has been observed during the Stage 1 microbat monitoring (Dr Anna McConville, pers. comms, March 2022).

Overall the available information indicates that:

- Rawdon Island Bridge supports a locally significant Southern Myotis population, of approximately 120-199 individuals (Echo Ecology and Surveying, 2021b; Dr Anna McConville, pers. comms, March 2022; **Figure 5.1**)
- the Subject site is important to the long-term survival of the species in the locality.

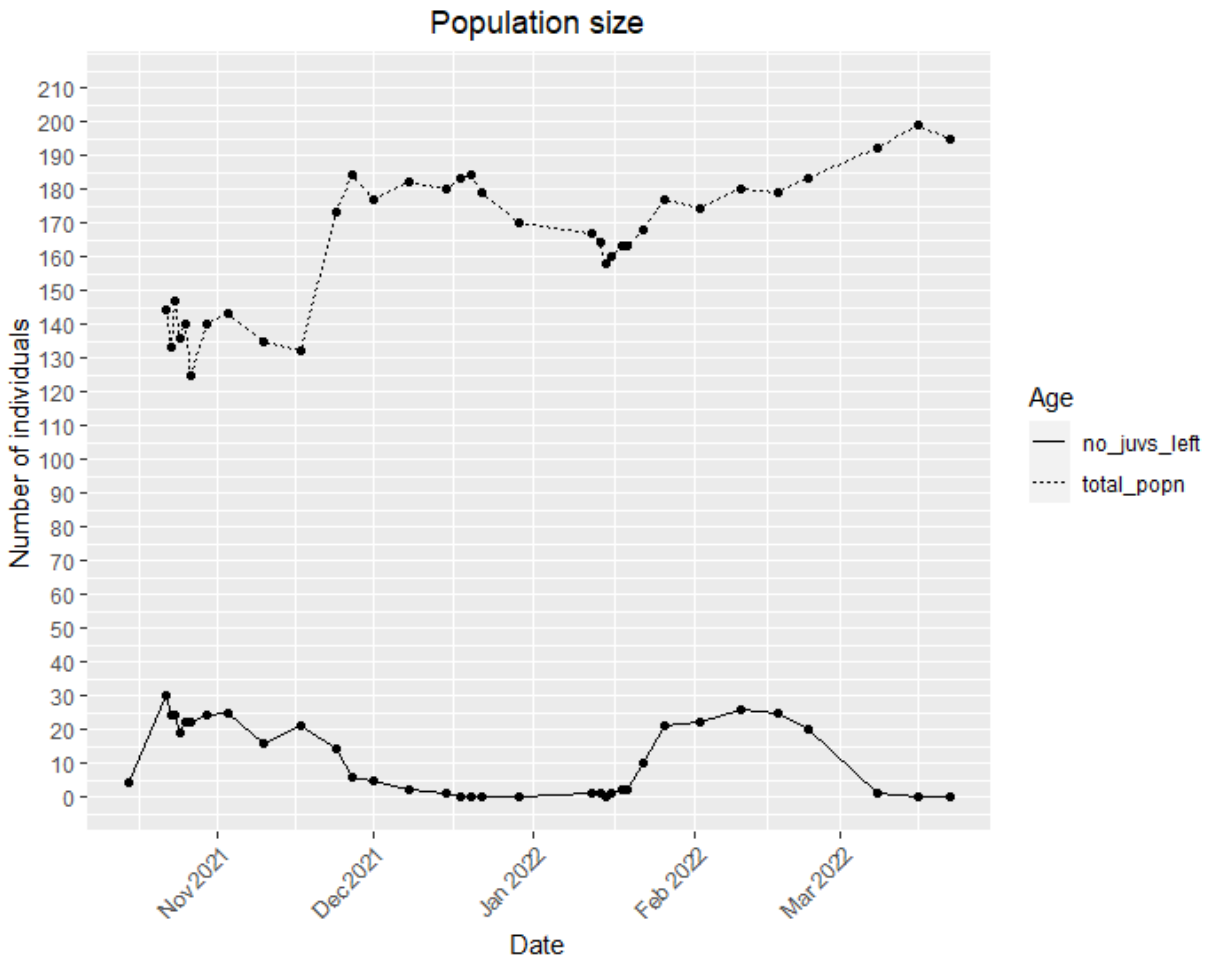


Figure 5.1 Southern Myotis numbers at Rawdon Island Bridge during Stage 1 Monitoring (source: Echo Ecology and Surveying, 4/04/2022)

Table 5.2 Potential and known Southern Myotis roosts in locality

Roost Name/ ID	Easting*	Northing*	Source	Structure type	Evidence of bats	Distance from site (direct path)	Distance from site (via waterways)
Potential roosts							
RI003 – Little Rawdon Island Bridge	479083	6525033	Echo Ecology and Surveying (2021)	Bridge	No	2.9km	<10km
RI011	481646	6521413	Echo Ecology and Surveying (2021)	Culvert	No	2.2km	<10km
RI013	482316	6521453	Echo Ecology and Surveying (2021)	Culvert	No	2.9km	<10km
RI014	482811	6521533	Echo Ecology and Surveying (2021)	Culvert	No	3.3km	<10km
RI025	476035	6520279	Echo Ecology and Surveying (2021)	Bridge	No	4km	<10km
RI027 - Sarah's creek	478064	6518820	Echo Ecology and Surveying (2021)	Bridge	No	3.6km	<10km
RI031 - Partridge creek	481223	6518540	Echo Ecology and Surveying (2021)	Bridge	Yes – 10 x Little Bent-winged Bats	4km	<10km
RI041	478973	6523142	Echo Ecology and Surveying (2021)	Culvert	No	1.1km	<10km
RI043	478984	6518444	Echo Ecology and Surveying (2021)	Culvert	Yes – 250 x Little Bent-winged Bats	3.7km	<10km
RI045	476323	6520671	Echo Ecology and Surveying (2021)	Culvert	No	3.5km	<10km
RI046	475660	6523407	Echo Ecology and Surveying (2021)	Culvert	Yes – 2 x Little Bent-winged Bats and 4 x Large Bent-winged Bats	4.1km	<10km
Known roosts							
Yippen Creek Bridge	472976	6520486	BioNet	Bridge	Yes – 2 x Southern Myotis	6.8km	<10km
Beechwood Rd	472941	6520510	BioNet	Culvert	Yes – 5 x Southern Myotis	6.8km	<10km

Kippara	453500	6541914	BioNet	Bridge	Yes – 1 x Southern Myotis	32.7km	>10km
Upsalls Creek	458147	6503713	BioNet	Bridge	Yes – 1 x Southern Myotis	28.3km	>10km

* **Note**: GDA94 - Zone 56

5.3.2 Discussion of habitat utilisation

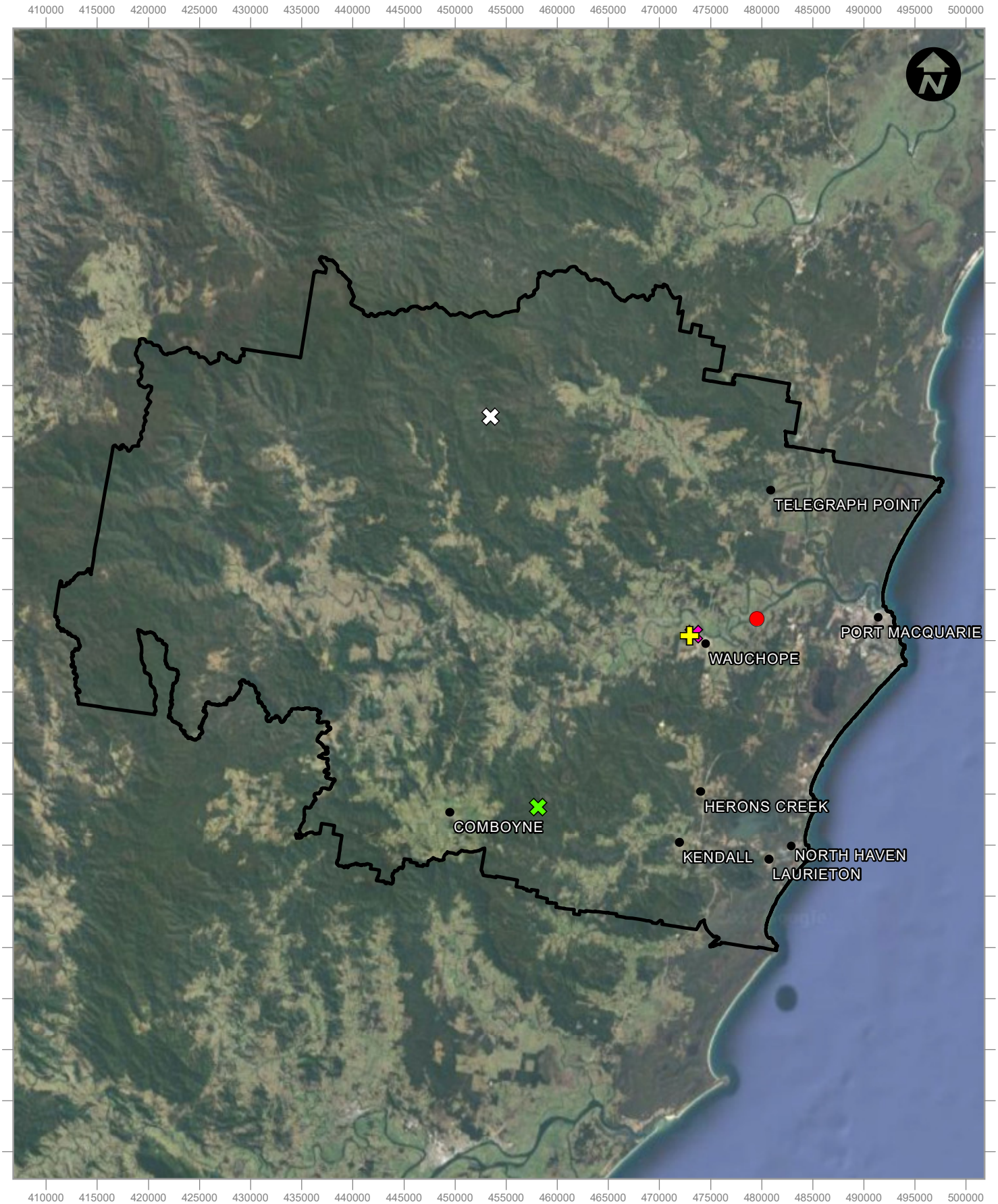
5.3.2.1 Little Bent-winged Bat and Large Bent-winged Bat

Bent-winged Bats are known to breed in maternity caves, of which, only five nursery/ maternity roost sites are known in Australia (Office of Environment and Heritage, 2022). These maternity caves can support large numbers of bats, with estimates ranging from 50,000 – 150,000 individuals (Dwyer, 1966, 1968; G. Hoye and Spence, 2004). Local roost searches (within 5km of the Subject site) undertaken by Echo Ecology and Surveying (2021) (2021) identified three roosts, containing <260 Little Bent-winged Bats and =/<10 Large myotis Bent-winged Bat individuals (Echo Ecology and Surveying, 2021a). Monitoring of Rawdon Island Bridge has recorded only a few Little Bent-winged Bat (<10 individuals on one occasion) and no Large Bent-winged Bats. Rawdon Island Bridge (pier 6) is unlikely to supports significant numbers of bent-winged bats or constitute a breeding roost. Overall it is unlikely to be a significance roost for these species.

5.3.2.2 Southern Myotis

Southern Myotis appears to display variable roosting behaviour depending on roosting habitat resources and their proximity to favoured foraging habitat (Campbell, 2009). It has been found roosting in hollow-bearing trees, caves, timber and concrete bridges, jetties, culverts, aqueduct tunnels and disused railway tunnels (Campbell, 2009, 2011; Gonsalves and Law, 2017a, 2017b; Law et al., 2020; Richards et al., 2008). As long as roosts are near water, is has been found to successfully breed in a wide variety of roosts (Campbell, 2011).

Local roost searches at drainage structures within 5km of the Subject site did not record any Southern Myotis colonies, however 11 structures were assessed as moderate to high quality roosting habitat for Southern Myotis (refer to **Table 5.2**) (Echo Ecology and Surveying, 2021a). While hollow-bearing trees are scattered throughout the locality, due to past clearing associated with agriculture, these hollow-bearing trees are unlikely to support substantial numbers of Southern Myotis or act as larger breeding colonies. It is likely that the key type of roosting habitat in the locality appears to be artificial structures like Rawdon Island Bridge. The Subject site is significant in terms of habitat as it provides important roosting habitat for the local Southern Myotis population, and it supports a large breeding colony (120-199 individuals). Overall, Rawdon Island Bridge habitat is considered high significance and important for the local population.



LEGEND

- Port Macquarie - Hastings LGA boundary
- The site
- Known roost (bridge) - 1 Southern Myotis
- Known roost (bridge) - 2 Southern Myotis
- Known roost (bridge) - unknown number of Southern Myotis
- Known roost (culvert) - 5 Southern Myotis

0 10 km

Local Southern Myotis Known Roosts - Illustration 5.1

Information shown is for illustrative purposes only
Drawn by: AB Checked by: DSA Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 04/04/2022

5.4 Assessment of habitat

5.4.1 Description of habitat values

Key habitat features for microbats within the Subject site include:

- roosting habitat (for both Bent-winged Bats and Southern Myotis) provided by the existing Rawdon Island Bridge (Pier 6) (**Plate 4.2**, **Plate 4.4** and **Plate 4.5**). Refer to **Section 4.3.2** for a description of roosting habitat values within the existing bridge structure
- aquatic foraging habitat (Southern Myotis only) which is provided by the Hastings River. This waterway and associated tributaries provide significant foraging habitat for Southern Myotis and is also important foraging habitat for the species within the locality.

No foraging habitat (forested areas) for Bent-winged Bats would be impacted as a result of this proposal.

The main microbat roosting area in Rawdon Island bridge is in the expansion joint above Pier 6. Inspections undertaken by Wolf Peak (September 2021) identified approximately 100-120 Southern Myotis in the eastern end of the expansion joint in Pier 6 (**Plate 5.1**) and approximately 20 individuals identified in the western end of the expansion joint. Large guano deposits and staining were identified on top of the blade wall on the eastern section of Pier 6, indicating that the eastern section roost is the main roosting location for individuals (Echo Ecology and Surveying, 2021). From September 2021 to March 2022, the Southern Myotis population has been estimated to range between 120 and 199 individuals.

Plate 5.1 – Rawdon Island Bridge - Pier 6 eastern expansion joint and Southern Myotis roosting (Photos: Will Steggall)

5.4.2 Impacts on threatened species in national parks

The proposal would not cause any direct or indirect impacts to species in national park estates.

5.5 Discussion of the likely effect of the activity at local and regional scales

5.5.1 Significance within a local context

The proposal would involve the disturbance and modification of roosting habitat for subject species. For the Southern Myotis, this habitat comprises important breeding and roosting habitat for the local population and the only known colony within 5km of the Subject site. The impacted habitat is not breeding habitat for either subject bent-winged bat species and only provides non-breeding roosting habitat that is likely only to support small numbers of individuals of these species.

Left unmitigated the impacts of the proposal would be significant to Southern Myotis in regards to its local viability. However, ameliorative measures outlined in **Section 7** will alleviate the identified potential impacts and the proposed approach has proven to be effective in alleviating the impacts associated with Southern Myotis roost disturbance and reduction in roosting habitat (GeoLINK, 2014, 2016; M. Hoye and Hoye, 1999; Stokes, 2018; Stokes and Silver, 2016; refer to **Appendix D**).

5.5.2 Connectivity

The proposal only includes bridge repairs to the existing Pier 6 bridge structure and does not include the removal or fragmentation of habitat for any subject species. No direct habitat fragmentation to corridors would occur as a result of the proposal and barriers to fly-ways for microbats along Hastings River are unlikely to be created.

Minor short term disturbance to foraging habitat (Hasting River) will occur during repair work, however, this is considered to be relatively low risk given the large extent of the Hastings River and small extent of impediment by works (i.e. working platforms and boat movements).

5.5.3 Threatening processes

The key impacts to subject species include reduction in roosting habitat and disruption to roosting habitat (repairing the concrete surface of the existing expansion joints in Pier 6). No specifically listed Key Threatening Process (a total of 39) listed under the BC Act will occur as a result of the proposal, however, specific threats listed under each species profiles (Office of Environment and Heritage, 2022) associated with the proposal include:

- destruction of caves that provide seasonal or potential roosting sites (Little Bent-winged Bat)
- loss or disturbance of roosting sites (Southern Myotis).

Left unmitigated the resulting impacts of the proposed disturbance and modification to roosting habitat within the Subject site would exacerbate these threatening processes. Ameliorative measures outlined in **Section 7** aim to alleviate the identified potential impacts.

5.6 Description of feasible alternatives

A discussion of the priority of the proposal and alternatives are provided in the Stage 2 REF (PMHC, 2022). In summary, PMHC need to repair, strengthen and rehabilitate the existing bridge to extend its useful design life by at least 25 years, in order to cater for current operating heavy vehicle loads. Consequences of not completing the maintenance and repair works may result in further degradation of the structure, or collapse due to environmental loads or vehicle overload, and isolation of the local businesses and the community. The microbat roosting habitat values of the bridge may also be compromised. The additional benefits of the proposal include improved public safety, stabilisation of

existing riverbanks, and reduction of potential siltation and turbidity in the river due to reinstatement of the abutment scour protection. Ultimately critical repair works at Pier 6 must be undertaken in order to ensure the continued access of Rawdon Island and safety of people and vehicles utilising the existing structure.

6. Assessment of impacts on threatened ecological communities

6.1 Assessment of ecological communities

One vegetation community associated with a TEC, PCT 1068: Pepperberry - Giant Stinging Tree - Fig lowland rainforest in the NSW North Coast Bioregion occurred within the study area. This PCT corresponded to the TEC – *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* listed as Endangered under the BC Act.

Works within the study area including works directly impacting vegetation, specifically the listed TEC - *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* was assessed and approved under the Stage 1 REF (Port Macquarie - Hastings Council, 2021). A Test of Significance for *Lowland Rainforest on Floodplain of the NSW North Coast Bioregion* concluded that the proposed action would not result in a significant impact on this ecological community (Wolfpeak, 2021).

The proposed Stage 2 repair works do not include the removal of vegetation or impacts to any listed TEC. As such no additional direct or indirect impacts to TECs in the study area will occur as a result of the proposal and further assessment of impacts to TECs are not warranted.

7. Ameliorative measures

7.1 Description of ameliorative measures

This section outlines the measures proposed to mitigate and ameliorate any adverse or significant impacts associated with the proposal and associated subject species.

7.1.1 Biodiversity impact amelioration strategies

Key components of impact amelioration for the subject species include:

- provision of alternative microbat roosting habitat prior to works at Pier 6 and microbat exclusion installation
- staged microbat exclusion outside the Southern Myotis breeding season
- maintaining permanent microbat roosting habitat at completion of the repair works on Rawdon Island Bridge within Pier 2, 5 and 6 and via compensatory habitat
- monitoring of roosting microbat populations.

Proposed measures including the exclusion methods and use of alternative/ compensatory roosting habitat have been proven to be effective in alleviating the impacts associated with microbat roost disturbance and reduction in roosting habitat (GeoLINK, 2014, 2016; M. Hoye and Hoye, 1999; Stokes, 2018; Stokes and Silver, 2016; refer to examples in **Appendix D**). Monitoring pre, during and post exclusion is also proposed to ensure any issues can be identified and addressed at the earliest Stage possible.

Compensatory microbat roosting habitat has been effective on other bridge and culvert projects involving microbats and specifically breeding Southern Myotis colonies where habitat has been permanently removed or altered such as Sportsmans Creek Bridge (GeoLINK, 2016), Marom Creek (GeoLINK, 2018), Barrington Bridge (GeoLINK, in prep.), Briner Bridge (GeoLINK, in prep.), Binna Burra Culvert (GeoLINK unpublished) and McFarlane Bridge (GeoLINK, 2017).

The proposed amelioration strategies have been developed by the project manager, construction managers, GeoLINK ecologists, council environmental officers and staff responsible for the long-term management of the bridge. The safeguards proposed are therefore feasible, practical, effective and within realistic construction limitations (including constructability issues, time and budget constraints, etc). Further detail regarding mitigation measures, compensatory strategies and proposed exclusion methodology/timing is outlined in the Stage 2 MMP in **Appendix C.** Flexibility and adaptive management will be required throughout the Stage 2 MMP implementation to avoid conflicts with the Stage 1 works and to accommodate microbat behaviour and responses (particularly during the exclusion phase).

An outline of amelioration strategies for the proposal are provided in **Table 7.1**. As animals can display unpredicted or unexpected behaviour, management measures need to be adaptable to deal with a range of potential outcomes. The mitigation measures, work procedures and strategies may be adapted in response to factors such as the pace of the work, or results of inspections and monitoring. Additionally, changes to procedures may be carried out, for example, minor modification may be required to the exclusion devices to improve their success.

Table 7.1 Biodiversity amelioration strategies for Rawdon Island Bridge Stage 2 works

Action	Objective	Description of action	Timing
Induct bridge personnel	Ensure actions and responsibilities of the Stage 2 MMP are understood by bridge personnel	An environmental induction would be prepared and delivered to all personnel involved with the bridge work.	Prior to relevant personnel working on site
Alternative microbat roosting habitat	Provide alternative compensatory habitat for microbats to roost whilst repair works are undertaken. This will reduce the disturbance and potential injury of microbats utilising the existing bridge structure.	Install microbat roosting habitat below bridge decking in the form of bat boxes. *Note: Alternative microbat roosting habitat installed as part of the Stage 1 works may be used to address this action.*	Microbat boxes will be available for microbat usage at least one month prior to temporary exclusion installation at Pier 6
Microbat baseline surveys - pre-removal/ exclusion installation	Determine current microbat species, numbers and roost locations within Pier 6 and surrounding structures. This will provide a baseline reference during the exclusion phase and be used to determine the success of the project.	Undertake microbat surveys at Rawdon Island Bridge and other local drainage structures that provide suitable habitat. The methodology would be via a combination of infrared camera monitoring used as part of Stage 1; torch/binocular inspections; inspection camera/pole camera inspections and/or direct inspections from suspended scaffolding	Prior to exclusion activities that displace microbats
Microbat exclusion installation	Prevent microbat injury/mortality during bridge repair works associated with Pier 6	Install microbat exclusion to make potential habitat associated with Pier 6 inaccessible to microbats prior to bridge repair works. Exclusion is anticipated to be required for 12 weeks (pending weather). Exclusion will begin outside the breeding season (Southern Myotis), however, once established may still persist at the start of the following breeding season (October), pending weather.	All exclusion must be installed between mid-April and September. Exclusion installation is not permitted during the Southern Myotis breeding season (October to mid-April, inclusive). *Note: exclusion may remain in place during the breeding season.*
Post exclusion inspections	Ensure microbat exclusion remains in place and functional	Daily inspections of exclusion works would be undertaken each day of work by the construction team and ecologist as required.	Daily at the start and end of the day
Maintain roosting habitat values permanently	Maintain the microbat roosting habitat values of Rawdon Island Bridge permanently.	■ Maintain the potential for microbats to roost in the expansion joints in Piers 2, 5 and 6 upon completion of the works.	Post repair works and before exclusion

Action	Objective	Description of action	Timing
		■ Provide permanent compensatory habitat for Southern Myotis as a contingency should the Pier 6 roosting habitat values be reduced as a result of the proposal.	measures have been removed
Monitoring	The objectives of monitoring include: ■ gathering data before exclusion to accurately define a baseline population number for the species utilising the bridge structure ■ identifying whether and how the microbat ameliorative measures have been implemented and their success ■ identifying the need to implement additional contingency measures to minimise impacts to the subject species should post repair works not be successful ■ providing further recommendations for consideration on future projects/ works with similar impacts on threatened microbats.	Microbat monitoring would be carried out pre, during and post exclusion, details of monitoring schedule is outlined in the Stage 2 MMP and provided in **Appendix C**.	Microbat monitoring would be carried out pre, during and post exclusion.

7.1.2 Long-term management strategies

Long term strategies aim to maintain the microbat roosting habitat values of Rawdon Island Bridge permanently.

Proposed measures including:

- leaving the expansion joints at Piers 2, 5 and 6 available for microbat use and roughing the repaired diaphragm beam surfaces at entry points to enable microbats to climb into the expansion joints
- installing permanent compensatory habitat for Southern Myotis as a contingency should the Pier 6 roosting 6 roosting habitat values be reduced as a result of the proposal. This habitat would comprise specifically designed timber habitat that will be able to cater for the carry capacity of >400 Southern Myotis. This will provide enough roosting habitat based on current population numbers seen to date whilst allowing for future population fluctuations.

Compensatory microbat roosting habitat has been effective on other bridge and culvert projects involving microbats and specifically breeding Southern Myotis colonies where habitat has been permanently removed or altered such as Sportsmans Creek Bridge (GeoLINK, 2016), Marom Creek (GeoLINK, 2018), Barrington Bridge (GeoLINK, in prep.), Briner Bridge (GeoLINK, in prep.), Binna Burra Culvert (GeoLINK unpublished) and McFarlane Bridge (GeoLINK, 2017)(refer to examples in **Appendix D**.

Specific details addressing long-term strategies including timing, methods, location and corrective actions are outlined in the Stage 2 MMP provide in **Appendix C**.

8. Conclusion

Based on the assessment carried out through the SIS process and consideration of ameliorative strategies proposed in this SIS, it is considered that the impact upon the subject species has been minimised. Based upon previous experience and success from similar projects, there is high likelihood that the proposed strategies would effectively exclude microbats from work areas, provide alternative roosting habitat during the works, minimise the potential of injury and death to microbats and provide permanent roosting habitat.

Overall the existing habitat values of Rawdon Island Bridge for the subject Southern Myotis population and other subject species are likely to be maintained upon completion of the works and the risk of a significant impact is substantially reduce through implementation of the provisions of the MMP. If a significant impact is however identified during the works and microbat monitoring, PMHC would consult with DPE and implement appropriate contingency measures.

In conclusion, in context of the proposed works and based on the implementation of ameliorative strategies proposed, it is unlikely that the subject species would be significantly impacted resulting in a reduction in long-term viability of the species locally or regionally.

9. Additional information

9.1 Qualifications and experience

The qualifications and experience of the primary author, technical reviewer and contributing author for this SIS are provided in **Table 9.1**.

Table 9.1 Qualifications and experience

Name	Qualification	Years of experience	Role
Troy Jennings	■ Master of Wildlife Management ■ Bachelor of Biodiversity and Conservation ■ Certificate 3 Conservation and Land Management ■ BAM Accredited Assessor (BAAS 18172)	9	SIS report content
David Andrighetto	■ Bachelor of Applied Science (Environmental Resource Management) ■ BAM Accredited Assessor (BAAS20015)	14	Project manager SIS technical review

9.2 Other approvals required

The *Environmental Planning and Assessment Act 1979* is the prevailing planning legislation that applies to all development and environmental assessment within NSW. The Stage 2 Rawdon Island Bridge repair project is considered to be *'development that is an activity requiring environmental assessment under Division 5.1 before it is carried out by a public authority or before a public authority gives approval for the carrying out of the activity' (Environmental Planning and Assessment Act 1979 Clause 1.5 (3c)).* The determining authority and proponent for this Project is the Port Macquarie - Hastings Council.

As outlined in the corresponding Stage 2 (PMHC, 2022), the proposal is permitted without consent in accordance with *SEPP (Transport and Infrastructure) 2021* Section 2.108 (1) '*Development for the purpose of a road or road infrastructure facilities may be carried out on or behalf of a public authority without consent on any land*'. This includes caveats to National Parks land, but this does not apply to this project. The development includes the following activities, as detail further in Section 2.108:

- Section 2.108 (3) (b): '*emergency works or routine maintenance works*'.
- Section 2.108 (3) (c): '*alterations or additions to an existing road (such as widening, duplication or reconstruction of lanes, changing the alignment or strengthening of the road)*'.

Stage 2 REF (PMHC, 2022) has assessed the impact of the proposed works on the Pier 6 microbat roost and found the works have potential to result in a significant impact on a BC Act listed threatened species; the Southern Myotis. Referral to the DPE has been made with preparation of a SIS and Stage 2 MMP, to allow concurrence from the Department under the *Biodiversity Conservation Act (2016)* and to allow works to be determined by PMHC.

9.3 Licences

GeoLINK ecologists hold a scientific licence (SL100152) under the *Biodiversity Conservation Act 2016* which authorises the principal licensee (Veronica Silver) and associates to conduct general flora and fauna surveys for environmental impact assessment which includes harm, trap, survey, release protected animals and to pick protected plants for identification purposes.

GeoLINK also hold an Animal Research Authority (17/1189) issued by the NSW Department of Primary Industries (Chief Scientist Branch) Animal Care and Ethics Committee for fauna surveys for environmental assessments which requires compliance with the *Animal Research Act 1985*, *Animal Research Regulation 2021*, and the Australian code for the care and use of animals for scientific purposes (8th Edition 2013).

9.4 Assumptions

GeoLINK has prepared this report on the basis of information provided by PMHC, which GeoLINK has not independently verified or checked beyond the agreed scope of work. GeoLINK does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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Appendix A

Environment Agency Head's Requirements

NSW GOVERNMENT

Department of Planning and Environment

Your Ref: P2021.033
Our Ref: DOC22/57622

Chief Executive Officer
Port Macquarie Hastings Council
PO Box 84
PORT MACQUARIE NSW 2444

Attention: Mr Stephen Wood

Dear Dr Allen

ENVIRONMENT AGENCY HEAD'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR THE RAWDON ISLAND BRIDGE REHABILITATION, SANCROX

Thank you for your e-mail dated 28 January 2022 seeking Environment Agency Head's (EAH's) Requirements for a Species Impact Statement (SIS) for the Rawdon Island Bridge Rehabilitation in accordance with Section 7.21 of the *Biodiversity Conservation Act 2016* (BC Act).

The Department understands the Port Macquarie Hastings Council is assessing the project under Part 5 Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Part 7 of the BC Act.

In response to your request, please find attached the EAH's Requirements for a SIS (**Attachment A)** to address threatened species (known or likely to be present in the area), ecological communities (known to be present in the area), or their habitats present in the area.

The SIS must be submitted to the Department as part of a request for concurrence within 12 months of the date of this letter.

If concurrence is requested outside the 12 month timeframe, then the Department must be consulted to determine whether the EAH Requirements for the SIS need to be modified to reflect, amongst other things, changes to the listings of threatened species, populations and ecological communities, new information on threatened species, populations and ecological communities, or changes to relevant legislation.

Please note that the issuing of EAH's Requirements is a statutory requirement and should not be construed as support or endorsement of the activity.

When lodging a request to the Department seeking concurrence, the Department must be provided with the SIS, any submissions made in response to the SIS, a Submissions Report prepared by the proponent, and any further assessment report for the activity prepared by or on the behalf of the proponent, including a determination and determination conditions.

The further assessment report should, amongst other matters, set out how the activity facilitates ecologically sustainable development.

If you require any further information about these requirements, please contact Senior Operations Officer, Mr Krister Waern on 6640 2503 or krister.waern@environment.nsw.gov.au

Yours sincerely

3 March 2022

DIMITRI YOUNG
Senior Team Leader Planning, North East Branch
Biodiversity and Conservation

ATTACHMENT A

ENVIRONMENT AGENCY HEAD'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR THE RAWDON ISLAND BRIDGE REHABILITATION, SANCROX

PURPOSE

The purpose of a Species Impact Statement (SIS) is to:

- allow the proponent to identify threatened species, assess the likely effect of impact from the activity on threatened species and provide appropriate amelioration for adverse impacts resulting from the activity.
- assist the Environment Agency Head (EAH) in assessing the activity in accordance with Part 7 of the *Biodiversity Conservation Act 2016* (BC Act).

Sections 7.20 and 7.21 of the BC Act and clause 7.6 of the *Biodiversity Conservation Regulation 2017* (BC Regulation) describe the form and content of a SIS. The matters listed in sections 7.20 and 7.21 of the BC Act and clause 7.6 of the BC Regulation have been incorporated into the Environment Agency Head's requirements provided below.

DEFINITIONS

The definitions below are relevant to these requirements:

- **Abundance** means a quantification of the population of the species or community.
- **Action** means the proposed activity.
- **Activity** has the same meaning as in the EP&A Act.
- **Affected species** means subject species likely to be affected by the activity.
- **BC Act** means the Biodiversity Conservation Act 2016
- **BC Regulation** means the Biodiversity Conservation Regulation 2017
- **Environment Agency Head** means the Secretary of the Department of Planning and Environment (or delegate).
- **EP&A Act** means the Environmental Planning and Assessment Act 1979
- **Conservation status** is regarded as the degree of representation of a species or community in formal conservation reserves.
- **Department** means the Department of Planning and Environment (or any name it may be known by in the future)
- **Development** has the same meaning as in the EP&A Act.
- **DP** means Deposited Plan which is the plan number given to a subdivision that is registered by the Land Property Information.
- **LGA** means Local Government Area.
- **Locality** means the area within a 5 km radius of the study area.
- **PCT** means a NSW plant community type derived using the PCT classification system
- **Study area** is the subject site and any additional areas which are likely to be affected by the activity, either directly or indirectly.
- **Subject land** means the area which is proposed for activity.
- **Subject species** means those threatened species and ecological communities which are known or considered likely to occur in the study area.
- **Threatening process** has the same meaning as that contained in the BC Act; the definition is not limited to key threatening processes.

All other definitions are the same as those contained in the BC Act.

MATTERS WHICH HAVE BEEN LIMITED OR VARIED

The Environment Agency Head may vary the matters otherwise required to be included in a SIS in a particular case (section 7.21(4) BC Act).

For this activity, none of the matters required to be included in a SIS have been varied.

NEW LISTINGS

If key threatening processes are added to Schedule 4 of the BC Act between the issue of these requirements and the granting of concurrence, these must be addressed in the SIS and considered by the consent or determining authority and concurrence authority (the Environment Agency Head).

If threatened species or ecological communities are added to Schedule 1 of the BC Act between the issue of these requirements and the granting of concurrence, these additional matters will need to be addressed in the SIS and considered by the consent or determining authority and concurrence authority (the Environment Agency Head).

A SIS is not required to address a new listing of a vulnerable species or vulnerable ecological community after the principal author signs the SIS. This exemption ceases to apply if the activity has not commenced or been approved within 12 months after the SIS has been publicly notified by the consent or determining authority (clause 7.4, Biodiversity Conservation Regulation 2017). In this case, the newly listed vulnerable species or ecological community will need to be addressed in the SIS.

MATTERS TO BE ADDRESSED

The SIS must meet all the matters specified in sections 7.20 and 7.21 of the BC Act and clause 7.6 of the BC Regulation. The requirements outlined in the BC Act and the BC Regulation have been repeated below (italics) along with the specific EAH's Requirements for your activity.

The SIS must be formatted to follow the sections and subsections provided in the EAH's Requirements.

Failure to comply with the EAH's Requirements is a potential breach of the legislation, and the Department may be unable to grant concurrence to a request by the determining authority to carry out the activity.

1 FORM OF THE SPECIES IMPACT STATEMENT

A species impact statement for the purposes of this Part must be in writing signed by the principal author of the statement and by the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires). BC Act section 7.20 (1)

The proponent must sign the following declaration:

"I...[insert name], of ..[address], being the proponent of the activity [insert name of activity, Lot & DP numbers, street, suburb and LGA names] have read and understood this species impact statement. I understand the implications of the recommendations made in the statement and accept that they may be placed as conditions of consent or concurrence for the activity".

The principal author must sign the following declaration:

> "I [insert name] of [address], being the principal author, have prepared the SIS in accordance with the EAH's Requirements issued on [insert date]."

2. CONTEXTUAL INFORMATION

2.1 Description of activity and study area

> *A species impact statement must include a full description of the proposed development or activity and the information as to matters relating to the impact on threatened species or ecological communities as is required by the regulations. (BC Act Section 7.20(2))*

2.1.1 Describe the activity

The SIS must include a comprehensive description of the nature, extent and timing of all components of the activity. A full description of the activity includes a description of all associated actions, including, but not restricted to, installation and maintenance of any proposed structures / dwellings and associated infrastructure, location of any associated facilities (including roads, amenities and other services), location of proposed roadway and associated infrastructure, fire protection zones, access and egress routes, changes in surface water flows, impacts of noise disturbance and pollution, and any increases in people and road traffic. Actions that occur both on and off the subject land resulting from the activity must be assessed, including actions conducted during any construction phase and any proposed action post-construction (e.g. proposed actions within a management plan).

2.1.2 Define the study area

The SIS must define the location, size and dimensions of the study area.

The study area should include the subject site and any adjacent land containing suitable habitat for threatened species that will be directly or indirectly affected by the activity.

Direct impacts are those that directly affect individuals or their habitat, including for example:

- poisoning or removal of the organism itself,
- removal of habitat, and
- clearing of native vegetation / habitat.

Indirect impacts occur when the activity affects threatened species or ecological communities or their habitats in a manner other than direct loss. Examples of indirect impacts include (but are not limited to):

- sediment, pollutant or nutrient runoff into adjacent vegetation
- habitat fragmentation or isolation
- implementation of asset protection zones (though these may also represent direct impact)
- loss of genetic diversity of threatened species, populations or communities
- altered pollination syndromes that may adversely affect seed set
- soil erosion
- altered hydrology regimes (including downstream impacts)
- changes to the saline / freshwater balance in marine environments
- exposure to heat or predators, or loss of shade

- inhibition of nitrogen fixation
- weed invasion and feral animal incursion
- introduction and spread of pathogens,
- noise
- dust
- light pollution
- fire (such as changes to intensity and frequency)
- fertilizer drift
- increased human activity (including litter) within or directly adjacent to sensitive habitat areas.

2.2 Relevant plans and maps

The SIS must include a map of the study area based on digital aerial photography (such as ADS40 imagery) or the best available imagery at an appropriate scale to clearly show:

- The boundary of the study area
- Land tenure and zoning, including protected areas, and any proposed changes
- Relevant Local Government planning instruments, including Local Environmental Plans and Development Control Plans
- Interim Bio-Regionalisation of Australia (IBRA) bioregions and IBRA subregions
- Rivers, streams, estuaries classified by stream order and including riparian buffers
- Wetlands including important wetlands and riparian buffers
- Habitat connectivity that may serve as movement corridors
- Karst, caves, crevices, cliffs, rocks and other geological features of significance
- Areas of outstanding biodiversity value
- Vegetation cover identifying the extent of woody and non-woody native vegetation and cleared areas
- Any access limitations.

The SIS must include a map of the subject land based on digital aerial photography or the best available imagery at an appropriate scale to clearly show:

- The boundary of the subject land
- Map scale
- Topography
- Land tenure
- Vegetation cover identifying the extent of woody and non-woody native vegetation and cleared areas
- Locally significant areas for threatened species and areas of high human activity
- Any access limitations.

Digital files of maps must be supplied with the SIS.

2.3 Vegetation

The SIS must identify and map the distribution of PCTs, or the most likely PCTs, and all Threatened Ecological Communities (TECs) in the subject site.

The identification must be in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification.

The identification of TECs must be consistent with the Threatened Species Scientific Committee Final Determination for the TEC.

Information that can support the identification of PCTs and TECs can be found on the:

a) BioNet Vegetation Classification database, which describes how to identify PCTs and TECs as per the NSW PCT classification, and details each PCT and its geographic distribution
b) Threatened biodiversity profile search webpage, which describes TECs.

Any existing information on native vegetation that is relevant to the study area should be reviewed and referenced to justify PCT and TEC identifications. This includes:

a) survey data or individual species records that are held in the Flora Survey (BioNet), or
b) existing maps of native vegetation in the area such as those held by the Department, or a local government authority, or
c) information in ecological reports, soil surveys or previous native vegetation surveys that is relevant to the study area.

3 INITIAL ASSESSMENT

A general description of the threatened species known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action, BC Regulation clause 7.6(2)(a)

3.1 Identifying candidate species

The SIS must identify candidate species that have or may have suitable habitat on the subject land or study area.

The following species must be considered as candidate species, as they have either been recorded in the general area, are within the species' known geographic limits or their broad habitat preferences may be present on site:

Scientific Name	Common Name	Legal Status
Myotis macropus	Southern Myotis	Vulnerable
Miniopterus australis	Little Bent-winged Bat	Vulnerable
	Lowland Rainforest on Floodplain	Endangered

This list is not exhaustive. One of the roles of the SIS is to determine which species may be utilising a site given the limitations of existing databases.

A list of additional candidate species should be compiled by considering:

a) the distribution of species in the IBRA subregion within which the subject land and study area are mostly located
b) any geographic limitations of a species identified at a) that exclude it from the subject land and/or study area
c) associations between the species identified at a) and the PCTs occurring within the subject land
d) the native vegetation cover required to provide viable habitat for the species
e) the patch size required to provide viable habitat for the species

The identification of candidate species must be informed by databases including the *Threatened Biodiversity Data Collection* (TBDC) and other data available through the *Bionet Atlas* (www.bionet.nsw.gov.au/), *Atlas of Living Australia* (www.ala.org.au/), *Australian Museum* (http://ozcam.org.au/), *Birdlife Australia*

(http://birdsaustralia.ala.org.au/BDRS/home.htm), and the *Royal Botanic Gardens* (http://plantnet.rbgsyd.nsw.gov.au/).

Previous surveys and assessments that are relevant to the locality may be used to assist in identifying candidate species.

3.2 Identify subject species

An assessment of which threatened species known or likely to be present in the area are likely to be affected by the action (BC Regulation clause7.6(2)(b)).

3.2.1 Habitat assessment to confirm suitable habitat

A comprehensive habitat assessment should be conducted across the study area, identifying key habitat features for both flora and fauna. The SIS must evaluate the habitat of the study area for each candidate species. It is important to record all areas of native and introduced vegetation, as even weeds can potentially provide habitat for threatened fauna. As part of the habitat assessment, you should look for:

- hollow-bearing trees, including dead stags
- bush rock and rocky outcrops
- natural burrows
- large trees with basal cavities
- logs
- wetlands, streams, rivers, dams and other water bodies
- nests and roosts
- permanent soaks and seepages
- areas that can act as corridors for plant or animal species.

The SIS must include an analysis of the suitability of the habitat for each candidate species based on the information in the TBDC and including:

- habitat constraints
- microhabitats or other habitat features
- breeding features
- any buffer area around habitat or breeding features
- any considerations around the size or shape of the habitat area

The list of candidate species should be refined based on the outcomes of the habitat assessment to exclude species that are not likely to be present in the study area, to create the list of subject species.

3.2.2 Targeted survey

A targeted species survey for all subject species must be undertaken.

The survey must:

a) only occur during the time specified for that species in the TBDC, unless there is clear justification to vary the timing and the reasoning is documented in the SIS
b) comply with the Department's threatened species survey guides published by the Secretary of the Department or anyone authorised by the Secretary
c) use best-practice methods that can be replicated for repeat surveys, if the Department has not published any relevant guides, after consulting the TBDC and the Department's relevant accountable officer for the entity.

The SIS must describe the survey timing, methods, design and effort used for each species survey. The SIS must record weather conditions (e.g. minimum ambient air temperature, maximum ambient air temperature, amount of precipitation that occurs each 24 hour period, details about wind speed and direction and the amount of cloud cover) and the phase of the moon for each day of survey (including dates).

Surveys must be undertaken by appropriately experienced and qualified persons.

A biodiversity expert recognised under the Biodiversity Offsets Scheme, a recognised expert from institutions such as the Australian Museum (Sydney), the National Herbarium of NSW at the Royal Botanic Gardens (Sydney) or an expert who is otherwise approved by the Environment, Energy and Science Division (EES) within the Department must be used to determine or confirm the identification of species that are unknown or which have been only provisionally identified.

If a proposed survey methodology is likely to vary significantly from widely accepted methods, the proponent must discuss the proposed methodology with Biodiversity and Conservation Division of the Environment, Energy and Science Group in the Department.

The outcome of the survey must be a mapped area of habitat in which the species is present or is likely to use for each subject species.

For each species recorded by survey, the mapped areas must include:

- For fauna species, the entire area of the PCTs associated with that species in the TBDC that occur on the subject land
- For flora species assessed by count as per the TBDC, a buffer of 30m around individuals or groups of individuals on the subject land
- For flora species assessed by area as set out in the TBDC, all recorded individuals and the entire area of suitable habitat for them on the subject land, such as the PCT in which they occur, and/or microhabitats in which they occur

The SIS must include a map of the subject land based on digital aerial photography or the best available imagery at an appropriate scale to show key habitat features for each subject species.

3.2.3 Final review of the list of subject species

The results of the survey may be used to further refine the list of subject species to reflect those threatened species that are known or likely to be present in the study area and which may be affected by the activity in the study area.

4 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES

4.1 Assessment of species likely to be affected

Assessment of impacts must include the assessment of indirect impacts and those of associated activities, including, but not restricted to, installation and maintenance of utilities, access and egress routes, and changes in surface water flows. These actions or impacts may occur on or off the subject land.

Assessment of impacts must also include an assessment of impacts from the provision of fire protection zones. If, as part of the development, there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland, the impacts of this on any

threatened species and/or populations must be addressed as part of the impacts of the overall activity. Proponents should also consider recommendations in '*Planning for Bushfire Protection*' (NSW Rural Fire Service 2019) and consider the use of perimeter roads as an option in providing fuel free zones and reducing impacts on retained bushland.

4.2 Discussion of conservation status

For each species likely to be affected — details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it and its habitat requirements (BC Regulation clause 7.6(2)(c))

An assessment of whether those species are adequately represented in conservation reserves (or other similar protected areas) in the region, (BC Regulation clause 7.6(2)(e))

An assessment of whether any of those species is at the limit of its known distribution, (BC Regulation 7.6(2)(f))

Assessment must include reference to the key threatening processes (Schedule 4 to the BC Act). Assessment should also include reference to any approved or draft recovery plans which may be relevant to the activity; including those prepared by other state Governments of the Commonwealth Government.

4.3 Discussion of local and regional abundance and distribution

An estimate of the local and regional abundance of those species (BC Regulation clause 7.6(2)(d))

4.3.1 Discussion of other known local populations

A discussion of other known populations in the locality must be provided, along with an assessment of their regional significance. The long-term security of other habitats must be examined as part of this discussion. The relative significance of the subject site for threatened species in the locality must be discussed.

4.3.2 Discussion of habitat utilisation

An estimate of the numbers of individuals utilising the area and how these individuals use the area (e.g. residents, transients, adults, juveniles, nesting, foraging). This should include discussion of the significance of these individuals to the viability of the threatened species in the locality.

4.4 Assessment of habitat

A full description of the type, location, size and condition of the habitat of those species and details of the distribution and condition of similar habitats in the region (BC Regulation Clause 7.6(2)(g))

4.4.1 Description of habitat values

Specific habitat features shall be described, such as frequency and location of stags, hollow bearing trees (including size), mature / old growth trees, culverts, rock shelters, rock outcrops, presence of feed tree / shrub / groundcover species areas of native grasses, crevices, caves, drainage lines, soaks etc, and density of understorey vegetation / groundcover.

The condition of the habitat within the study area shall be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads, and assessment of the potential for native seed bank resilience in disturbed areas.

Details of the fire history of the subject site (e.g. frequency, time since last fire, intensity) and the source of fire history (e.g. observation, local records) shall be provided.

4.4.2 Impacts on threatened species and/or populations in the national park estate

This section only needs to be addressed when threatened species and/or populations in the national park estate (e.g. National Parks, Nature Reserves) are likely to be either directly or indirectly impacted upon.

The SIS must assess the potential impacts on any threatened species and/or populations which may likely be directly or indirectly impacted upon that reside with the national park estate, including but not limited to fragmentation or loss of connective linkages, edge effects (e.g. increased boundary to area ratio), increased predation potential, weed invasion, loss or impacts on pollination vectors, changes to hydrology, nutrient increases, pollution, anthropogenic impacts (e.g. increased visitation, refuse) etc.

4.5 Discussion of the likely effect of the activity at local and regional scales

A full assessment of the likely effect of the action on those species, including, if possible, the quantitative effect of local populations in the cumulative effect in the region (BC Regulation Clause 7.6(2)(h))

4.5.1 Significance within a local context

If the activity involves the clearing of vegetation and/or removal / damage to habitat, the SIS must clearly articulate the size of this impact, and where applicable delineate this based on PCT or habitat features. Indirect impacts may lead to direct loss and must be adequately quantified and assessed in the SIS where this is the case. Both impacts within the study area and subject land must be considered and addressed.

The significance of impacts in the study area for conservation of affected threatened species in the *locality* must be discussed. An assessment of the significance of such impacts must compare and take into account the differences in the type, condition, tenure and long-term security, of other areas of known habitats in the *locality* with those in the study area.

4.5.2 Discussion of connectivity

The potential of the activity to increase fragmentation of the habitat or decrease the ability for movement of individuals and/or gene flow between habitats or populations of a threatened species or population must be appraised. The SIS must include an analysis of the connectivity value of the site to the subject species.

4.5.3 Consideration of threatening processes

Assessment of effects must not be limited only to threats that are recognised as key threatening processes, but must include other threatening processes that are generally accepted by the scientific community as affecting the species and are likely to be caused or

exacerbated by the activity. This threat assessment should also include consideration of the threats and information in the Threatened Biodiversity Profiles available at https://www.environment.nsw.gov.au/threatenedSpeciesApp/.

4.6 Description of feasible alternatives

A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development (BC Regulation Clause 7.6(2)(i)).

Where an Environmental Impact Statement (EIS) or Review of Environmental Factors (REF) deals with these matters, the SIS may refer to the relevant section of the EIS or REF.

This section must include details of alternative locations considered or alternative footprints within study area and the condition and use of these areas. The SIS must include an explanation of why these are not considered feasible alternatives.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES

Part 5 of these requirements need only be addressed when ecological communities are likely to be affected.

Assessment of impacts must include the assessment of indirect impacts and those of associated activities, including, but not restricted to, installation and maintenance of utilities, access and egress routes, and changes in surface water flows. These actions or impacts may occur on or off the subject land.

Assessment of impacts must also include an assessment of impacts from the provision of fire protection zones. If, as part of the development, there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland, the impacts of this on any endangered or critically endangered ecological communities must be addressed as part of the impacts of the overall activity.

5.1 Assessment of ecological communities (both endangered and critically endangered) likely to be affected

A general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action (BC Regulation clause 7.6(3)(a)).

This must include reference to the ecological community as described by the NSW Scientific Committee, including maps of the extent and condition of the community with particular reference to those parts of the community that may only be represented by soil stored seed with no above ground components of the community present.

5.2 Discussion of conservation status

For each ecological community present — details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it and its habitat requirements (BC Regulation clause 7.6(3)(b))

An assessment of whether those ecological communities are adequately represented in conservation reserves (or other similarly protected areas) in the region (BC Act Clause 7.6(3)(c)).

An assessment of whether any of those ecological communities is at the limit of its known distribution (BC Act Clause 7.6(3)(d)) .

Assessment should include reference to the threatening processes that are generally accepted by the scientific community as affecting the endangered and/or critically endangered ecological community and are likely to be caused or exacerbated by the activity. The assessment should also include reference to any approved or draft recovery plans which may be relevant to the action.

5.2.1 Significance within a local context

An assessment of the community on the subject site in relation to other sites in the study area and in the locality. The tenure and long-term security of the community in the locality shall be examined as part of this discussion.

The relative significance of the subject site for the endangered and/or critically endangered ecological community shall be discussed. The assessment of the community should be considered in terms of the following features including, the size of the remnant, the quality of the habitat and the level of disturbance on this site in comparison to other sites in the locality.

5.2.2 Discussion of corridor values

The potential of the activity to increase fragmentation of the community and increase edge effects. If corridors that allow connectivity between localities of endangered and/or critically endangered ecological communities are present within the subject site, the impact of the proposal on these areas shall also be discussed.

5.2.3 Discussion of regional significance

The significance of the locality for the community from a regional perspective shall be noted and discussed.

5.2.4 Impacts on Ecological Communities in the national park estate

This requirement only needs to be addressed when endangered and/or critically endangered ecological communities in the national park estate are likely to be either directly or indirectly impacted upon.

The SIS must assess the potential impacts on any endangered and/or critically endangered ecological communities which may likely be directly or indirectly impacted upon that reside with the national park estate.

5.3 Assessment of habitat

A full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region (BC Regulation clause 7.6(3)(e))
a full assessment of the likely effect of the action on the ecological community, including, if possible, the quantitative effect of local populations in the cumulative effect in the region (BC Regulation clause 7.6(3)(f))

5.3.1 Description of disturbance history

If the site shows signs of disturbance, details should be provided of the site's disturbance history and an assessment should be made of the ability of the ecological community to recover to a pre-disturbance condition.

5.3.2 Extent of habitat removal

The location, nature and extent of habitat removal or modification which may result from the proposed activity including the cumulative loss of habitat from the study area (including all proposed development applications and those areas in the locality already with development consent or identified for development) and the impacts of this on the viability of the endangered and/or critically endangered ecological community in the locality.

This shall include an assessment of the proportion of the ecological community to be affected by the activity, in relation to the total extent of the ecological community, and the impact of this on the viability of the ecological community in the locality.

5.4 Description of feasible alternatives

> *A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development* (BC Regulation Clause 7.6(3)(g)).

Where an Environmental Impact Statement (EIS) or Review of Environmental Factors (REF) deals with these matters, the SIS may refer to the relevant section of the EIS or REF.

In the discussion of feasible alternatives to the proposed development with regards to biophysical, economic and social considerations, and the principles of ecologically sustainable development, the SIS must also include details on the alternative locations considered or alternative footprints within study area and the condition and use of these areas. The SIS must include an explanation of why these are not considered feasible alternatives.

6 AMELIORATIVE MEASURES

6.1 Description of ameliorative measures

> *A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species, including a compilation (in a single section of the statement) of those measures,* (BC Regulation Clause 7.6(2)(j))

> *A full description and justification of the measures proposed to mitigate any adverse effect of the action on the ecological community, including a compilation (in a single section of the statement) of those measures,* (BC Regulation Clause 7.6(3)(h))

6.1.1 Biodiversity impact amelioration strategy

The SIS must include a strategy to outline all measures to minimise, mitigate, manage or offset the impacts of the activity on threatened species and ecological communities, or their habitats. This could include but not be limited to revegetation, vegetation management, habitat restoration/rehabilitation, habitat enhancement, monitoring and biodiversity offsets.

The strategy should include the timing and frequency of actions and nominate the roles responsible for completing actions.

6.1.2 Long-term management strategies

Consideration shall be given to developing long-term management strategies to protect areas within the study area which are of particular importance for the threatened species or , ecological communities likely to be affected. This may include proposals to restore, improve or provide long term protection for habitat on site where possible. Any such proposal is to be accompanied by a plan of management identifying the specific areas to be restored, improved or protected, the threatened species / ecological community values of those areas, and detailing the management actions to be implemented to maintain and protect those values, including corrective actions to be taken in the event that monitoring indicates that management does not achieve specified objectives.

7 STATEMENT OF LONG-TERM VIABILITY

The SIS must include a concluding statement on whether the activity is likely to reduce the long-term viability for each of the subject threatened species or ecological communities at the local and bioregional scales. Conclusions must be justified and supported by the information and data presented in the SIS. Uncertainties should be acknowledged and discussed.

8 ADDITIONAL INFORMATION

8.1 Qualifications and experience

A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement (BC Act 7.20(3).

8.2 Other approvals required for the development or activity

A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species (BC Regulation clause 7.6(2)(k))

A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the ecological community (BC Regulation clause 7.6(3)(i))

In addition to the list of other approvals the SIS must include the name of the determining authority or authorities under Part 5 of the *Environmental Planning and Assessment Act 1979* and when these approvals are proposed to be obtained.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

An activity will require the approval of the Australian Government Minister for the Environment (in addition to any State or Local Government approval or determination) if that activity will have, or is likely to have, a significant impact on a matter of national

environmental significance. Threatened species and communities listed in the EPBC Act are considered to be matters of national environmental significance.

Many of the species and ecological communities listed in the BC Act are also listed in the EPBC Act. Further information regarding the operation of the EPBC Act (including Commonwealth-listed threatened species and communities) may be obtained from the Commonwealth Department of Agriculture, Water and Energy (DAWE) website www.environment.gov.au/ or by contacting the DAWE on (02) 6274 1111.

8.3 Licensing matters relating to the survey

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are contained in Division 3 of Part 2 of the BC Act or in the *Animal Research Act 1985* in relation to animal research authorities:

Typically, you will require a biodiversity conservation licence under Division 3 of Part 2 of the BC Act to undertake activities that would otherwise constitute an offence (such as picking plants, harming animals or damaging a declared area of outstanding biodiversity value).

Information pertaining to licences can be obtained from the following websites:

- www.environment.nsw.gov.au/licences-and-permits/wildlife-licences/licences-to-control-or-harm/licences-to-harm-threatened-species
- www.service.nsw.gov.au/transaction/apply-native-flora-and-fauna-research-licence

Please be aware of the requirements relating to animal care and ethics when conducting wildlife surveys. The handling and capture of animals are regulated by the NSW *Animal Research Act 1985* and the *Animal Research Regulation 1995*, which are administered by Department of Primary Industries. The Act requires that persons undertaking animal research must hold an Animal Research Authority. See www.animalethics.org.au/home for further information.

Appendix B

Likelihood of occurrence assessments

Potential of Occurrence and Habitat Assessment
A potential of occurrence assessment was completed to assess the likelihood of occurrence of each threatened species or population identified with the in the Subject site. All threatened biodiversity identified in background research were considered. The assessment is based on the habitat profile for the species and other habitat information in the Threatened Species Profile Database (Environment Energy and Science Group). The assessment also takes into consideration the dates and locations of nearby records and information about species populations in the locality.

Threatened Flora Potential Occurrence Assessment
For this proposed activity, the likelihood of occurrence of threatened flora species and populations was determined based on the criteria shown in **Table B1.**

Table B1 Potential of occurrence criteria for threatened species and populations of flora

Potential of occurrence	Criteria
Known	The species was observed in the Subject site either during the current survey or during another survey less than one year prior.
High	A species has a **high** likelihood of occurrence if: • the Subject site contains or forms part of a large area of high-quality suitable habitat that has not been subject to recent disturbance (e.g. fire), the species is known to form a persistent soil seedbank and the species has been recorded recently (within 5 years) in the locality • the species is a cryptic flowering species that has been recorded recently (within 5 years) in the locality and has a large area of high-quality potential habitat within the proposal footprint that was not seasonally targeted by surveys.
Moderate	A species has a **moderate** likelihood of occurrence if: • the species: o has a large area of high-quality suitable habitat in the Subject site that has not been subject to recent disturbance (e.g. fire) o the species is known to form a persistent soil seedbank, but o the species has not been recorded recently (within 5 years) in the locality • the species: o has a small area of high-quality suitable habitat or a large area of marginal habitat in the Subject site That has not been subject to recent disturbance (e.g. fire) o the species is known to form a persistent soil seedbank o the species has been recorded recently (within 5 years) in the locality o the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the proposal footprint, that was not seasonally targeted by surveys.
Low	A species has a low likelihood of occurrence if: • it is not a cryptic species, nor a species known to have a persistent soil seedbank species and was not detected despite targeted searches • the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the proposal footprint, that was not seasonally targeted by surveys as the species has not been recorded within 50 years in the locality.
None	Suitable habitat is absent from the Subject site.

Table B2 Threatened flora potential of occurrence assessment

Scientific Name	Common Name	BC Act (1)	EPBC Act (1)	Source	Habitat	Potential occurrence and Outcome
Acronychia littoralis	Scented Acronychia	E	E	PMST	Occurs in transition zones between littoral rainforest and swamp sclerophyll forest; between littoral and coastal cypress pine communities; and margins of littoral forest.	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
Allocasuarina thalassoscopica	-	-	E	PMST	The species is restricted to the low closed heathland community that occurs on the upper slopes at an altitude of 150-200m.	None. No suitable habitat in Subject site.
Arthraxon hispidus	Hairy Jointgrass	V	V	PMST	Moist shady places in or on the edges of rainforest and wet eucalypt forest, often near creeks or swamps.	None. No suitable habitat in Subject site.
Asperula asthenes	Trailing Woodruff	V	V	PMST	Occurs in damp sites, often along riverbanks.	None. No suitable habitat in Subject site.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	E	PMST	Does not have well defined habitat and is known from a range of communities, including swamp-heath and woodland.	None. No suitable habitat in Subject site.
Cynanchum elegans	White-flowered Wax Plant	E	E	PMST	Dry, littoral or subtropical rainforest, and occasionally in scrub or woodland.	None. No suitable habitat in Subject site.
Dendrobium melaleucaphilum	Spider Orchid	E	-	Bionet	Occurs in coastal districts and nearby ranges. Grows frequently on *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks in coastal districts.	None. No suitable habitat in Subject site.
Euphrasia arguta	-	CE	CE	PMST	Found in eucalypt forest with a mixed grass and shrub understorey. Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'.	None. No suitable habitat in Subject site.
Hakea archaeoides	Big Nellie Hakea	V	V	PMST	Found only in NSW. It is restricted to the hinterland between Kempsey and Taree, around Mt Boss, Broken Bago and Lansdowne. Found on steep, rocky, sheltered slopes and in deep gullies in open eucalypt forest. Commonly occurs at the interface of dry eucalypt forest and gully communities.	None. No suitable habitat in Subject site.
Macadamia integrifolia	Macadamia Nut	-	V	PMST	While specimens have been collected from the North Coast of NSW (e.g. Lismore, Gross 1995), this species is not known to occur naturally in NSW. Grows in remnant rainforest, preferring partially open areas such as rainforest edges	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act (1)	EPBC Act (1)	Source	Habitat	Potential occurrence and Outcome
Marsdenia longiloba	Slender Marsdenia	E	V	PMST	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	None. No suitable habitat in Subject site.
Maundia triglochinoides	-	V	-	Bionet	Restricted to coastal NSW and extending into southern Queensland. Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	None. No suitable habitat in Subject site.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Bionet	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.	None. No suitable habitat in Subject site.
Melaleuca groveana	Grove's Paperbark	V	-	Bionet	Widespread, scattered populations in coastal districts north of Yengo National Park to southeast Queensland. Also found as a disjunct population near Torrington on the nothern tablelands. Grove's Paperbark grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcopping granite, rhyolite and sandtone on rocky outcrops and cliffs.	None. No suitable habitat in Subject site.
Parsonsia dorrigoensis	Milky Silkpod	V	E	PMST	Found in subtropical and warm-temperature rainforest, on rainforest margins, and in moist eucalypt forest up to 800 m, on brown clay soils.	None. No suitable habitat in Subject site.
Persicaria elatior	Tall Knotweed	V	V	PMST	Damp or swampy situations and sometimes with *Melaleuca linariifolia*.	None. No suitable habitat in Subject site.
Phaius australis	Southern Swamp Orchid	E	E	PMST	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest mostly in coastal areas.	None. No suitable habitat in Subject site.
Rhodamnia rubescens	Scrub Turpentine	CE	CE	Bionet, PMST	Subtropical rainforests, warm temperate rainforests, littoral rainforests, and wet sclerophyll forests. It may also occur as a pioneer in adjacent areas of dry sclerophyll and grassy woodland associations.	None. No suitable habitat in Subject site.
Rhodomyrtus psidioides	Native Guava	CE	CE	Bionet, PMST	Rainforest and its margins with sclerophyll vegetation, often near creeks and drainage lines. Pioneer species in disturbed environments such as regrowth and rainforest margins.	None. No suitable habitat in Subject site.
Sarcochilus fitzgeraldii	Ravine Orchid	V	V	PMST	Usually grows on rocks or rarely on bases of trees, in subtropical rainforest, usually near streams, from 500-700m altitude.	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act (1)	EPBC Act (1)	Source	Habitat	Potential occurrence and Outcome
Syzygium paniculatum	Magenta Lilly Pilly	E	V	PMST	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	None. No suitable habitat in Subject site.
Thesium australe	Austral Toadflax	V	V	PMST	Grassland or grassy eucalypt woodland where *Themeda australis* is predominant, on grassy headlands.	None. No suitable habitat in Subject site.
Tylophora woollsii	Cryptic Forest Twiner	E	E	PMST	Moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins.	None. No suitable habitat in Subject site.

(1) V = Vulnerable; E = Endangered; CE = Critically Endangered

Threatened Fauna Potential Occurrence Assessment
For this proposed activity, the likelihood of occurrence of threatened and migratory species and populations was determined based on the criteria shown in **Table B3.**

Table B3 Potential of occurrence criteria for threatened fauna species and populations

Potential of occurrence	Criteria
Known	The species was observed in the Subject site either during the current survey or during another survey less than one year prior.
High	A species has a **high** likelihood of occurrence if: • the Subject site contains or forms part of a large area of high-quality suitable habitat • important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are abundant within the Subject site • the species has been recorded recently in similar habitat in the locality • the Subject site is likely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration.
Moderate	A species has a **moderate** likelihood of occurrence if: • the Subject site contains or forms part of a small area of high-quality suitable habitat • the Subject site contains or forms part of a large area of marginal habitat • important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) occur but are sparse within the Subject site
Low	A species has a **low** likelihood of occurrence if: • potentially suitable habitat exists but the species has not been recorded recently (previous 10 years) in the locality despite intensive survey (i.e. the species is considered to be locally extinct) • the Subject site is unlikely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration. • the species is considered to be a rare vagrant, likely only to visit the Subject site very rarely, e.g. during juvenile dispersal or exceptional climatic conditions (e.g. extreme drought conditions in typical habitat of inland birds).
None	Suitable habitat is absent from the Subject site.

Table B 4 Threatened fauna potential of occurrence assessment

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
Amphibians						
Litoria aurea	Green and Golden Bell Frog	E	V	PMST	Amongst vegetation in and around permanent swamps, lagoons, farm dams and on flood-prone river flats, particularly where there are bullrushes or spikerushes.	None. No suitable habitat in Subject site.
Litoria brevipalmata	Green-thighed Frog	V	-	Bionet	Rainforest, moist to dry eucalypt forest and heath, typically where surface water gathers after rain.	None. No suitable habitat in Subject site.
Mixophyes balbus	Stuttering Frog	E	V	PMST	Cool rainforest, moist eucalypt forest and occasionally along creeks in dry eucalypt forest. Typically, at elevations between 200 and 1420m above sea level in their northern range.	None. No suitable habitat in Subject site.
Mixophyes iteratus	Giant Barred Frog	E	E	PMST	Deep, damp leaf litter in rainforests, moist eucalypt forest and near dry eucalypt forest.	None. No suitable habitat in Subject site.
Birds						
Anseranas semipalmata	Magpie Goose	V	-	Bionet	Shallow wetlands (<1m deep), large swamps and dams with dense growth of rushes or sedge.	None. No suitable habitat in Subject site.
Anthochaera phrygia	Regent Honeyeater	CE	CE	Bionet, PMST	Dry open forest and woodland with an abundance of nectar-producing eucalypts, particularly box-ironbark woodland, swamp mahogany forests, and riverine sheoak woodlands.	None. No suitable habitat in Subject site.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Bionet	Woodlands and dry open sclerophyll forests, usually dominated by eucalypts; also recorded in shrublands, heathlands and various modified habitats.	None. No suitable habitat in Subject site.
Botaurus poiciloptilus	Australasian Bittern	E	E	PMST	Permanent freshwater wetlands with tall dense vegetation, particularly bullrushes and spikerushes.	None. No suitable habitat in Subject site.
Calidris canutus	Red Knot	-	E	PMST	Sheltered coasts on mudflats and sandbars of estuaries, harbors, lagoons; occasionally on beaches, reefs.	None. No suitable habitat in Subject site.
Calidris ferruginea	Curlew Sandpiper	E	CE	PMST	Tidal mudflats, sandy ocean shores and occasionally inland freshwater or salt-lakes.	None. No suitable habitat in Subject site.
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Bionet	Sheoaks in coastal forests and woodlands, timbered watercourses, and moist and dry eucalypt forests of the coast and the Great Divide up to 1,000 m.	None. No suitable habitat in Subject site.
Charadrius mongolus	Lesser Sand Plover	V	E	PMST	Mudflats, wide sandy beaches, estuaries and tidal areas in mangroves.	None. No suitable habitat in Subject site.
Circus assimilis	Spotted Harrier	V	-	Bionet	Grassy open woodland, inland riparian woodland, grassland and shrub steppe.	None. No suitable habitat in Subject site.
Climacteris picumnus victoriae	Brown Treecreeper	V	-	Bionet	Eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range, and less commonly on coastal plains and ranges.	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	CE	E	PMST	Drier rainforests and adjacent wet eucalypt forest, wetter lowland also wetter lowland rainforests.	None. No suitable habitat in Subject site.
Daphoenositta chrysoptera	Varied Sittella	V	-	Bionet	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	None. No suitable habitat in Subject site.
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Bionet	Swamps, mangroves, mudflats, dry floodplains.	None. No suitable habitat in Subject site.
Erythrotriorchis radiatus	Red Goshawk	CE	V	PMST	Open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water. Typically found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus Forest of coastal rivers. Population in NSW is naturally small (probably only one pair) and lies at extreme of the natural range of the species in Australia.	None. No suitable habitat in Subject site.
Falco hypoleucos	Grey Falcon	E	V	PMST	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range.	None. No suitable habitat in Subject site.
Glossopsitta pusilla	Little Lorikeet	V	-	Bionet	Forages in open Eucalyptus forest and woodland; also feeds on Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	None. No suitable habitat in Subject site.
Grantiella picta	Painted Honeyeater	V	V	PMST	Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. Specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	None. No suitable habitat in Subject site.
Grus rubicunda	Brolga	V	-	Bionet	Shallow swamps, floodplains, grasslands and pastoral lands, usually in pairs or parties.	None. No suitable habitat in Subject site.
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	Ma	Bionet	Coastal habitats and around terrestrial wetlands characterised by the presence of large areas of open water (larger rivers, swamps, lakes, ocean). Habitats may include freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds in addition to bays and inlets, beaches, reefs, lagoons, estuaries and mangroves.	None. Species may occur as a fly-over whilst foraging in locality, however, no suitable habitat in Subject site which is likely to be impacted as a result of the proposal.
Hieraaetus morphnoides	Little Eagle	V	-	Bionet	Open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used.	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
Hirundapus caudacutus	White-throated Needletail	-	V	Bionet, PMST	Most often recorded aerial foraging above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy. Breeding does not occur in Australia.	None. No suitable habitat in Subject site.
Irediparra gallinacea	Comb-crested Jacana	V	-	Bionet	Among vegetation floating on slow-moving rivers and permanent lagoons, swamps, lakes and dams.	None. No suitable habitat in Subject site.
Lathamus discolor	Swift Parrot	E	CE	Bionet, PMST	On mainland Australia foraging occurs where eucalypts are flowering profusely or where abundant lerp infestations occur. Favoured feed trees include winter flowering species such as Swamp Mahogany (Eucalyptus robusta), Spotted Gum (Corymbia maculate), Red Bloodwood (C. gummifera), Forest Red Gum (E. tereticornis), Mugga Ironbark (E. sideroxylon), and White Box (E. albens). Commonly used lerp infested trees include Inland Grey Box (E. microcarpa), Grey Box (E. moluccana), Blackbutt (E. pilularis) and Yellow Box (E. melliodora).	None. No suitable habitat in Subject site.
Limosa lapponica baueri	Black-tailed Godwit	-	V; M	PMST	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms. Often occurs around beds of seagrass, and sometimes in nearby saltmarsh or the outer margins of mangrove areas.	None. No suitable habitat in Subject site.
Lophoictinia isura	Square-tailed Kite	V	-	Bionet	Dry woodland and open forest, particularly along major rivers and belts of trees in urban or semi-urban areas. Home ranges can extend over at least 100km2.	None. Species may occur as a fly-over whilst foraging in locality, however, no suitable habitat in Subject site which is likely to be impacted as a result of the proposal.
Ninox strenua	Powerful Owl	V	-	Bionet	Woodland and open forest to tall moist forest and rainforest. Requires large tracts of forest or woodland habitat but may also occur in fragmented landscapes.	None. No suitable habitat in Subject site.
Numenius madagascariensis	Eastern Curlew	-	CE, M	PMST	Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats and sometimes saltmarsh of sheltered coasts.	None. No suitable habitat in Subject site.
Pandion cristatus	Eastern Osprey	V	-	Bionet	Littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Typically occur in coastal areas but occasionally travel inland along major rivers. Wetland habitats include inshore waters, reefs, bays, coastal	None. Species may occur as a fly-over whilst foraging in locality, however, no suitable habitat in Subject site which is

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
					cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes.	likely to be impacted as a result of the proposal.
Petroica boodang	Scarlet Robin	V	-	Bionet	Dry eucalypt forests and woodlands with an open and grassy understorey with few scattered shrubs. Both mature and regrowth vegetation are utilised; habitat usually contains abundant logs and fallen timber.	None. No suitable habitat in Subject site.
Petroica phoenicea	Flame Robin	V	-	Bionet	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes; prefers clearings or areas with open understoreys. Breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	None. No suitable habitat in Subject site.
Rostratula australis	Australian Painted Snipe	E	E	PMST	Well-vegetated shallows and margins of wetlands, dams, sewage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea-tree scrub, and open timber.	None. No suitable habitat in Subject site.
Sternula nereis nereis	Australian Fairy Tern	-	V	PMST	Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. Feeds in Coastal waters.	None. No suitable habitat in Subject site.
Tyto novaehollandiae	Masked Owl	V	-	Bionet	Dry eucalypt forest and woodlands.	None. No suitable habitat in Subject site.
Invertebrates						
Argynnis hyperbius	Australian Fritillary	E	CE	PMST	Open swampy coastal habitat where the caterpillar's food plant, Arrowhead Violet (*Viola betonicifolia*) occurs.	None. No suitable habitat in Subject site.
Mammals						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	PMST	Near cave entrances and crevices in cliffs. Found in well-timbered areas containing gullies.	Low. Subject site does not occur near rocky escarpments and known breeding areas. Species not known to actively utilise artificial habitats such as concrete structures or culverts.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Bionet, PMST	Dry and moist eucalypt forests and rainforests, fallen hollow logs, large rocky outcrops.	None. No suitable habitat in Subject site.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Bionet	Moist and dry eucalypt forest and rainforest, particularly at high elevations.	Low. Species not known to actively utilise artificial habitats such as concrete structures or culverts for roosting.

Scientific Name	Common Name	BC Act [1]	EPBC Act [1]	Source	Habitat	Potential occurrence and Outcome
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	Bionet	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts in tree hollows.	Low. Species not known to actively utilise artificial habitats such as concrete structures or culverts for roosting.
Miniopterus australis	Little Bent-winged Bat	V	-	Bionet	Moist eucalypt forest, rainforest and dense coastal scrub.	**Known.** Recorded previously utilising (roosting) habitat within Subject site. **Considered further as a candidate species.**
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Bionet	Forest or woodland, roost in caves, old mines and stormwater channels.	**High.** Potential habitat within Subject site (roosting habitat). **Considered further as a candidate species.**
Myotis macropus	Southern Myotis	V	-	Bionet	Bodies of water, rainforest streams, large lakes, reservoirs.	**Known.** Recorded previously utilising (roosting) habitat within Subject site. **Considered further as a candidate species.**
Petauroides volans	Greater Glider	-	V	PMST	Ranges and coastal plains of eastern Australia, where it inhabits a variety of eucalypt forests and woodlands.	None. No suitable habitat in Subject site.
Petaurus australis	Yellow-bellied Glider	V	-	Bionet	Tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Dens in tree hollows of large trees, often in family groups. 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.	None. No suitable habitat in Subject site.
Petaurus norfolcensis	Squirrel Glider	V	-	Bionet	Blackbutt, bloodwood and ironbark eucalypt forest with heath understorey in coastal areas, and box-ironbark woodlands and River Red Gum Forest inland.	None. No suitable habitat in Subject site.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	PMST	North-facing cliffs and dry eucalypt forest and woodland, inhabiting rock crevices, caves, overhangs during the day, and foraging in grassy areas nearby at night.	None. No suitable habitat in Subject site.
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Bionet	Drier forests and woodlands with hollow-bearing trees and sparse ground cover.	None. No suitable habitat in Subject site.
Phascolarctos cinereus	Koala	V	E	Bionet, PMST	Appropriate food trees in forests and woodlands, and treed urban areas.	None. No suitable habitat in Subject site.

Scientific Name	Common Name	BC Act (1)	EPBC Act (1)	Source	Habitat	Potential occurrence and Outcome
Potorous tridactylus	Long-nosed Potoroo	V	V	PMST	Cool temperate rainforest, moist and dry forests, and wet heathland, inhabiting dense layers of grass, ferns, vines and shrubs.	None. No suitable habitat in Subject site.
Pseudomys novaehollandiae	New Holland Mouse	-	V	PMST	Occurs in open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	None. No suitable habitat in Subject site.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Bionet, PMST	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	None. No suitable habitat in Subject site.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Bionet	Forages in a variety of habitats, roosts in tree hollows and buildings.	Low. Species not known to actively utilise artificial habitats such as concrete structures or culverts for roosting.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Bionet	Woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	Low. Species not known to actively utilise artificial habitats such as concrete structures or culverts for roosting.
Vespadelus troughtoni	Eastern Cave Bat	V	-	Bionet	Cave roosting species found in dry open forest and woodland near cliffs and rocky overhangs.	Low. Subject site does not occur near rocky escarpments and known breeding areas. Species not known to actively utilise artificial habitats such as concrete structures or culverts for roosting.
Reptiles						
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	E	PMST	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	None. No suitable habitat in Subject site.

(1) V = Vulnerable; E = Endangered; CE = Critically Endangered

Appendix C

Microbat Management Plan

Microbat Management Plan

PMHC Rawdon Island Bridge – Stage 2 Repairs

Quality solutions. Sustainable future.

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Certification

	Name	Signature	Date
Prepared by	Troy Jennings		29/03/2022
Reviewed by	David Andrighetto		29/03/2022

UPR	Description	Issued By	Date Issued
4203-1004	Version 1 (draft)	David Andrighetto	29/03/2022
4203-1016	Version 2	David Andrighetto	5/04/2022
4203-1018	Version 3	David Andrighetto	12/04/2022

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1. Introduction

1.1 Background information

Rawdon Island Bridge is located within Port Macquarie – Hastings Council (PMHC) Local Government Area (LGA) and spans from the suburbs of Sancrox and Rawdon Island (**Illustration 1.1**). The bridge is a beam and slab concrete bridge spanning the Hastings River. It is approximately 164m long and 6.5m wide, has seven piers and was constructed in 1961. The deck is approximately 6m above the high tide water level, with the top of the blade wall approximately 1.6m beneath the deck.

Rawdon Island Bridge was closed to traffic in July 2021 due to severe structural damage of pile foundations impacting stability and was seen as a high risk to public safety. As a result, repair and strengthening works were required for the bridge and 'Stage 1' works were approved via a Review of Environmental Factors (REF) determined in October 2021 (D2021/291331 & D2021/317837) (Port Macquarie - Hastings Council 2021). Investigations associated with Stage 1 REF, identified a 'local population' of Southern Myotis (*Myotis macropus*) roosting on Rawdon Island Bridge in Pier 6 bridge expansion joints. No other roosts were identified locally (Echo Ecology and Survey 2021a).

Critical bridge repairs have been approved via the Stage 1 REF with an associated Stage 1 Microbat Management Plan (MMP) (Echo Ecology and Survey 2021b). The Stage 1 MMP followed a process of behavioural monitoring, staged repair works and adaptive management to guide the Stage 1 works. Activities that modify the roost or are likely to cause a high level of disturbance to roosting bats are excluded from the Stage 1 Assessment of Significance (AoS) and Stage 1 MMP due to their potential to be a significant impact. Such activities (considered to be disturbing activities) are covered under a separate scope of works termed 'Stage 2 repair works' and include the following works at Pier 6: joint replacement; concrete repairs immediately adjacent to the joint at headstock, diaphragms, deck joint and pier blade wall; and installation of cathodic protection system to extend the life of the bridge structure.

As a result, a Species Impact Statement (SIS) in accordance with Section 7.21 of the *Biodiversity Conservation Act 2016* was undertaken and this Stage 2 Microbat Management Plan (MMP) aims to minimise impacts to the Rawdon Island Bridge (specifically Pier 6 works) and the associated microbat (primarily Southern Myotis *Myotis macropus*) population whilst undertaking bridge works/repairs.

The scope of work and activities associated with the Stage 2 repair works and which are to occur in the Subject site, are as follows:

1. Pier 6 bridge joint rehabilitation – This work involves removal of the existing rubber compression seal, concrete break back utilising saw cutters and handheld jackhammers to remove deteriorated or poor quality concrete, cleaning and reinstating reinforcing, pouring a new epoxy shoulder to support the new joint sealant, and installing a pourable joint sealant to prevent water draining through to the substructure. This work primarily impacts the bridge decking and joint above the diaphragm beams and girders.
2. Pier 6 Diaphragm Beam Repairs – Concrete repairs to existing concrete diaphragm beams directly below the joint due to severe corrosion and delamination of concrete. This would involve saw cutting the edge of damaged concrete area, concrete break-back to remove damaged materials and expose reinforcement, cleaning and reinstating reinforcement, and concrete repairs using hand packable or pourable proprietary grout materials. No works on the inside face of the diaphragm beams are proposed.
3. Pier 6 Headstock Repairs - Concrete repairs to existing headstock directly below the joint due to severe corrosion and delamination of concrete, due to poor construction cover. This would involve saw cutting the edge of damaged concrete area; concrete break-back to removal damaged materials and expose reinforcement; cleaning and reinstating reinforcement; concrete repairs

using hand packable or pourable proprietary grout materials; and provision of a protective coating over the full extent of the headstock.

4. Pier 6 Blade Wall Repairs and Protection – The existing pier blade walls between headstock and top of pile foundations have localised deterioration throughout due to chloride ingress and carbonation. Repairs involve saw cutting the edge of damaged concrete area; concrete break-back to removal damaged materials and expose reinforcement; cleaning and reinstating reinforcement; concrete repairs using hand packable or pourable proprietary grout materials; and provision of a protective coating over the full extent of the blade wall. Installation of an Impressed Current Cathodic Protection (ICCP) system in the bottom 2m of the blade wall is also included, which includes saw-cutting and grinding strips in the surface of the concrete to install zinc anodes around the full perimeter of the pier and connection to a solar powered TRU to provide current to the system (located at Abutment A).

Specific areas associated with Stage 2 works on Pier 6 are shown in **Figure 1.1.**

Bridge repair activities are being carried out or are approved to be carried out on other parts of the bridge under the separate Stage 1 REF approval. The specific Stage 1 program (i.e. timing of activities) is subject to change due to weather impacts and progressive bridge condition assessments affecting location specific repair requirements.

Suspended scaffold will be hung around the perimeter of Pier 6 during the repair works. The scaffold would take 2-3 days to assemble nearby, then floated into position around the pier and hung from the bridge kerb. It would remain in place for the duration of works, estimated at 10-12 weeks for the works, plus 2-3 additional weeks to enable microbat inspection and management.

Bridge works are scheduled for the following work hours:

- Monday to Friday – 06:00 am to 08:00 pm
- Saturday – 06:00 am to 08:00 pm
- Sunday – 08:00 am to 02.00 pm.

The Stage 2 repair works would be undertaken following the Stage 2 MMP to minimise impacts on threatened microbats. Key actions include:

- Induction of personnel
- Install alternative compensatory microbat roosting habitat
- Microbat baseline surveys (including microbat data collected as part of the Stage 1 repair works)
- Install temporary microbat exclusion (estimated 12 week duration)
- Post exclusion inspections
- Maintenance and restoration of pre-existing roosting habitat (expansion joints)
- Monitoring.

Some out of hours work would be required as part of microbat management.

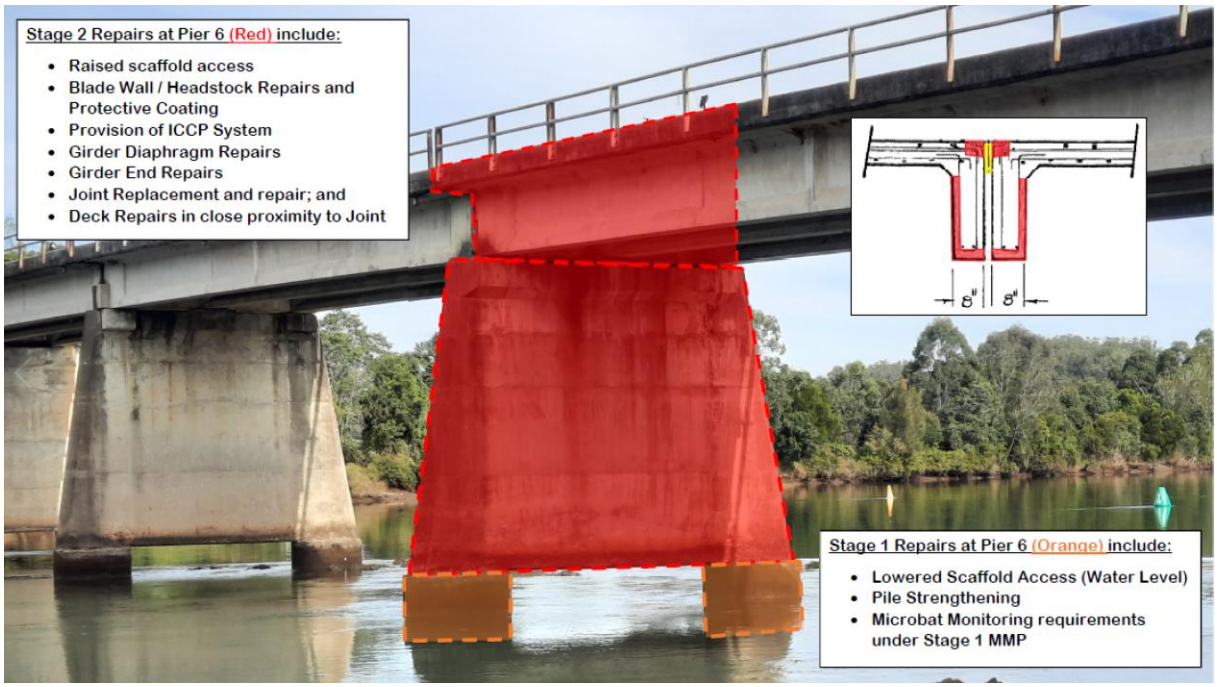


Figure 1.1 Staged works on Pier 6 Rawdon Island Bridge – Stage 2 works (this proposal) shown in red

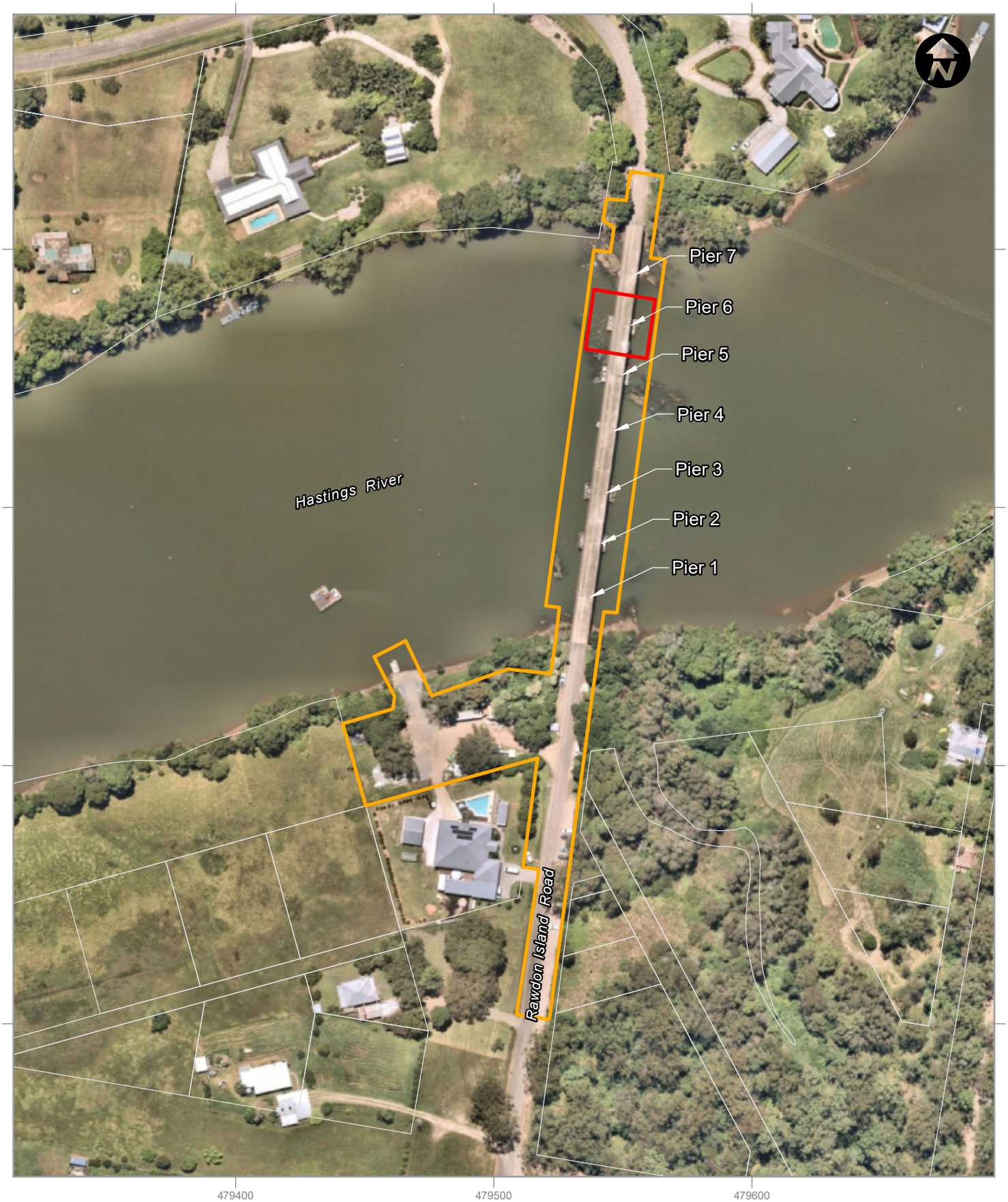
1.1.2 Alternative microbat roosting habitat

The provision of alternative microbat roosting habitat (microbat boxes) prior to the works and maintaining permanent microbat roosting habitat that is available upon completion of the works would be incorporated into the proposal bridge repair scope. By providing adequate habitat microbats will be able to roost at Rawdon Island Bridge during and after the works; reducing disturbance and the potential impacts associated with the proposal.

0 2 km

Site Locality - Illustration 2.1

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TJC
Source of base data: OpenStreetMap
Date: 09/12/2021



LEGEND

- Subject site
- Study area
- Cadastre

0 40 Meters

The Site - Illustration 2.2

GeoLINK environmental management and design

Rawdon Island Bridge - Microbat Management Plan
4203-1012

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: TLJ
Source of base data: Nearmap 10/02/2022
Date: 25/03/2022

1.2 Microbat population at Rawdon Island Bridge

Rawdon Island Bridge supports a significant breeding Southern Myotis (*Myotis macropus*) population that roost in Pier 6 in the bridge expansion joint. Surveys and monitoring between September 2021 (Wolfpeak 2021) and March 2022 (Echo Ecology and Survey 2021b; Dr Anna McConville pers. comms, March 2022) have observed a population between 120 and 199 individuals roosting at this site, particularly at the eastern end of the pier (**Plate 1.1**).

A small (<10) non-breeding group of Little Bent-winged Bats (*Miniopterus australis*) have also been recorded at the Pier 6 roost. The Large Bent-winged Bat (*Miniopterus orianae oceanensis*) is also considered a potential occurrence. Rawdon Island Bridge is not likely to comprise significant roosting habitat (breeding or important overwintering habitat) for the subject Bent-winged Bat species.

All three species are listed as 'Vulnerable' under the NSW *Biodiversity Conservation Act 2016* (BC Act).

Plate 1.1 – Rawdon Island Bridge - Pier 6 eastern end of expansion joint and Southern Myotis roosting (Photos: Will Steggall)

1.2.1 Other Rawdon Island Bridge microbat habitat

Other roosting opportunities for microbats occur in the bridge in small cracks and gaps in the concrete. The most suitable alternative roost location is the deck expansion joint at Pier 2 (**Plate 1.2** and **Plate 1.3**) that is similar to the expansion joint at Pier 6 (**Figure 1.2**). However, no evidence of use was observed (no bats present, guano or staining) during the inspection by the Wolf Peak (Wolfpeak 2021) or monitoring at Pier 2 as part of the Stage 1 works (Echo Ecology and Survey 2021b). Pier 5 will also provide similar structured habitat upon completion of the Stage 1 works.

Plate 1.2 – Pier 2 potential microbat habitat with monitoring cameras

Plate 1.3 – Pier 2 microbat habitat in expansion joints

1.3 Potential impacts

General potential environmental impacts of the proposal are described in the Stage 2 REF (PMHC 2022), while potential microbat impacts are detailed in the corresponding SIS (GeoLINK 2022). The main potential impacts of the proposed Stage 2 repair works at Pier 6 on microbats or their habitat include:

- Roosting habitat loss/modification.
- Disturbance to roosting microbats.
- Direct mortality or injury to roosting microbats during bridge repair works.

This MMP focuses on managing these potential impacts.

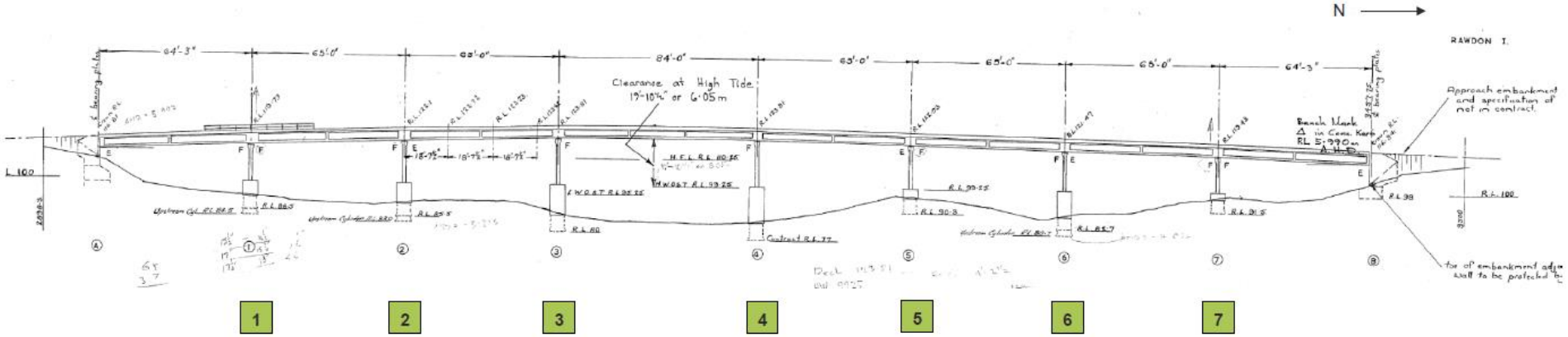


Figure 1.2 – Plan View of Rawdon Island Bridge (pier numbers in green boxes – source: (Echo Ecology and Survey, 2021b)

2. Microbat management plan

2.1 Aim and objective

The objective of the microbat management plan is to minimise impacts to the Rawdon Island Bridge Southern Myotis (*Myotis macropus*) population during the Stage 2 bridge repair works (the proposal). The actions would have dual benefits for the Little and Large Bent-winged Bats.

The actions and measures proposed are based on the methodology, observations made and outcomes achieved during similar work to concrete culverts and bridge projects in NSW. More specifically, the MMP aims to:

- Provide advice for construction personnel on how to manage microbat conflicts during repair work.
- Guide microbat exclusion installation process.
- Reduce potential for microbat injury or mortality.
- Avoid disturbances to breeding microbats.
- Maintain breeding roosting habitat for the Southern Myotis at Rawdon Island Bridge upon completion of the repair works.

Other projects in NSW that have adopted this approach during bridge/culvert maintenance or replacement have been able to maintain large, permanently occupied breeding Southern Myotis populations (>50 to >500) (e.g. Sportsmans Creek Bridge, Barrington Bridge, Briner Bridge, Glebe Bridge and McFarlane Bridge (GeoLINK, 2017, 2016, 2018; David Andrighetto, pers. obs.).

Flexibility and adaptive management will be required throughout Stage 2 MMP implementation to avoid conflicts with the Stage 1 works and to accommodate microbat behaviour and responses (particularly during the exclusion phase).

An ecologist would be engaged to help manage microbats and provide advice throughout the microbat exclusion and bridge removal process. The ecologist may determine that additional mitigation actions are required. In the Stage 2 MMP, an 'ecologist' refers to a person with:

- Minimum three years' experience working as an ecologist with extensive microbat handling experience.
- A NSW BC Act scientific licence and Animal Care and Ethics Committee approval.
- Current Lyssavirus vaccination.

The ecologist would be responsible for managing the microbats, including capture and release of microbats when required, identifying if there are potential issues with microbats in torpor and the need for additional exclusion or timing of habitat removal/exclusion to be changed.

2.2 Action 1: Induct bridge personnel

2.2.1 Objective

Ensure actions and responsibilities of the Stage 2 MMP are understood by bridge personnel.

2.2.2 Action

An environmental induction would be prepared and delivered to all personnel involved with the bridge work. Key points to be delivered in the induction in relation to microbat management are as follows:

- Microbat presence on site (identification and potential habitat).
- Education on the potential of microbats to carry disease and that any microbats found during the works would be reported immediately to the project ecologist /supervisor and bats would not be handled by an untrained or unvaccinated person.
- Pre-work inspection requirements, methods and actions.
- Protocols on what to do if an injured bat is found.
- Stop works if microbats flyout during the day or are encountered within the works area.
- Contact details of local wildlife rescue organisations (FAWNA 02 6581 4141).

2.2.3 Timing

Prior to relevant personnel working on site.

2.2.4 Performance indicator

- All personnel involved with the bridge works know Stage 2 MMP requirements.
- Actions of Stage 2 MMP are effectively implemented.
- Records of training/indication are recorded.
- Site supervision during work to ensure procedures are being follows. Pre-start reminders or toolbox training undertaken as required.

2.2.5 Responsibility

Project manager, supervisor.

2.2.6 Contingency triggers and corrective actions

Contingency trigger	Corrective action
■ MMP provisions are not understood. ■ Untrained personnel onsite.	Hold induction or additional toolbox training on MMP provisions.

2.3 Action 2: Alternative microbat roosting habitat (microbat box)

2.3.1 Objective

Provide alternative microbat roosting habitat whilst Pier 6 repair works are undertaken.

2.3.2 Action

- Install ten four-chamber timber microbat boxes (*Hollow Logs Homes* design www.hollowloghomes.com.au; with metal reinforcement to strength lid and side connection) below bridge decking over water spans (carrying capacity of 20-30 Southern Myotis per box; refer to **Plate 2.1**).
- Microbat boxes will be installed in close proximity to Pier 6, whilst avoiding locations vulnerable to other construction conflicts. Current proposed locations based on the construction program are:
  - Pier 3 (five microbat boxes).
  - Pier 4 (five microbat boxes).

  Locations may be refined in consultation with the project manager and ecologist.

Note:

- *The expected design life is 10-15 years based on observations at other bridge structures. No ongoing maintenance is proposed. With reinforcement, the boxes should not completely fail and degrade slowly over time.*
- *Alternative microbat roosting habitat installed as part of the Stage 1 works may be used to address this Action.*

2.3.3 Timing

Microbat boxes will be installed and available for microbat use **at least one month** prior to exclusion installation at the Pier 6 expansion joint.

2.3.4 Performance indicator

- Microbat boxes are installed at least one month prior to exclusion installation.

2.3.5 Responsibility

Project manager, supervisor and ecologist.

2.3.6 Contingency triggers and corrective actions

Contingency trigger	Corrective action
Microbat boxes are not available for microbat use for one month prior to exclusion	Microbat boxes are installed and made available for microbat use and Pier 6 exclusion works are delayed to allow a minimum one month period between microbat box installation and Pier 6 exclusion.

Plate 2.1 Example of alternative microbat boxes secured with anchor bolts into insitu slab (between expansion joint) on a super-T bridge. The microbat boxes are re-enforced with galvanised steel brackets securing the lid to the side.

2.4 Action 3: Long-term compensatory roosting habitat

2.4.1 Objective

Provide permanent compensatory habitat for microbats to roost in as a precautionary measure should Pier 6 repair works unexpectedly result in reduced habitat value upon completion of the works.

2.4.2 Action

- Install four permanent timber (marine ply) microbat habitats below bridge decking in over water spans (carrying capacity of >80 Southern Myotis per habitat; refer to preliminary designs in **Appendix A**).
- The final designs and location would be determined in consultation with the ecologist and project manager.
- The ecologist would inspect the habitat during construction and initial installation to ensure the potential for microbat (specifically Southern Myotis) is maximised.

Note: The expected design life is 25 years. No ongoing maintenance is proposed as it is expected that expansion joints at Piers 2, 5 and 6 would continue to provide microbat roosting habitat upon completion of the works; and any potential loss to current roosting habitat values would be 'restored' over this period through aging /deterioration. Concrete constructed boxes were eliminated as an option due to constructability constraints.

2.4.3 Timing

Prior to demobilisation of bridge repair contractor (prior to microbat exclusion if possible and avoids conflicts with other Stage 1 and Stage 2 repair works).

Note: A requirement for installation prior to exclusion is negated through temporary microbat box use due to construction considerations (i.e. access /installation considerations and avoiding Stage 1 work conflicts).

2.4.4 Performance indicator

- Permanent compensatory roosting habitat designs, construction and proposed installation locations validated by ecologist as suitable.
- Permanent compensatory roosting habitat is installed and available for microbat use prior to demobilisation of the bridge repair contractor.

2.4.5 Responsibility

Project manager, supervisor and ecologist.

2.4.6 Contingency triggers and corrective actions

Contingency trigger	Corrective action
Permanent compensatory roosting habitats design, construction and installation not approved by Ecologist	Design, construction and/or installation is rectified and endorsed by Ecologist
Permanent compensatory roosting habitats are not installed prior to demobilising bridge repair contractor	Permanent compensatory roosting habitats are installed and endorsed by Ecologist or Project manager

2.5 Action 4: Exclusion phase baseline microbat surveys (prior to exclusion installation)

2.5.1 Objective

Determine microbat species, numbers and roost locations within Pier 6 and other available habitat in Rawdon Island Bridge prior to Pier 6 exclusion installation. This will provide a baseline reference for the exclusion phase of the project and be used to determine the success of this phase.

2.5.2 Action

Undertake microbat surveys targeting:

- Pier 6 and any other available roosting habitat at Rawdon Island Bridge.
- Local moderate to high potential microbat roosts within 5km (Echo Ecology and Survey 2021a)

The methodology would be via a combination of infrared camera monitoring (already established at Pier 6 as part of the Stage 1 works), torch/binocular inspections, inspection camera/pole camera inspections and/or direct inspections from suspended scaffolding. Information to be recorded includes:

- Species and number of individuals per roost.
- Roost location and habitat type.

2.5.3 Timing

Prior to exclusion activities that displace microbats. May be undertaken up to one week prior to commencing exclusion works.

***Note**: This action can be undertaken during the exclusion installation process when exclusion is being installed in locations without microbats such as Piers 2 and 5 and completed prior to any microbat displacement.*

2.5.4 Performance indicator

Current microbat species, roost locations and numbers of microbats per species present are known prior to commencing exclusion works that displace microbats.

2.5.5 Responsibility

Project manager, site supervisor, and ecologist.

2.5.6 Continency triggers and corrective actions

Contingency trigger	Corrective action
Microbat species, roost locations and numbers of microbats have not been documented	Exclusion delayed and baseline microbat surveys are completed

2.6 Action 5: Temporary exclusion installation at unoccupied potential roosting habitat

2.6.1 Objective

Avoid potential conflicts from displaced microbats roosting in other locations where bridge repair works are required.

2.6.2 Action

- Temporary microbat exclusion will be installed in areas of potential microbat roosting habitat that is unoccupied by microbats and requires construction work (including works continuing in parallel as part of the Stage 1 works). These areas include Piers 2 and 5. Additional locations where work may occur post exclusion should also be considered.
- An ecologist would inspect the area for microbats and confirm it is free of microbats prior to installing the exclusion.
- Should microbats be detected, the ecologist would be consulted to determine a suitable microbat exclusion procedure for that location.

Note: Temporary exclusion will be removed as soon as practicable at a time that avoids any conflicts with Stage 1 repair works.

2.6.3 Timing

As soon as practicable prior to temporary exclusion installation at Pier 6.

2.6.4 Performance indicator

- Prior to Pier 6 exclusion microbats are completely excluded from roosting in locations where other bridge repair works are required.
- No microbat mortality/injury or entrapment occurs as a result of exclusion installation.

2.6.5 Responsibility

Project manager, site supervisor, and ecologist

2.6.6 Continency triggers and corrective actions

Contingency trigger	Corrective action
Exclusion on other potential roost locations has not been completed	Pier 6 exclusion delayed and exclusion at other locations completed
Microbat mortality/injury or entrapment occurs as a result of exclusion. **Or** Microbats fly out during daylight hours	Stop exclusion works contact Ecologist and Project manager and reassess exclusion procedure

2.7 Action 6: Temporary microbat exclusion installation at Pier 6

2.7.1 Objective

Prevent microbat injury/mortality during bridge repair works associated with Pier 6.

2.7.2 Action

Install microbat exclusion at the expansion joint at Pier 6 to make it inaccessible to microbats prior to bridge repair works.

2.7.3 Methodology

The following methodology would be undertaken associated with Pier 6 works:

1. **Additional Temporary Habitat**: Install at least two additional four-chamber timber microbat boxes under the bridge decking adjacent to pier 6 once the scaffolding is in place (refer to **Section 2.3** - **Action 2** for microbat box design details).
2. **Ecologist Inspection**: Ecologist would undertake direct torch/inspection camera searches for microbats from the suspended scaffolding to record microbat numbers and current roosting locations within the expansion join.
3. **Daytime Preparation**: If appropriate, some exclusion installation preparation may occur during the day under the direction and supervision of the ecologist ensuring that microbats aren't entrapped, harmed or displaced. Preparation activities may include installing exclusion in the unused areas of the expansion joint or caping the ends of the expansion joint.
4. **Night Exclusion Installation**: The remaining exclusion would be installed at night after flyout. This process would involve:

    - Waiting for the microbats to leave roost sites and have the ecologist confirm the microbats have vacated the roost (following inspection with an inspection camera, torch and/or thermal imagery device).
    - Installing exclusion, removing a maximum of 1/3 of the available occupied roosting area.
    - Ongoing ecologist inspection to ensure no microbats re-enter the exclusion installation area during installation.

    Exclusion materials may require removal the following morning to allow inspection to ensure no microbats were trapped or able to penetrate the exclusion. The exclusion would then be reinstalled.
5. **Post Exclusion Inspection**: When ≥10 microbats have been displaced:

    - The ecologist would return to site at least 1 hour prior to dawn and check for trapped microbats and observe the behaviour of microbats when returning to roost. Attempts at re-entry would be observed and any breaches noted for repair/alteration. Any microbats attempting to roost in inappropriate locations would be captured by the ecologist and released the following evening.
    - The remaining microbat habitat would be inspected to determine where the displaced microbats have relocated (i.e. the installed alternative microbat habitat).

6. **Continue with Exclusion Installation**: Steps 3 and 4 would repeat over a minimum of two more nights, with a maximum of 1/3 of the original available occupied roosting area excluded each night. The process would take a minimum of three nights, unless the microbats completely

abandon the Pier 6 habitat. To manage microbat stress, the ecologist may determine that a break night from exclusion installation may be required. Factors to consider include the location of roosting microbat and 'settling' behaviour.

7. **Transfer Occupied Microbat Boxes**: At least one night after exclusion installation is complete, the microbat boxes at Pier 6 would be relocated to another section of the bridge (location to be determined in consultation with the ecologist). The following process would apply:

   - Ecologist to inspect microbat boxes and record the number of microbats per box.
   - Entrance to microbat boxes would be covered with cloth (e.g. duct taped pillowcase).
   - Ecologist with help of construction crew transfer microbat boxes to the new location.
   - Allow sufficient time for microbats to settle in the microbat box before removing entrance cover.
   - The following day, the ecologist would return and inspect the boxes and available habitat at the bridge to determine where the microbats are roosting. Any microbats attempting to roost in inappropriate locations would be captured by the ecologist and released at dusk.

Use of 'one-way valve' exclusion devices that enable animals to vacate, but not re-enter may be considered depending on the results of the above.

By the end of exclusion installation, the only habitat available for microbats to roost in would be the microbat boxes and other pier structures where repair works have been completed (if relevant).

Flexibility in the microbat exclusion process would be required following advice from the ecologist. The ecologist would be responsible for managing the microbats, including capture and release of microbats throughout the exclusion process, identify if there are potential issues with microbats in torpor and the need for the exclusion to be delayed, etc. The ecologist would confirm the exclusion is installed and adequate upon completion.

During the exclusion installation process, bridge repair works may commence in locations where the exclusion is complete, subject to ecologist approval and sufficient buffers being maintained from active roost sites. This would be determined on a case-by-case basis.

Note: Exclusion will be removed as soon as practicable upon completion of the Stage 2 works.

2.7.4 Exclusion methods

Exclusion devices may comprise a combination of the following depending on the span and timing of works:

- Foam battens
- Plastic sheeting
- Gap filler or expandable foam.
- Plywood secured with screws
- One-way flap (for deep cavities that would not be able to be confidently inspected to ensure they are free of bats)

Specific methods would be discussed with the construction team prior to commencement of works. If expandable foam is used (particularly at night), exposed areas would be covered (e.g. with gaffer/silver ductile tape) to prevent bats trying to access the bridge making contact with the foam prior to it hardening. The exclusion design would allow for water drainage where necessary and be durable enough to ensure it stays functional throughout the exclusion period.

2.7.5 Timing

All exclusion installation activities must be undertaken outside the breeding season for the Southern Myotis (October to mid-April inclusive). Exclusion installation activity can only occur between mid-April and September (inclusive). *Note: Exclusion may remain in place during the breeding season.*

Exclusion installation programming would allow for some flexibility (i.e. potential short delays during cold/wet weather) during this period to avoid disturbing microbats during torpor periods or for example if the microbats are still active then exclusion may proceed. The ecologist would be responsible for identifying periods of torpor or in appropriate weather conditions.

2.7.6 Performance indicator

The following performance indicators for the success of the works are prescribed:

- Microbats are completely excluded from Pier 6 and occupy other available habitat at the bridge.
- Exclusion installation is completed between mid-April and September outside of the Southern Myotis breeding season (October to mid-April, inclusive).
- No mortality/injury occurs as a result of exclusion installation process.

2.7.7 Responsibility

Project manager, site supervisor, and ecologist.

2.7.8 Contingency triggers and corrective actions

Contingency trigger	Corrective action
Following any event that displaces ≥10 microbats from the bridge, if ≥10 microbats or 67% of pre-exclusion microbat numbers are not locatable within the available alternative habitat.	The ecologist is to investigate (if accessible) the whereabouts of the animals, including: ■ Survey alternative available habitat at the bridge. ■ Inspection of the Pier 6 habitat for breaches in the exclusion. If microbats are not recorded at Rawdon Island Bridge, undertake surveys of the 11 moderate to high potential roosting structures within 5km as identified by (Echo Ecology and Survey 2021a). The exclusion method would be reviewed (e.g. reducing the rate of exclusion installation) and additional measures identified by the Ecologist where appropriate.
>33% of microbats (based on pre-exclusion numbers) vacate Rawdon Island Bridge and cannot be found within local roosting habitat (Echo Ecology and Survey 2021a).	The exclusion method would be reviewed (e.g. reducing the rate of exclusion installation) and additional measures identified by the Ecologist where appropriate.
Microbats aren't completely excluded from Pier 6.	The exclusion method would be reviewed (e.g. reducing the rate of exclusion installation) and additional measures identified by the Ecologist where appropriate.
Exclusion installation not completed outside breeding season	Pier 6 works delayed until nonbreeding season (October to mid-April inclusive)
Microbat mortality/injury or entrapment occurs as a result of exclusion. Or microbats fly out during daylight hours	Stop exclusion works contact Ecologist and Project manager and reassess exclusion procedure

2.8 Action 7: Post exclusion inspections

2.8.1 Objective

- Ensure microbat exclusion remains in place and functional.
- Implement stop work provisions if microbats fly out from the bridge during the day.

2.8.2 Action

1. Daily inspections would be undertaken each day of work by the construction team, including:
    - **Start of day inspection**: Ensure the exclusion is in place and has not been breached. If any defects are found, the ecologist would be contacted to re-inspect the subject area for microbats and the defect/breach would be rectified.
    - **End of day inspection**: Ensure the exclusion is functional, has not been damaged and any defects are rectified prior to dusk.
2. If microbats are detected within the Pier 6 structure or other active work site, stop works and contact the ecologist.

See **Appendix B** for work crew daily inspection field sheets.

2.8.3 Timing

Daily at the start and end of the day.

2.8.4 Performance indicator

- Microbat exclusion remains in place, any defects are rectified, and Pier 6 and other work areas remains microbat free.
- Stop work provisions are implemented if microbats are detected within Pier 6 or other active work areas.

2.8.5 Responsibility

Project manager, site supervisor, and ecologist.

2.8.6 Contingency triggers and corrective actions

Contingency trigger	Corrective action
Microbat exclusion is damaged	Pier 6 works delayed and exclusion defects are rectified
Microbats are detected within Pier 6 or other active work areas	Stop works contact Ecologist and Project manager and reassess exclusion procedure

2.9 Action 8: Maintain Pier 2, 5 and 6 microbat roosting habitat values

2.9.1 Objective

Maintain the potential for microbats to roost in the expansion joints in Piers 2, 5 and 6 upon completion of the works.

2.9.2 Action

- Ensure the concrete at the top of the expansion joint and bottom /inside of the diaphragm beam that is subject to repair works remains textured (minimum 2 mm variation) so that microbats:
  - Grip onto the diaphragm beam and climb into the expansion joint.
  - Grip onto the concrete inside the expansion joint at junction with the joint seal.
- The ecologist would inspect this concrete during the repairs to validate that applied texturing is appropriate and has been applied to Pier 6.

The repair works on Pier 2 and /or 5 (potential, but not known habitat; as approved under Stage 1) may be used as a trial before undertaking equivalent repairs at Pier 6 (known microbat roosting habitat). Refer to **Plate 2.2** for examples of effective concrete texturing created on other bridge and culvert projects for the purpose of creating or enhancing microbat habitat.

2.9.3 Timing

During diaphragm beam and expansion joint repair works at Piers 2, 5 and 6.

2.9.4 Performance indicator

- Concrete impacted by expansion joint and diaphragm beam repair works is textured.
- Microbat roosting habitat values of Piers 2, 5 and 6 are retained upon completion of the repair works.
- Microbats return to Pier 6 upon completion of the works and removal of the exclusion.

2.9.5 Responsibility

Project manager, site supervisor, and ecologist.

2.9.6 Contingency triggers and corrective actions

Contingency trigger	Corrective action
Concrete impacted by expansion joint and diaphragm beam repair works is not textured	Before completion of works Project manager and ecologist to sign off on texturing and validate habitat suitability
Microbats don't return to Pier 6 within the year 1 monitoring period (refer to **Section 5**)	The ecologist is to investigate (if accessible) the whereabouts of the animals, including survey of alternative available habitat at the bridge. If microbats are not recorded in available habitat – undertake surveys of high and moderate habitat within 5km as identified by (Echo Ecology and Survey 2021a).

*Note: The permanent compensatory roosting habitat (**Section 2.4 - Action 3**) is a contingency measure which is being installed prior to completion of the works due to logistic constraints with installing this habitat upon completion of the repair works.*

Plate 2.2 Examples of concrete texturing on bridge and culvert structures to create/enhance microbat roost habitat values.

3. Contingency measures

3.1 Adaptive management

Animals can display unpredicted or unexpected behaviour, so management plans such as this need to be adaptable to deal with a range of potential outcomes. The procedures of this plan may be adapted in response to factors such as the pace of the work, or results of inspections and monitoring. Additionally, modifications to the exclusion procedure may be carried out, for example, minor modification may be required to the exclusion devices to improve their success.

The aim of adaptive procedures is to facilitate the identification of the best course of action for the particular situation, including time and logistical constraints, as well as any biological constraints posed by the bats. This requires open communication between the work supervisor, project manager and ecologist.

Potential adaptive measures include:

- Stopping works and reviewing and modifying the exclusion method (e.g. reducing the rate of exclusion)
- Modifying the permanent roosting habitat (i.e. Piers 2, 5 and 6) to maintain habitat values
- Installing additional or modifying compensatory roosting habitat
- Extending monitoring
- Stopping works and consulting with the NSW Department of Planning and Environment (DPE).

3.2 Capturing and releasing healthy microbats

All handling of microbats would be carried out by a qualified and vaccinated ecologist experienced in handling microbats. The ecologist must hold an Animal Care and Ethics Committee approval, a NSW BC Act scientific licence for handling native flora and fauna and be vaccinated against Lyssavirus. Any microbats captured during nocturnal or diurnal inspections would be housed in small cloth bags in a suitable location for nocturnal release on the evening/night following capture.

Bags containing microbats would be hung in a cool, dry place off the ground, preferably within a wire box, similar to a cat carry cage for safety. Microbats housed in this way can be taken off site if required. Microbats would be kept in a cool, shaded environment (< 25°C) and be assessed for heat stress as required. If temperatures exceed 30°C, a cooler location within a local building would be sought.

Microbats of the same species would be housed together in the same groups as they were collected. In the unlikely event that other species are captured, large bats (head and body ≥75mm) would not be grouped with smaller bats (head and body <75mm) as some larger species predate on smaller species. The ecologist is responsible for releasing the microbats in the evening at the site.

Bats would not be held for any period longer than 24 hours. It is expected that bats captured at night would be released that night if dawn is more than two hours away. If dawn is less than two hours away, microbats would be released the following night or relocated into the compensatory roosting habitat or bat box. The longest anticipated holding time for microbats is 16 hours.

Note: Any microbats captured during the work must be released at the site.

3.3 Injured or dead microbats

It is the responsibility of any worker that identifies a dead or injured microbat during the work, to notify work supervisor and project manager immediately. Work within the area of the find would stop until the microbat is collected.

The local wildlife carer group or ecologist would then be contacted immediately for collection of any injured microbat/s. Options for treatment and future release would be decided at the discretion of the wildlife carer, ecologist or veterinarian (if necessary). Any costs for treatment of the injured microbat would be the responsibility of PMHC.

The vaccinated local wildlife carer or ecologist would use a gloved hand encased within a cloth bag, gently pick up the microbat and then turn the bag inside out to free their gloved hand and capture the microbat. If the bat does not need veterinary treatment, the bag would be tied off at the entrance and hung in a cool, shaded and sheltered location.

Where possible, all dead microbats would be collected by the ecologist and if the ecologist is not available, by a vaccinated local wildlife carer group and retained for the ecologist. The ecologist would be responsible for storage and lodgement of the specimen. The Australian Museum Mammal Section (pers. comm Anja Divljan) recommend freezing the specimen if a fresh specimen cannot be lodged. Avoid thawing and re-freezing the microbat if possible. The ecologist would lodge bodies with the Australian Museum Mammal Section (contact Dr Sandy Ingleby) as specimens for future research and study.

Additional general bat handling mitigation measures:

- Construction personnel are prohibited from handling bats unless bats are injured or killed during work and advice has been sought from environmental officer about the collection of the injured/dead microbat. In the case of above, the construction worker would wear gloves and carefully remove the injured/dead bat with a cloth (e.g. cloth bag), by gently encasing the animal and turning the cloth over or inside-out over the bat to encase it.
- The microbats would be placed in a cloth bag that is carefully tied off so that parts of the microbats are not crushed and stored in a cool (not cold), quiet and dark location for collection by the local care group i.e. WIRES, ecologist or environmental officer.
- Large bats (75-95 millimetres head and body length) would not be placed with small bats (<75 millimetres) to avoid predation.
- Arrangements for the care and welfare of captured bats must be made immediately upon discovery/capture of injured bat.
- Bat rescue equipment and personal protective equipment for workers must be available on site. Equipment includes pillowcases, small cloth bags (e.g. soil sample bags), string to tie off pillowcase, thick rubber gloves or Nitrile Grip rubber gloves, soap and water to wash hands and laminated information sheet on Lyssavirus.

3.4 Risks

Some of the procedures detailed within the plan pose various risks to human safety. Microbats can carry diseases, particularly Lyssavirus which can be passed onto humans if bitten. It is therefore recommended that any persons handling microbats have the relevant vaccinations and annual boosters as required. A recent titre level test result should be submitted by the ecologist before work starts. It is recommended that appropriate bat rescue equipment/personal protective equipment is available on site before work starts (cotton bags, gloves, soap and water to wash hands).

4. Roles and responsibility

The construction personnel, ecologist, project manager and environmental officer form a team that work together to achieve long term management and deliver the aims of this exclusion strategy.

Project manager or the construction contractor would be responsible for providing exclusion material and installation of exclusion devices. An ecologist would be present during installation.

An ecologist would be responsible for inspections prior and during the installation of exclusion material. The project supervisor (or delegate) would carry out daily microbat checks prior to the commencement of work to ensure that microbats had not penetrated the exclusion or were roosting in exposed/unsafe locations. Any resident bats would be captured by the ecologist by hand and released in accordance with this strategy. PMHC and the ecologist would communicate proactively with the work supervisor and environmental officer if work needs to cease, be modified and/or to report all observations.

The ecologist is to provide guidance to PMHC such that the aims of the exclusion strategy are achieved and impact to microbats is minimised. Any decision relating to PMHC meeting its statutory obligations would be discussed or referred to the project manager and environmental officer in the earliest instance.

It is the responsibility of any worker that identifies a dead or injured microbat to notify worker supervisor, project manager and environmental officer immediately. Work may need to stop in the area of the find.

5. Monitoring and reporting

5.1 Monitoring

Microbat monitoring would be carried out by the ecologist pre, during and post exclusion, with the objectives of:

- Gathering data before exclusion to accurately define a baseline population number for the species utilising the bridge structure.
- Identifying whether and how the microbat management actions of this plan have been implemented and their success.
- Identifying the need to implement additional contingency measures to minimise impacts to microbats (particularly the subject Southern Myotis colony) should any management actions not be successful.
- Providing further recommendations for consideration on future projects with similar impacts on threatened microbats.

The proposed monitoring schedule is provided in **Table 5.1**. The proposal would be considered successful if a significant proportion of Southern Myotis are seen utilise the bridge structure or compensatory habitat as a breeding site post repair works. A significant proportion is regarded as 67% of the Southern Myotis numbers present:

- At completion of exclusion installation in comparison to the numbers recorded immediately prior to exclusion; and
- During post exclusion monitoring in comparison to baseline numbers derived from previous/ongoing Stage 1 microbat surveys/monitoring (e.g. Echo Ecology and Survey 2021b) and **Action 4 Exclusion phase baseline microbat surveys** datasets.

The 67% values would be identified at completion of **Action 4 Exclusion phase baseline microbat surveys** datasets. Environmental variability and natural fluctuations would be considered when quantifying the overall success of the project. Methods such as radio tracking and banding have been excluded from monitoring procedures due to the feasibility and probability of determining the success of performance indicators.

Throughout the monitoring and implementation of the proposal, the ecologist would be responsible for identifying the need to trigger and implement contingency/corrective measures.

The results of each monitoring phase would be emailed to the project manager and supervisor, along with a summary of key outcomes/findings to date. A comprehensive report would be provided upon completion of the monitoring program.

If a significant impact was identified from the post exclusion monitoring results, PMHC would consult with Department of Planning and Environment (DPE) and implement appropriate contingency measures.

5.2 Reporting and communication

The results of microbat inspections made throughout the project, particularly during the exclusion and bridge removal phases would be progressively reported to the project manager. A log (refer to **Appendix B**) would be maintained of the decisions made and installation of exclusion devices to be included in formal monitoring reporting.

Table 5.1 Monitoring Schedule

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Continency triggers	Corrective actions
Pre- exclusion	Determine microbat species, numbers and roost locations	Refer to Action 4.	Prior to exclusion activities that displace microbats. May be undertaken up to one week prior to commencing exclusion works.	Microbat species, roost locations and numbers of microbats have not been documented	Exclusion delayed and baseline microbat surveys are completed
During exclusion	Monitor microbat roosting behaviour response to exclusion activities. Document exclusion activities and outcomes to identify the effectiveness of exclusion activities.	Refer to Actions 6.	■ Daily during exclusion installation. ■ Prior to and the morning after installing each exclusion stage where ≥10 microbats are displaced. ■ Prior to and the morning after microbat box transfer.	Following any event that displaces ≥10 microbats from the bridge, if ≥10 microbats or 67% of pre-exclusion microbat numbers are not locatable within the available habitat.	The ecologist is to investigate (if accessible) the whereabouts of the animals, including: ■ Survey alternative available habitat at the bridge. ■ Inspection of the Pier 6 habitat for breaches in the exclusion. If microbats are not recorded at Rawdon Island Bridge, undertake surveys of the 11 moderate to high potential roosting structures within 5km as identified by (Echo Ecology and Survey 2021a). The exclusion method would be reviewed (e.g. reducing the rate of exclusion installation) and additional measures identified by the Ecologist where appropriate.
				Microbats aren't completely excluded from Pier 6.	The exclusion method would be reviewed (e.g. reducing the rate of exclusion installation) and additional measures identified by the Ecologist where appropriate.
				Exclusion not completed outside breeding season	Pier 6 works delayed until nonbreeding season
				Microbat mortality/injury or entrapment occurs as a result of exclusion. Or microbats fly out during daylight hours	Stop exclusion works contact Ecologist and Project manager and reassess exclusion procedure
Post exclusion (one month)	Observe if, when, the species and number of microbats that return to the Pier 6 roost after exclusion is complete	The infrared cameras at Pier 6 used for the Stage 1 monitoring (Echo Ecology and Survey 2021b) would be reinstated for one month to enable observation of the roost during this period. Data to be collected includes: ■ Do microbats return to the roost during this period? ■ If so, record when, what species, the number of microbats and changes in microbat numbers in the Pier 6 roost over this period.	One month upon removal of Pier 6 exclusion.	Microbats do not return to Pier 6 one month after exclusion has been removed	Ecologist is to investigate (if accessible) the whereabouts of the animals, including: ■ Survey alternative available habitat at the bridge. ■ Inspection of the Pier 6 habitat for breaches in the exclusion. If microbats are not recorded in available habitat – undertake surveys of high and moderate habitat within 5km as identified by (Echo Ecology and Survey 2021a).
Post exclusion (seasonal)	Document microbat species, population numbers and roost locations seasonally post exclusion.	Determine microbat species, numbers and roost locations seasonally (three events) during the first year post exclusion removal at Pier 6. The monitoring method would be via a combination of boat based torch/binocular inspections, inspection camera/pole camera inspections and/or flyout counts (camera assisted).	Three events in total, in: ■ Spring (late October/early November; first breeding event of the season). ■ Summer (early February; second breeding event of the season). ■ Winter (July).	<67% of microbats be present bridge structures compared to pre-exclusion numbers, or in comparison to seasonal baseline numbers	Ecologist and PHMC would determine the need for additional measures. This may include: ■ Modifying the compensatory roosting habitat. ■ Installing additional compensatory roosting habitat on existing bridge structures. ■ Extending the post exclusion monitoring.

References

Echo Ecology and Survey 2021a, *Rawdon Island Bridge Repair - Local Area Bat Roost Search*, Port Macquarie.

Echo Ecology and Survey 2021b, *Rawdon Island Bridge - Microbat Management Plan*, Crescent Head.

GeoLINK 2022, *Species Impact Statement - PMHC Rawdon Island Bridge*, Lennox Head.

Port Macquarie - Hastings Council 2021, *Rawdon Island Bridge Repairs - Review of Environmental Factors*, Port Macquarie.

Wolfpeak 2021, *Ecological Assessment for Rawdon Island Bridge Repairs*, Wauchope.

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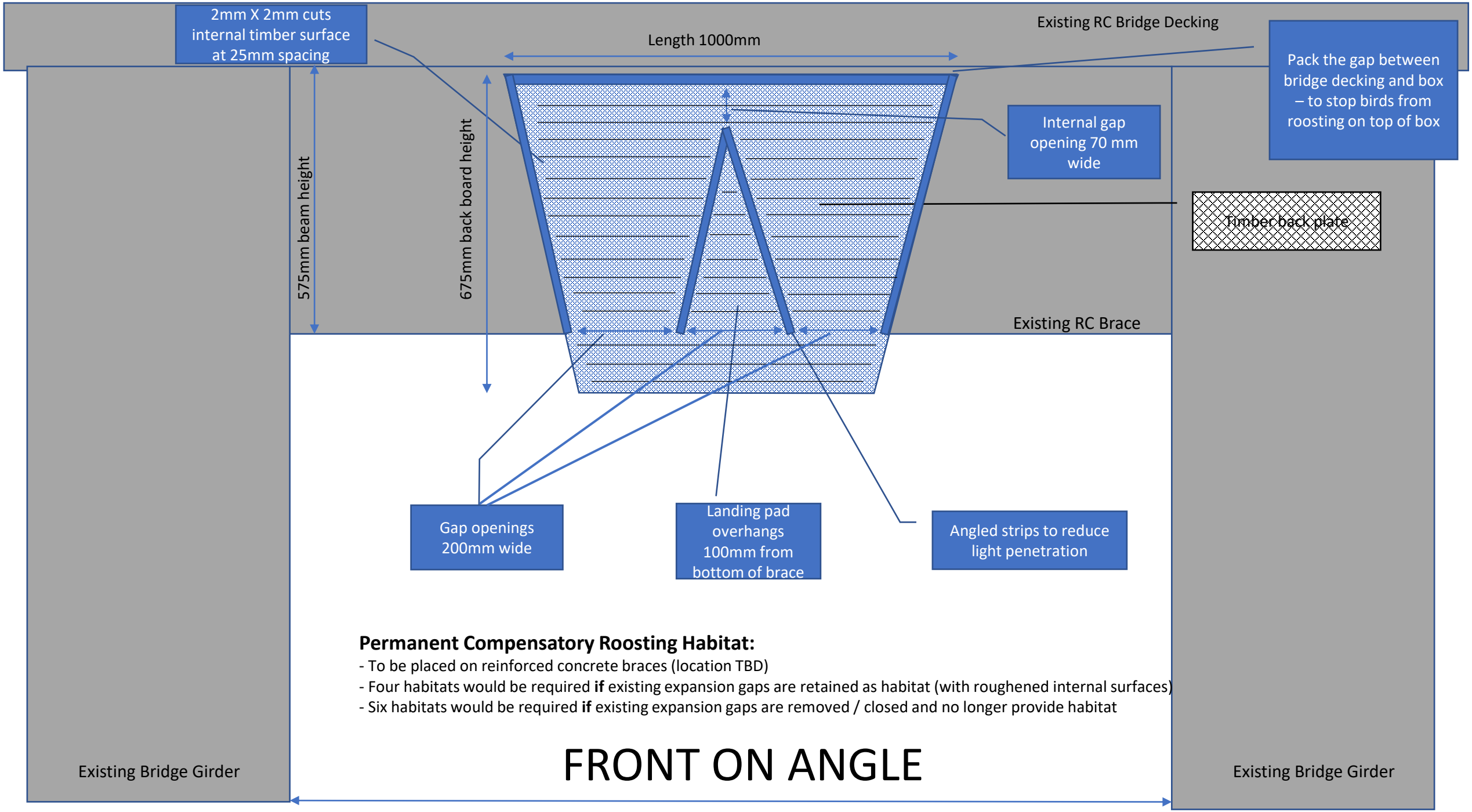
Appendix A

Preliminary permanent compensatory roosting habitat designs



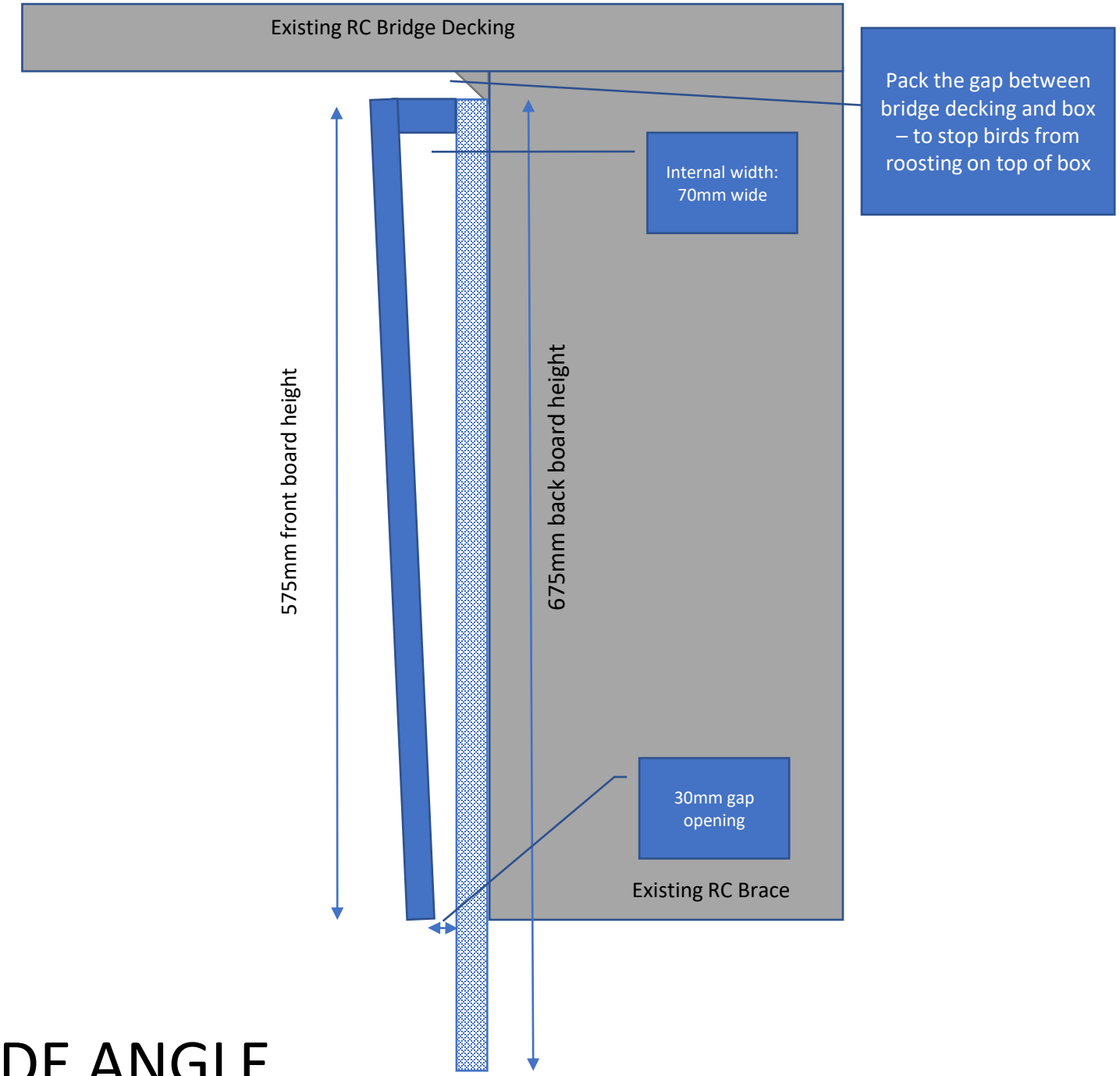
Permanent Compensatory Roosting Habitat:

- To be placed on reinforced concrete braces (location TBD)
- Four habitats would be required **if** existing expansion gaps are retained as habitat (with roughened internal surfaces)
- Six habitats would be required **if** existing expansion gaps are removed / closed and no longer provide habitat

FRONT ON ANGLE

Approx. 2100mm (1.9m)

Permanent Compensatory Roosting Habitat



SIDE ANGLE

Appendix B

Example checklists/field data sheets

Table B1 Exclusion Phase Microbat Inspection Register

Roost No.	Section of bridge	Habitat Type and Ref. No.	Species	No. of Adults	No. of Juveniles	Total Microbats	Other Evidence of Usage (if not occupied)	Comment

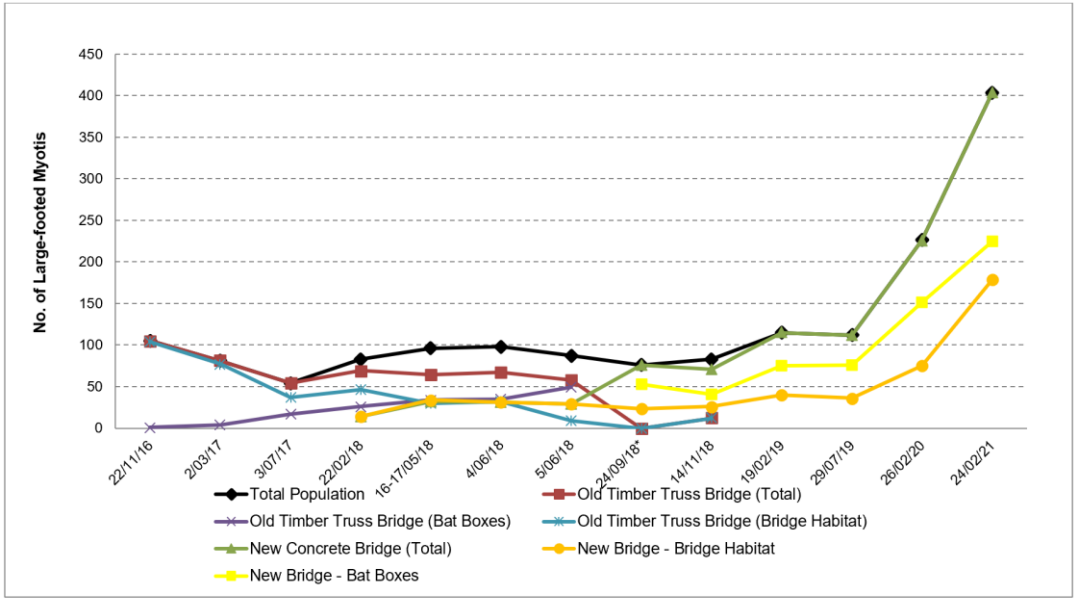
Table B2 Daily Exclusion Inspection Sheet

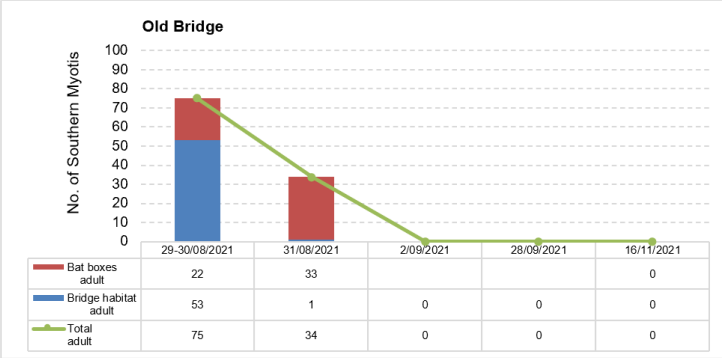
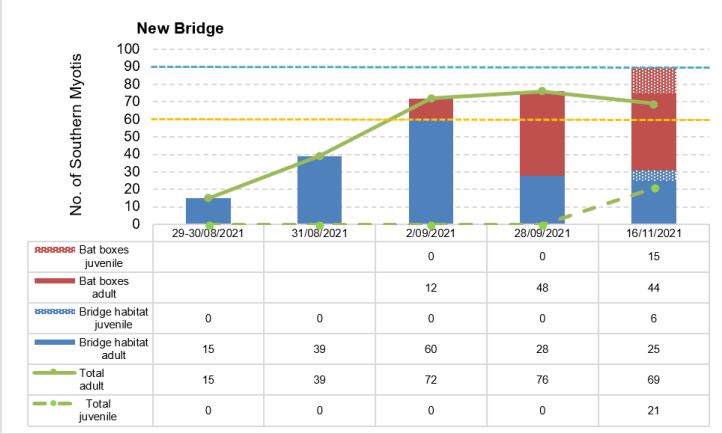
Date	Morning inspection time	Afternoon inspection time	Personnel inspecting	Result of inspection (No breach, breach)	Response (ecologist contacted, work suspended etc)

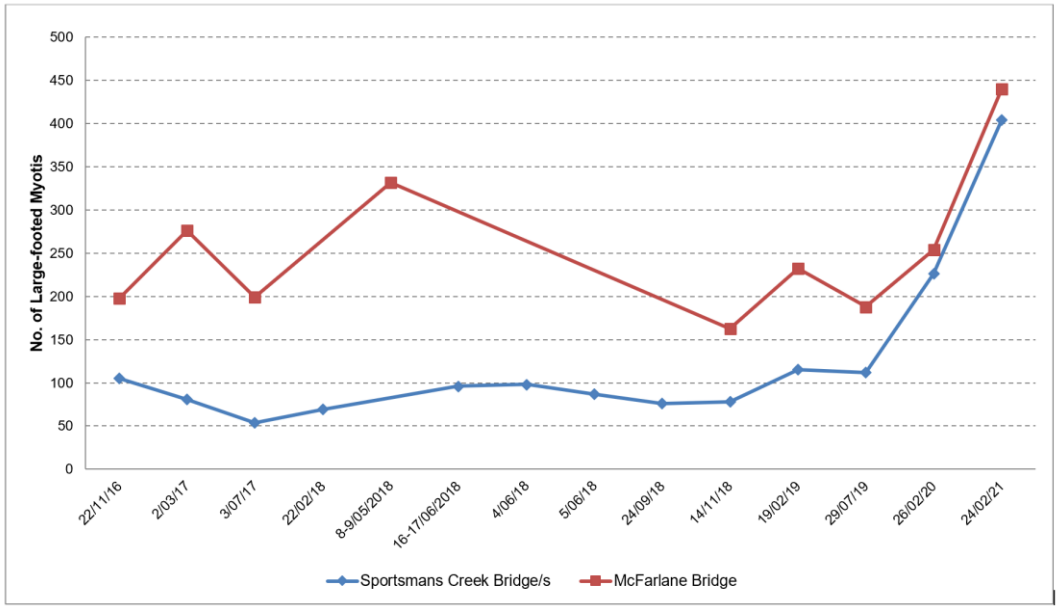
Appendix D

Example projects

Table D1 Example Projects Where Proposed Stage 2 MMP Provisions Have Been Implemented

Project	Proposal Description	Key Mitigation Measures	Outcome	Reference
Sportsmans Creek Bridge removal, Lawrence NSW	Replacement of a timber truss bridge with a new concrete bridge approximately 120m away. The timber bridge supported a locally significant Southern Myotis population.	■ Staged microbat exclusion outside of breeding season (completed 5/6/2018). ■ Permanent concrete habitat constructed on new bridge. ■ Microbat boxes used as temporary habitat during exclusion and transfer to new bridge.	■ Southern Myotis population maintained at new bridge during three years of post-exclusion monitoring. ■ Constructed permanent roost habitats occupied and used as breeding habitat.  **Figure 1 Large-footed Myotis Numbers at Sportsmans Creek Bridge/s** *Note: Population numbers displayed include both adults and young when present.* ** denotes transfer of timber bat boxes from the old timber truss bridge to the new concrete bridge on 24/09/2018.*	GeoLINK (2021a). Sportsmans Creek Bridge Microbat Post Exclusion Monitoring: Year 3 Summer-Autumn (2021).

Barrington Bridge replacement, Barrington NSW	Replacement of a timber truss bridge with a new concrete bridge approximately 10-30m away. The timber bridge supported a locally significant Southern Myotis population.	■ Staged microbat exclusion outside of breeding season (completed 30/08/2021). ■ Permanent habitat constructed on new bridge. ■ Microbat boxes used as temporary habitat during exclusion and transfer to new bridge.	■ Between >70% of population retained during exclusion (confirmed by visual surveys and radio tracking) ■ Southern Myotis population maintained at new bridge (*note: monitoring due to finish in July 2022*). ■ Constructed permanent roost habitats occupied and used as breeding habitat.  **Figure 1.1 Number of Southern Myotis in bat boxes and bridge habitat at the old bridge per monitoring event.**  **Figure 1.2 Number of Southern Myotis in bat boxes and bridge habitat at the new bridge per monitoring event.** *Note: Pre-exclusion total population shown on figure by a blue dashed line (both bridges); performance indicator shown on figure for new bridge by an orange dashed line.*	GeoLINK (2022). TfNSW Barrington Bridge Replacement – Bridge Removal Phase Microbat Surveys and Post Exclusion Monitoring Event 1, 2021.

Project	Proposal Description	Key Mitigation Measures	Outcome	Reference
McFarlane Bridge timber strengthening works, Maclean NSW	Replacement of degraded timber elements including bridge decking. The bridge supports a locally significant Southern Myotis population.	■ Staged microbat exclusion outside of breeding season. ■ Maintenance of habitat (bridge decking gaps retained). ■ Microbat boxes as additional habitat.	■ Long-term monitoring (2012-2021) shows the Southern Myotis population has been continued to occupy McFarlane Bridge with significant numbers.  **Figure 2 Large-footed Myotis Numbers at Sportsmans Creek and McFarlane Bridges** *Note: Population numbers displayed include both adults and young when present.*	Chart extract is from GeoLINK (2021a). Sportsmans Creek Bridge Microbat Post Exclusion Monitoring: Year 3 Summer-Autumn (2021). McFarlane Bridge was used as a control site as part of this project.