Roads & Maritime

Species impact statement

Sportsmans Creek Bridge removal, Lawrence

March 2016

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Contents

Illustrations

Plates

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DGR checklist

Matter	Yes/No	Comments
Has the SIS been signed by both its author and the applicant for consent approval?	Not yet	Will be signed by Roads and Maritime upon approval.
Has the description of the proposal included all associated activities and works, such as hazard reduction zones, access roads and road upgrades, utilities, etc?	Yes	Refer to Section 2.2.
Have all requested plans, maps and aerial photographs been provided? This includes any A1 or AO sized proper survey plans prepared by a registered surveyor that clearly show the location and boundaries of any proposed offsets.	Yes	Illustrations in A3.
Has the SIS determined the subject species by reviewing the suggested list in the DGRs, other available information and survey results and assessing which species, populations and ecological communities are to be impacted by the development?	Yes	Refer to Section 3.1.
Has the survey undertaken provided sufficient information to determine the likely impacts of the proposal on threatened species, populations and ecological communities?	Yes	Refer to Sections 3, 4 and Appendix C.
Have surveys been undertaken during the appropriate season(s) for the detection of the species that may possibly occur on site?	Yes	Microbat surveys were carried out during the breeding season between November and February (refer to Table 4.1).
Have surveys been undertaken during appropriate weather conditions?	Yes	Refer to Section 4.1.2.1.
Have climatic conditions preceding the surveys (eg, drought c/f. wet) affected the possibility of subject species being detected?	No	
Have all specific survey methods, techniques and intensities requested in the DGRs been followed completely?	Yes	Refer to Sections 4.1.1, 4.1.2 and Appendix E.
Has the documentation of survey effort, locations and techniques provided sufficient information to determine the above?	Yes	Refer to Sections 4.1.1, 4.1.2, 4.2 and Appendix E.
Has the assessment of impacts included the impacts of ALL activities associated with the development, including fire hazard reduction requirements, access road upgrades, downstream and downslope impacts, detention basins, severing of fauna movement corridors, etc.	Yes	Refer to Section 2.2 and Table 5.1.
Has the SIS discussed the extent, conservation significance and security of other occurrences of the subject species' in the locality (locality is defined in the	Yes	Refer to Section 5.2.

Matter	Yes/No	Comments
DGRs)?		
Has the SIS discussed the significance of the population/ remnant to be affected, relative to others within the locality?	Yes	Refer to Section 5.3.
Has the SIS discussed the extent, conservation significance and security of other occurrences of the subject species in the region (region is defined in the *Threatened Species Conservation Act 1995*).	Yes	Refer to Section 5.2.
Has the SIS discussed the significance of the population/ remnant to be affected, relative to others within the region?	Yes	Refer to Section 5.2.
Have alternatives to the proposal been discussed? Alternatives may include relocation of infrastructure or, for example, reducing minimum lot·size so that a similar number of lots may be realised whilst retaining a larger conservation lot within a subdivision, or changing mining techniques.	Yes	Refer to Section 5.5.
Has the discussion of alternatives included assessment of the social and economic (not merely financial) aspects of these alternatives (particularly, of not proceeding)?	Yes	Refer to Section 5.5.
Does the proposal use biodiversity offsets to compensate for loss or impact to threatened species, populations, ecological communities and their habitat? Have these offsets been determined in accordance with either (i) OEH's Principles for the use of biodiversity offsets in NSW, or (ii) a biodiversity assessment using BioBanking Assessment Methodology under Biodiversity Banking and Offsets Scheme, as outlined in the 'BioBanking Assessment Methodology 2014' (State of NSW and OEH 2014)?	No	In accordance with the *Guideline for Biodiversity Offsets* (Roads and Maritime 2011), biodiversity offsets are not considered necessary for the proposal, as no native vegetation that is habitat for threatened species would be removed or modified. Also, in accordance with Section 9 of the Biobanking Assessment Methodology (BBAM) Large-footed Myotis is a threatened species that <u>can</u> withstand a loss within the major catchment area and therefore the assessor is not required to determine an offset (State of NSW and OEH 2014). Extensive mitigation measures have been proposed to further minimise impacts to the species.
Has the discussion included an assessment of how the project meets the principles of Ecologically Sustainable Development (ESD), as defined in section 6(2) of the *Protection of the Environment Administration Act 1991*?	Yes	The precautionary principle, which is one of the principles of ESD is a critical component in assessing whether the proposal has a significant effect on the local

Matter	Yes/No	Comments
		Large-footed Myotis population. Furthermore, conservation of biological diversity and ecological integrity is a fundamental driver of the mitigation measures that are proposed.
Have all proposals for compensatory actions (eg purchase of similar vegetation/ habitat or revegetation of habitat, where appropriate) been discussed with the relevant landowners/manager?	Yes	The new bridge is to be managed by Clarence Valley Council (Council) who have been involved in meetings regarding the bridge design and microbat habitat features.
Is there documented agreement for sale or revegetation activities?	N/A	
Is there agreement to change zoning or enter into a covenant on title in order to secure the conservation of the properties being purchased or revegetated?	N/A	
If translocation is proposed, has the impact of the translocation on the recipient site(s) been assessed?	N/A	
Is there a 'Plan of Management' or similar titled document?	Yes	Refer to Microbat Management Plan in Appendix J.
Has the SIS utilised relevant information from published draft and final recovery plans? If no plan has been published, but it is known that one is being prepared, has the SIS utilised advice from the NPWS as to the likely contents of that recovery plan {liaison to obtain this advice may have been specified in the DGRs)? For example, would the proposal result in the loss of a local population or remnant that a recovery plan describes as being of particular importance to the conservation of the species, population or ecological community?	No	No draft or approved recovery plans have been prepared under the TSC Act for Large-footed Myotis.
If a BioBanking assessment has been done for the proposal have the following been provided: copies of BioBanking Credit reports, copies of field datasheets, copies of a checklist that includes all data used in the credit calculator and the underlying assumptions, such as how local vegetation communities were assigned to Biometric vegetation types I Plant Community Types?, and has the Credit Calculator files been submitted via the OEH portal?	N/A	
Has the SIS discussed the relationship of the proposal to any listed Key Threatening Processes (eg, does the proposal result in the need for High Frequency Fire as a fire hazard reduction measure, or does it result in the Clearing of Native Vegetation)?	Yes	Refer to Section 5.2.2.

Matter	Yes/No	Comments
Has the SIS discussed the relationship of the proposal to any published Threat Abatement Plan (eg, does the proposal result in an increased threat in a manner that is specifically at odds with a published plan)?	Yes	Refer to Section 5.2.4.
Has a revised Part 5A assessment of significance been included?	Yes	Refer to Section 7.1.
Has the ‘Additional Information’ specified in section 9 of the DGRs been provided?	Yes	Refer to Section 8.
Have the qualifications and experience of those involved in the surveys been included?	Yes	Refer to Section 8.1, Appendix K and Appendix L.
Have other approvals which are required for the development or activity been documented?	Yes	Refer to Section 8.2.
Any licensing requirements (eg s91 under TSC Act)	Yes	Refer to Section 8.3.

Declaration

SIS Principal Author	
Name	Veronica Silver
Position	Senior Ecologist/Planner/Associate
Organisation	GeoLINK
Signature	V. Silver
Date	21/03/2016

I, Steve Arnold, of Roads and Maritime Services located at Miller Street, North Sydney being the proponent for the Sportsmans Creek Bridge removal, Bridge Street, Lawrence, Clarence Valley Council 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	Steve Arnold
Position	General Manager, Project Development
Organisation	NSW Roads and Maritime Services
Signature	
Date	

Definitions

Term	Definition
Abundance	A quantification of the population of the species or community.
Affected species	Subject species likely to be affected by the proposal.
Conservation status	The degree of representation of a species or community in formal conservation reserves.
Director General	Director General of OEH.
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.
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.
Join/s	When referring to microbat habitat 1 and microbat habitat 4, is the gap between the flanges of the Super-T girders.
Likely	A real chance or possibility (DEC 2004).
Life cycle	The series or stages of reproduction, growth, development, ageing and death of an organism.
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.

Term	Definition
	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 10 kilometre radius of the subject site. The topographical position is within the lower Clarence valley floodplain.
Northern Rivers Region	The area that includes Tweed Heads in the north, south to Laurieton, and west to Walcha and the Queensland border north-east of Tenterfield.
Proposal	The development, activity or action proposed. In this case it involves removal of the existing bridge over Sportsmans Creek, located on the southern approach to the village of Lawrence and associated ancillary works to the approaches on Bridge Street and areas within Sportsmans Park and Flo Clark Park.
Region	For the purposes of the provision in which it is used, a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General under subsection (4) of the TSC Act) to be appropriate for those purposes. 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.
Sub-region	Sportsmans Creek Bridge is located within the Clarence Basin subregion which characteristically has low stepped hills and plains, with hillier areas in the west and south. Beach, dune and lagoon barrier systems and estuarine fills along the main streams. Vegetation generally comprises dry sclerophyll forests and woodlands of Spotted Gum, Grey Gum, Blackbutt, Red Bloodwood and White Mahogany in the hills. Dune sequence includes Paperbark, Snappy Gum, Blackbutt, Dwarf Red Bloodwood, Bastard Mahogany with Banksia, Bangalow Palm and areas of heath and Paperbark Swamp. Mangroves occur in estuaries (Morgan 2001).
Significant proportion	Sixty-five percent of the Large-footed Myotis present from the baseline data recorded throughout the year pre-exclusion.
Significant species	Species not listed in the TSC Act but considered to be of regional or local significance.
Study area	Is the subject site plus a 100 metre buffer which includes areas that may be affected by the proposal, either directly or indirectly.

Term	Definition
Subject site	The area which is subject to direct impacts inclusive of permanent and temporary works and includes the existing Sportsmans Creek Bridge and its approaches, Sportsmans Park and Flo Clark Park.
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
AHD	Australian Height Datum
BBAM	Biobanking Assessment Methodology
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DPI	Department of Primary Industries
EEC	Endangered Ecological Community
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
ESD	Ecologically Sustainable Development
LGA	Local Government Area
MMP	Microbat Management Plan
KBR	Kellogg Brown and Root
KTP	Key threatening process
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	Office of Environment and Heritage
PAS	Priority Action Statement
REF	Review of Environmental Factors
RMS	Roads and Maritime Services
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TSC Act	*Threatened Species Conservation Act 1995*
WIRES	Wildlife Information, Rescue and Education Service Inc

Executive summary

This Species Impact Statement (SIS) has been prepared by GeoLINK for Roads and Maritime Services for the proposed removal of Sportsmans Creek Bridge. Sportsmans Creek Bridge is located on the southern approach to the village of Lawrence within the Clarence Valley Council Local Government Area (LGA) in the NSW Northern Rivers region.

A Review of Environmental Factors (REF) for the proposed bridge removal prepared by Kellogg Brown and Root (KBR 2016) and a *Microbat impact assessment for the construction of a new Sportmans Creek Bridge and demolition of the existing Sportsmans Creek Bridge* prepared by GeoLINK in August 2014 (ref: 2311-1010) concluded there is potential for significant impact on the Large-footed Myotis (*Myotis macropus*) which is listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and that a SIS would be required. Roads and Maritime therefore requested Director-General's Requirements (DGRs) for a SIS. GeoLINK has been commissioned to prepare this SIS for the proposal in accordance with the DGRs (ref: DOC15/19486) issued by the NSW Office of Environment and Heritage (OEH) on 26 February 2015.

The potential occurrence and likely impact of each of the subject species in the DGRs and BioNet wildlife atlas search with 10 kilometres radius were assessed. The assessment has taken into account a review of previous records in the study area and locality and the results of surveys to address the DGRs for the proposal. The review of affected subject species concluded that one threatened fauna species being the Large-footed Myotis would be affected by the proposal and would require further assessment in the SIS. This species is listed as vulnerable under the TSC Act.

Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. Large breeding colonies are uncommon in the lower Clarence (with only two other known populations at McFarlane Bridge and Shark Creek Bridge of greater than 100 Large-footed Myotis) and are not in close proximity to the Sportsmans Creek Bridge (ie >10 kilometres along waterways which is how Large-footed Myotis would be expected to disperse). Surveys of drainage structures in the locality found that potential unoccupied alternative breeding roost drainage structures are uncommon and likely to have a lower roost carrying capacity to occupied sites. Most of the surveyed drainage structures within the locality support potential microbat roost features (eg rough concrete, culvert cell joins and lift holes), however offer low suitability as important roost features for threatened microbats due to their high flood susceptibility and presence of only exposed roost opportunities.

Key components of impact amelioration for the local Large-footed Myotis population include the provision of alternative (compensatory) microbat roosting habitat on the new concrete Super-T bridge and staged microbat exclusion outside the Large-footed Myotis breeding period prior to removal of the existing Sportsmans Creek Bridge.

Roads and Maritime have investigated known roosting habitat for the Large-footed Myotis in concrete structures and incorporated similar habitat features into the new Sportsmans Creek Bridge. The inclusion of a variety of roosting habitat design features and replication within the bridge has been adopted to maximise opportunities and the potential for Large-footed Myotis take-up of the new bridge.

Four microbat roosting habitat features are proposed to be incorporated into the new bridge:

- Three targeted microbat breeding habitat features:
  - Microbat habitat 1: Walkway Super-T join void.
  - Microbat habitat 2: Walkway void.
  - Microbat habitat 3: Pre-cast parapet.
- One opportunistic alternative microbat roosting habitat feature:

– Microbat habitat 4: Super-T girder joins.

Staged microbat exclusion of the existing timber truss Sportsmans Creek Bridge would be carried out prior to removal of the bridge. Exclusion must be carried out outside the breeding season for the Large-footed Myotis (October to mid-April inclusive). The exclusion would aim to have the existing timber truss bridge completely free of roosting microbats prior to the removal of the bridge.

Monitoring for one year (baseline) prior to exclusion from the existing timber truss Sportsmans Creek Bridge, during the exclusion period, and three years post exclusion is proposed. This includes monitoring at key seasonal times (winter, spring, summer/autumn) for the first 12 months post exclusion as well as one monitoring event during the breeding season (summer/autumn) for each of the following two years (ie year 2 and 3 post exclusion).

Further to this, should <65% of microbats (a significant proportion based on baseline data) be present in the new bridge, the ecologist is to investigate the need for contingency measures (giving consideration to natural fluctuations and surveys in other drainage structures within a 10 kilometre radius of the site).

Potential contingency measures include:

- Modifying the compensatory roosting habitat on the new bridge
- Installing additional compensatory roosting habitat on the new bridge
- Reviewing and modifying the exclusion method (eg reducing the rate and extent of bridge excluded during each exclusion stage)
- Extend monitoring.

It is expected that the local population to be impacted by removal of the existing timber truss bridge would occupy the compensatory roosting habitat provided within the new concrete bridge and avoid a significant impact. Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use, is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program. However, a level of uncertainty warrants application of the precautionary principle and it is therefore possible that the proposal may still have a significant effect on the local Large-footed Myotis population. If a significant impact was identified from the post exclusion monitoring results, Roads and Maritime would consult with OEH to implement appropriate contingency measures.

1 Introduction

1.1 Background

The Roads and Maritime Services propose to remove the existing timber truss Sportsmans Creek Bridge located on the southern approach to the village of Lawrence within the Clarence Valley Council Local Government Area (LGA) in the NSW Northern Rivers region.

A Review of Environmental Factors (REF) for the proposed bridge removal prepared by Kellogg Brown and Root (KBR 2016) and a *Microbat impact assessment for the construction of a new Sportmans Creek Bridge and demolition of the existing Sportsmans Creek Bridge* prepared by GeoLINK in August 2014 (ref: 2311-1010) concluded that a significant impact was likely on the Large-footed Myotis (*Myotis macropus*) which is listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and that a Species Impact Statement (SIS) would be required. Roads and Maritime requested Director-General's Requirements (DGRs) for a SIS. GeoLINK has been commissioned to prepare this SIS for the proposal in accordance with the DGRs (ref: DOC15/19486) issued by the NSW Office of Environment and Heritage (OEH) on 26 February 2015 (refer to Appendix A).

1.2 Compliance with DGRs

The specific requirements of the DGRs and the sections within which they are addressed in this SIS are outlined in Table 1.1.

Table 1.1 DGR compliance

DGRs Section	DGRs Heading	SIS Section	SIS Heading
1	Form of the species impact statement		Declaration
2	Contextual information	2	Contextual information
2.1	Description of proposal, subject site and study area	2.1-2.5	Existing environment Description of the proposal Subject site Study area Locality
2.2	Provision of relevant plans and maps		Illustration 2.1-Illustration 2.3
2.3	Land tenure information	2.4.8	Land tenure
3	Initial assessment	3	Initial assessment
3.1	Identifying subject species, populations and/or ecological communities	3.1	Identifying subject species, populations and/or ecological communities
4	Survey	4	Survey
4.1	Requirement to survey	4.1	Requirement to survey and Appendix E
4.2	Documentation of survey effort and technique	4.2	Survey effort
4.3	Survey results	4.3	Survey results
4.4	Subject species habitat mapping		Illustration 4.1
4.5	General report structure	N/A	N/A

DGRs Section	DGRs Heading	SIS Section	SIS Heading
5	Assessment of likely impacts on threatened species and populations	5	Assessment of likely impacts
5.1	Assessment of species likely to be affected	5.1	Assessment of species likely to be affected
5.2	Discussion of conservation status	5.2	Discussion of conservation status
5.3	Discussion of local and regional abundance	5.3	Discussion of local and regional abundance
5.4	Assessment of habitat	5.4	Assessment of habitat
5.5	Description of feasible alternatives	5.5	Description of feasible alternatives
6	Assessment of likely impacts on ecological communities (endangered and critically endangered)		Appendix E
7	Ameliorative measures	6	Ameliorative measures
7.1	Description of ameliorative measures	6.1-6.2, 6.6	Long term management strategies Compensatory strategies Monitoring
8	Assessment of significance of likely effect of proposed action	7	Assessment of significance
9	Additional information	8	Additional information
9.1	Qualifications and experience	8.1	Qualifications and experience
9.2	Other approvals required for the development or activity	8.2	Other approvals required
9.3	Licensing matters relating to the survey	8.3	Licences
9.4	Section 110 (5) reports		Appendix D

2 Contextual information

2.1 Existing environment

Sportsmans Creek Bridge is located on the southern approach to the village of Lawrence within the Clarence Valley Council Local Government Area (LGA) in the NSW Northern Rivers region. It is located within a modified environment with parkland on the southern bank surrounded by sugar cane further south (refer to Plate 2.1-Plate 2.4), residential dwellings on the northern bank and open grazing land further north-west.

The existing bridge is to be replaced under the Roads and Maritime Timber Truss Bridge Conservation Strategy (2012) which has been endorsed by the NSW Heritage Office. Replacement of this bridge relates to issues of asset management, poor sight distance, poor alignment and no pedestrian access. Additionally, the bridge presents significant transport limitations at the present and in the future due to its geometry and design limitations. The project involves the building of a new bridge and the removal of the existing Sportsmans Creek Bridge.

The new bridge is to be under the care, control and management of Council.

Plate 2.1 View north-west toward Sportsmans Creek Bridge from Sportsmans Park

Plate 2.2 View south from Sportsmans Creek Bridge over Sportsmans Park and sugar cane

Plate 2.3 View south over Sportsmans Park

Plate 2.4 View west over Flo Clark Park

2.2 Description of the proposal

The proposal involves removal of the existing timber truss bridge over Sportsmans Creek and associated works. Sportsmans Creek Bridge is located on the southern approach to the village of Lawrence within the Clarence Valley Council LGA, in the NSW Northern Rivers region.

The broader project also involves building a new 145 metre long concrete ‘Super-T’ bridge located about 100 metres west (upstream) of the existing bridge however this SIS specifically addresses potential impacts of the removal of the existing timber bridge and associated work.

All timber and steel elements of Sportsmans Creek Bridge including steel central piers would be removed. The original bridge design is shown in Appendix B. The northern (rubble stone) abutment would be retained (refer to Plate 2.5) and the southern (earth) approach and abutment would be removed (refer to Plate 2.6). The southern approach (Bridge Street/Ensbey Road) would be lowered to the level of the adjacent Flo Clark Park and Sportsmans Park would be restored and landscaped. A description of the proposal is shown pictorially in Illustration 2.1.

Plate 2.5 Northern abutment to remain insitu

Plate 2.6 Southern abutment to be removed

The proposal would be carried out as part of four key activities:

- Site establishment
- Bridge removal
- Road treatments
- Site disestablishment.

2.2.1 Site establishment

- Consult with Council and other agencies following completion of the new bridge and prior to start of the removal of the existing bridge.
- Establish environmental controls.
- Install site perimeter fencing.
- Obtain approval for and establish temporary traffic management arrangements.

- Establish a site compound in Flo Clark Park/Sportsmans Park.
- Clear vegetation within Flo Clark Park and Sportsmans Park as required, retaining riparian vegetation on the banks of Sportsmans Creek.
- Establish spoil and waste material stockpile sites and access tracks within the compound sites.

2.2.2 Road treatments

- Inform Council, and local residents of works.
- Obtain approvals from Council.
- Install construction signage.
- Implement traffic control.
- Install environmental controls including temporary or permanent fencing and erosion, sediment and drainage control measures.
- Recycle suitable excavated material and incorporate suitable material in earthworks.
- Truck any unsuitable materials off-site for disposal.
- Place new pavement material/construct cul de sac on Bridge Street.
- Compact the resultant surface using compaction equipment, avoiding vibratory machines to prevent any damage to the stone wall.
- Seal pavement using roadwork machinery and equipment.
- Progressively landscape and revegetate.
- Install fencing avoiding any damage to the stone wall.
- Repair private access driveways.
- Install line marking, signs and guide posts.

2.2.3 Bridge removal

Bridge removal would include the following initial activities:

- Inform Council and local residents of work.
- Obtain necessary approvals (eg permit to occupy crown land).
- Undertake staged microbat exclusion including inspections by a qualified ecologist to ensure that all microbats have been successfully excluded.
- Install signage
- Implement traffic control.
- Install sediment controls to prevent material entering the waterway and dispersal of material in waterway (such as floating boom/turbidity curtain).
- Establish temporary access tracks.
- Build temporary pads for crane support consisting of a geotextile layer over the existing ground with a rock layer to provide a suitable working platform. Crane pads to be located adjacent to the stone wall at the northern bridge abutment, on the northern abutment and adjacent to the southern bridge approach.

- Establish a 5 metre long pontoon on the southern bank of Sportsmans Creek to provide waterway access for barge transport to the bridge.
- Sequentially disassemble and remove Sportsmans Creek Bridge (refer to Table 2.1) stockpiling bridge components in the site compound area. The spans are numbered south to north.

Table 2.1 Bridge removal sequence

Order	Component	Removal Method
1	Span 3 (truss span)	• Removal of timber bridge handrails by hand and excavator. • Removal of decking planks using mini excavators and labourers. • Removal of deck beams and individual trusses by 250 tonne crane from northern bank onto barges.
2	Span 2 (approach span)	• Removal of timber bridge decking boards by hand and mini-excavator. • Removal of the entire span by 250 tonne crane from the northern bank onto barges.
3	Span 1 (approach span)	• Removal of timber bridge decking boards by hand and mini-excavator. • Removal of the entire span by 250 tonne crane from the northern bank onto barges.
4	Span 4 (truss span)	• Removal of timber bridge handrails by hand and excavator. • Removal of decking planks using mini excavators and labourers • Removal of deck beams and individual trusses by 250 tonne crane from southern bank onto barges.
5	Span 5 (approach span)	• Removal of timber bridge decking boards by hand and mini-excavator. • Removal of the entire span by 250 tonne crane from the southern approach.
6	Pier 3	• Establishment of floating boom/curtain around pier work area. • Removal of the piers using a saw from within the waterway with the assistance of divers. • Support of each pile and removal by 250 tonne crane.
7	Piers 1 and 2	• Establishment of floating boom/curtain around pier to be removed. • Support of piers using a 250 tonne crane and cutting using axes/saws above the water line. • Removal onto barges. • Excavation of concrete spreader footings below the normal water line.
8	Pier 4	• Establishment of floating boom/ curtain around pier work area. • Removal of the piers using a saw from within the waterway with the assistance of divers. • Support of each pile and removal by 250 tonne crane.

Order	Component	Removal Method
9	Pier sections below existing creek bed	• Using an excavator, establishment of coffer dam using mass concrete blocks and lined with a waterproof lining to form a retaining wall around each footing. • Removal of piers to 0.5 m to below the existing bed levels.
10	Southern abutment (Abutment B)	• Earthwork to remove and reshape the southern abutment.
11	Northern abutment (Abutment A)	• Removal of existing guard fence and barriers with a small excavator and installation of new fence system.

2.2.4 Site disestablishment

- Remove the southern approach and level Flo Clark Park/Sportsmans Park.
- Remove all waste in accordance with NSW guidelines.
- Demobilise equipment and machinery.
- Remove temporary access tracks.
- Remove site compound.
- Complete landscaping and revegetation of Flo Clark Park and Sportsmans Park.
- Reshape Ensbey Road at the southern approach to the bridge and restore pavement.
- Remove traffic controls and signage.
- Remove environmental controls.
- Erect a sign displaying the historical importance of the bridge at a location to be chosen.

2.2.5 Ancillary facilities

The site compound would be located in Flo Clark Park/Sportsmans Park (refer to Illustration 2.1). The compound sites would be used for the storage of machinery, site sheds (including site office and portable toilets), fuels and chemicals, waste storage, temporary stockpiles and laydown areas. All structures, storage and stockpiles in this area would need to ensure appropriate distances between the banks of the waterway and provisions implemented to secure the site and remove equipment and dispersible material in flood events. Parking would also be provided at the compound sites for the small number of workers on site.

All fuels and chemicals would be stored in a double bunded area. It is likely that temporary stockpiles of soil which may be required at the compound site would contain acid sulfate soils (ASS) following the earthwork required for the southern abutment removal and within the waterway bed. All stockpiles would be managed in accordance with Roads and Maritime *Stockpile Site Management Procedures* and the *QA Specification R44 – Earthwork*.

The compound site would be securely fenced and signage would be erected to indicate the presence of removal work. Signage would also be placed to inform the public that the boat ramp is closed for public access and to utilise the boat ramp at the Lawrence Memorial Park on the Clarence River as an alternative.

2.2.6 Timing

Removal of the Sportsmans Creek Bridge is proposed to start at least three months after completion of the new bridge. The new bridge is proposed to start building work in March 2016 and take about one year to complete. Microbat exclusion would be carried out between May and September (outside the Large-footed Myotis breeding season) before the start of bridge removal.

Drawn by: PJS Checked by: VJS Reviewed by: DSA Date: September 2015
Source of base data: SIX Maps

Information shown is for illustrative purposes only

Species Impact Statement: Sportsmans Creek Bridge Removal, Lawrence
2465-1012

The Proposal

Illustration 2.1

2.3 Subject site

The subject site is the area which would be directly affected by the proposal and includes the existing Sportsmans Creek Bridge and its approaches, Sportsmans Park and Flo Clark Park (refer to Illustration 2.2). The subject site occupies an area of 1.5 hectares.

Sportsmans Creek Bridge is located at the mouth of Sportsmans Creek; about 40 metres from its confluence with the Clarence River. It was built in 1885 and reconstructed in 1911. It is 91.7 metre in length, consisting of three timber beam approach spans and two timber Dare Truss spans. The bridge is a wide single lane structure with a carriageway of 5.5 metres. It is located 25 kilometres north of Grafton on Bridge Street which receives traffic flows from Richmond Street to the north and Ensbey Road to the south.

Geometry and design limitations of the existing bridge mean it is unable to be upgraded to cater for future haulage requirements of local surrounding agricultural industries, two-way traffic and pedestrian access.

On the southern side of Sportsmans Creek Bridge, the land use is open space, with Flo Clark Park to the west of the bridge abutment and Sportsmans Park to the east of the bridge abutment. Flo Clark Park provides boat ramp access into Sportsmans Creek and a grassed area for parking next to the waterway. Sportsmans Park has a picnic shelter and barbeque facilities.

On the northern side of Sportsmans Creek Bridge, the land use is mostly residential including urban areas of Lawrence including dwelling houses, Lawrence Tavern and Lawrence Public Hall. The area north-west of Sportsmans Creek Bridge comprises agricultural land used for primary production.

2.3.1 Ecological features

Vegetation within the subject site on the southern side of Sportsmans Creek has been cleared and consists of mown grass with stands of cultivated trees that have been planted to landscape these areas including Bottlebrush (*Callistemon* sp), Cadagi (*Corymbia torreliana*), Jacaranda (*Jacaranda mimosifolia*), African Tulip Tree (*Spathodea campanulata*) and Water Gum (*Tristaniopsis laurina*) (refer to Plate 2.7). The southern bank of Sportsmans Creek which adjoins the northern edge of the parks includes about a 10 metre wide area of Common Reed (*Phragmites australis*) and exotic Para Grass (*Urochloa mutica*) (refer to Plate 2.8).

One threatened flora species; Durobby (*Syzygium moorei*) is located in the south-western corner of Flo Clark Park. The tree has been planted and is of low conservation significance due to it occurring well outside its natural range. No other threatened flora species were recorded.

One vegetation community within the far eastern portion of Sportsmans Park on the edge of the Clarence River was considered to represent a low condition form of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC) (refer to Illustration 2.2).

Plate 2.7 View north-east towards Sportsmans Creek Bridge showing isolated trees within Flo Clark Park

Plate 2.8 Exotic Para Grass (*Urochloa mutica*) on the steep southern bank

2.4 Study area

2.4.1 Definition of the study area

The study area includes the subject site and any additional areas that would be affected by the proposal either directly or indirectly and therefore comprises the existing Sportsmans Creek Bridge and its approaches, Sportsmans Park and Flo Clark Park plus a 100 metre buffer which includes Sportsmans Creek and the Clarence River (refer to Illustration 2.2). The study area occupies an area of 12.4 hectares.

2.4.2 Description of SIS study area

The study area includes a highly modified section of floodplain which was historically cleared as part of urban and agricultural development. Urban areas of Lawrence are located to the north of

Sportsmans Creek and the area to the south is dominated by open space for recreation and sugar cane.

Sportsmans Creek is about 70 metres in width (within the study area) and drains in a south-east direction under the existing bridge towards the Clarence River. During low flow conditions, Sportsmans Creek may be influenced by the flow of water from the Clarence River, whereby the water from the Clarence flows upstream into Sportsmans Creek. Both the Clarence River and Sportsmans Creek at this location are tidal.

2.4.3 Vegetation communities

Vegetation within the study area includes managed parkland (refer to Section 2.4.1), riparian zones and cleared pasture land.

Riparian zones associated with the southern and northern banks of Sportsmans Creek have been cleared and are largely free of native vegetation. Vegetation within these areas is dominated by exotic grasses and weeds, particularly Para Grass (*Urochloa mutica*) which thrives with the exotic vine, Coastal Morning Glory (*Ipomoea cairica*) as a dense matt in the high-disturbance flood-zone adjacent to both sides of Sportsmans Creek.

On the northern side of Sportsmans Creek, a large area of cleared pasture land occurs on the western side of Grafton Street. It includes a range of grass species dominated by Kikuyu (*Pennisetum clandestinum*), Common Couch (*Cynodon dactylon*) and *Paspalum* spp.

2.4.4 Land use

Current land uses of the study area comprise public recreation, urban development, pasture, road reserve and agriculture; predominantly sugar cane.

Historically, the study area was important for transport of trade and timber along the river (MAXIM Archaeology & Heritage Pty Ltd 2003). The Lawrence Conservation Area is bounded by Grafton Street and Clarence River to the north of Sportsmans Creek. The southern bank of Sportsmans Creek is not included within Lawrence Conservation Area.

2.4.5 Topography

Topography of the study area is characterised by typically low elevation flood plain terrain associated with the Clarence River and Sportsmans Creek systems. The typical site elevation within the study area on the southern bank of Sportsmans Creek ranges between 3.0 metres to 5.0 metres Australian Height Datum (AHD). Elevations on the northern bank vary laterally and range from 1.0 metre to 5.0 metres AHD.

2.4.6 SEPPs

No areas mapped or defined as the following State Environmental Planning Policy (SEPPs) are located within the study area:

- SEPP 14 Coastal Wetlands.
  The closest SEPP 14 Coastal Wetlands are located 1 kilometre south-west and 1.1 kilometre north-east of Sportsmans Creek Bridge.
- SEPP 26 Littoral Rainforests.
  The closest SEPP 26 Littoral Rainforest is located 24.7 kilometres north-east.

- SEPP 44 Koala Habitat Protection.
  One juvenile Forest Red Gum (*Eucalyptus tereticornis*) occurs on the southern bank of Sportsmans Creek and is being smothered by Coastal Morning Glory (*Ipomoea cairica*). The site is not defined as potential or core Koala habitat.

The study area is located within the area mapped and defined as SEPP 71 Coastal Protection. The proposal however is not considered a significant coastal development (as defined under Part 3 clause 9 and Schedule 3 of SEPP 71), hence a referral and an additional development approval is not required.

2.4.7 Key ecological features

No threatened fauna species (apart from the already identified colony of Large-footed Myotis) were recorded in the study area. Based on a fauna habitat assessment of the study area it is considered unlikely that the study area represents a significant area of habitat. This includes species such as the Black-necked Stork and Brolga which have potential to utilise the ephemeral wetlands to the west of the study area for foraging, and other species such as the Eastern Osprey and Grey-headed Flying-fox which are expected to occasionally fly over the site or occupy it briefly.

No OEH mapped wildlife corridors or areas of nominated key habitats occur within the study area.

2.4.8 Land tenure

Details of land tenure within the study area are listed within Table 2.2.

Table 2.2 Land tenure

Lot/ DP	Clarence Valley Council LEP Zone	Description	Ownership
338/751386	RE 1 Public Recreation	Flo Clark Park	Clarence Valley Council
7005/92580	RU1 Primary Production	Sportsmans Park	Clarence Valley Council
-	W3 Working Waterways	Sportsmans Creek	Department of Primary Industries – Lands
-	W3 Working Waterways	Clarence River	Department of Primary Industries – Lands
102/1199150	R2 Low Density Residential	Crane pad	Private

2.5 Locality

The locality is the area within a 10 kilometre radius of the subject site (refer to Illustration 2.3) and comprises mostly cleared floodplain used for agriculture (sugar cane and grazing) and rural residential properties.

The Clarence River is the dominant feature on the alluvial floodplain within the locality in which the lower parts of the township of Lawrence are located. The broader Clarence River, its estuary and the coastal floodplain which Sportsmans Creek forms part of, is the largest coastal river system in NSW (Umwelt 2003). The Clarence River Floodplain is also significant as it supports a commercial estuary fishing industry. Sportsmans Creek Bridge is located about 3.3 kilometres downstream of the Sportsmans Creek Weir.

Sportsmans Creek represents a regional corridor for bird species moving between habitats associated with the upstream reaches of Sportsmans Creek and the Everlasting Swamps and habitats associated with the lower Clarence River.

Freshwater wetland areas are present 230 metres north-west of Sportsmans Creek Bridge. These wetland areas largely consist of constructed ephemeral drainage lines which drain excess water from farm paddocks to Sportsmans Creek. They occur on the periphery of the Little Broadwater system of wetlands, located to the west, outside of the study area within the locality. Everlasting Swamp occurs 500 metres west of Sportsmans Creek Bridge (refer to Illustration 2.3) which is an important wetland.

Information shown is for illustrative purposes only

Drawn by: PJS Checked by: VJS Reviewed by: DSA Date: October 2015
Source of base data: SIX Maps

GeoLINK

Species Impact Statement: Sportmans Creek Bridge Removal, Lawrence
2465-1009

Subject Site and Study Area

Illustration 2.2

Information shown is for illustrative purposes only

Drawn by: PJS Checked by: VJS Reviewed by: DSA Date: September 2015
Source of base data: SIX Maps

North

Species Impact Statement: Sportsmans Creek Bridge Removal, Lawrence
2465-1011

Site Locality

Illustration 2.3

3 Initial assessment

3.1 Identifying subject species, populations and/ or ecological communities

3.1.1 Assessment of available information

The process of determining subject species, populations and ecological communities, consideration was given to the habitat/vegetation types present within the study area, records within the locality, the known distribution of threatened species, and the known and predicted use of habitat for all potential species.

A comprehensive 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:

- A 10 kilometre radius search of the BioNet Atlas of NSW Wildlife (OEH) to identify threatened flora/ fauna species and EECs known to occur within the search area.
- Threatened Species Profile Database (OEH).
- Critical Habitat Register (OEH).
- Directory of Important Wetlands in NSW (DIWA) Spatial Database.
- Mapped bird routes of the Clarence Valley (Clarence Valley Birdos, 2006).
- Clarence Valley Estuary Management Plan (Umwelt, 2003).
- State Environmental Planning Policy (SEPP 14) Coastal Wetland and SEPP 26 – Littoral Rainforest mapping (Department of Planning and Environment).
- Terrestrial and Aquatic Flora and Fauna Assessment: Proposed Replacement of the Sportsmans Creek Bridge, Lawrence (D and D Consultants, 2002).
- Environmental Impact Statement for Demolition of Existing Bridge and Construction of New Bridge over Sportsmans Creek, Lawrence (Maclean Shire Council, 2002).
- Bat Survey and Impact Assessment: Sportsmans Creek Bridge, Lawrence NSW (Ecotone, 2007).
- Technical paper – A review of the Status of Breeding Osprey in 2006 (Ekert and Brady, 2007).
- Biodiversity Assessment: Sportsmans Creek New Bridge (GeoLINK, 2014a).
- Microbat Impact Assessment: Construction of a new Sportsmans Creek Bridge and Demolition of the existing Sportmans Creek Bridge (GeoLINK, 2014b).

To collect anecdotal information on biodiversity associated with the study area the following individuals/ agencies were contacted in 2014 during preparation of the biodiversity assessment (GeoLINK 2104a):

- Mr Martin Swain, Council ecologist.
- Mr Greg Clancy, local ecologist and avifauna researcher.

Mr Swain was again contacted in August 2015 for the purposes of gathering any recent data.

Consultation was carried out with Krister Waern (OEH Senior Operations Officer) on 3 August 2015 during an onsite meeting.

3.1.1.1 Literature review

D and D Consultants 2002

An ecological survey at Sportsmans Creek Bridge in 2002 recorded a colony of Large-footed Myotis numbering eight to 15 individuals in span 3. Anabat analysis conducted by D and D Consultants in 2002 also recorded 'probable' Large-eared Pied Bat (*Chalinolobus dwyeri*) and Eastern Bentwing-bat (*Miniopterus schreibersii*) recordings. D and D Consultants (2002) note however that no bat species recorded in the area, other than the Large-footed Myotis colony, appeared to use the bridge as a roost. Large-eared Pied Bat and Eastern Bentwing-bat Anabat recordings were therefore assessed to be of foraging individuals.

Ecotone 2007

A microbat survey at Sportsmans Creek Bridge in 2007 by Ecotone recorded a colony of >30 Large-footed Myotis in span 2. The survey found the bridge to support a number of potential microbat roost sites across the bridge. Large-footed Myotis and Little Bentwing-bat (*Miniopterus australis*) were also recorded foraging below the bridge (Ecotone 2007).

GeoLINK Biodiversity Assessment 2014a

Flora and fauna habitat assessments were conducted within the study area for the new bridge (which encompasses the study area for the SIS) on 8 July 2014 as part of the biodiversity assessment prepared by GeoLINK. Targeted searches were carried out in areas of preferred habitat for threatened flora and fauna species and threatened ecological communities identified in desktop database searches as having potential to occur in the study area.

Results of field assessments found that the study area represents a highly modified agricultural landscape, previously cleared of indigenous vegetation. Pasture grasses dominate and remnant vegetation is degraded and generally exhibits low diversity with significant weed cover. Trees are few, generally isolated and mostly exotic. Vegetation generally lacked connectivity apart from pasture grasses and the dense mat of understorey vegetation adjacent to both sides of Sportsmans Creek.

Observations within the study area of fauna habitat features and resources are noted as follows, particularly in relation to the habitat requirements of threatened species recorded in the locality:

- Low species diversity of mostly exotic grasses and weeds dominate the vegetation cover. Three species of birds, ie Red-browed Finch (*Neochima temporalis*), Superb Fairy Wren (*Malurus cyaneus*) and Little Grassbird (*Megalurus gramineus*), were observed in the dense matt of Para Grass (*Urochloa mutica*) and Coastal Morning Glory (*Ipomoea cairica*) adjacent to Sportsmans Creek. The dense vegetation cover may also provide cover and breeding opportunities for ground dwelling birds and mammals. The lack of camouflage and tall, dense vegetation such as bulrushes and spikerushes is considered to make it unsuitable for the Australian Bittern (*Botaurus poiciloptilus*). No threatened ground dwelling birds and mammals have been recorded in the locality.
- Vegetation structure lacks complexity with regrowth of mostly low-growing, groundcover species dominating following past clearing of indigenous vegetation. This has created a general open landscape which lacks vegetation stratification and cover required by many fauna species.
- The native Common Reed (*Phragmites australis*) emerges in small, isolated patches from the dense mat of understorey vegetation on the southern creek bank. It offers only limited bird habitat value since dense stands are generally required as shelter for bird species.
- A single Brush Mistletoe (*Amylotheca dictyophleba*) was observed growing on a Camphor Laurel (*Cinnamomum camphora*). Mistletoes offer habitat for species such as mistletoe birds, honeyeaters, possums and invertebrates.

- Exotic pasture grasses cover parts of the site, particularly at the northern extent. Pasture grasses support commonly occurring herbivorous mammals such as macropods. No threatened macropod species have been recorded in the locality.
- Few trees are present to provide perching and roosting opportunities for birds. Most trees in the study area are exotic species occurring as isolated trees.
- Fruit from Camphor Laurel (*Cinnamomum camphora*) may support native birds such as fruit pigeons. No threatened bird species recorded in the locality are likely to rely on the fruit of this species.
- No tree stags or fallen logs were observed.
- Due to a lack of over-storey vegetation, leaf litter is generally sparse offering very little habitat for leaf litter dependant frogs and ground dwelling birds.
- No fauna scats were detected.
- No fauna tracks, diggings or burrows were detected.
- There were no obvious signs of fauna feeding.
- No scratch or claw marks were observed on smooth-barked trees.
- Vegetation connectivity exists in the dense matt vegetation adjacent to Sportsmans Creek which extends to the east and west. Otherwise, existing vegetation is generally fragmented.
- No significant surface rock, rock outcrops or ledges were observed to offer habitat for reptiles and ground-dwelling mammals. A small built rock wall on the southern side of the residential house block may support commonly occurring lizard species.
- Sportsmans Creek provides watering opportunities and aquatic habitat for a range of fauna. The creek and riparian area represents the zone with the greatest fauna habitat and habitat diversity.

Large-footed Myotis was the only threatened fauna species recorded in the study area during field surveys. Based on a fauna habitat assessment of the study area it is considered unlikely that the study area represents a significant area of habitat for any of the threatened fauna species that have been recorded in the locality. This includes species such as the Black-necked Stork and Brolga which have potential to utilise the ephemeral wetlands to the west of the study area for foraging, and other species such as the Eastern Osprey and Grey-headed Flying-fox which are expected to occasionally fly over the study area or occupy it briefly.

GeoLINK Microbat Impact Assessment 2014b

The Microbat Impact Assessment prepared by GeoLINK in 2014 found that Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. The results of the Sportsmans Creek Bridge microbat surveys are provided in Appendix C. About 300 Large-footed Myotis were recorded roosting at Sportsmans Creek Bridge during both the December 2013 and February 2014 surveys (numbering 308 and 301 respectively). No other microbat species were recorded.

GeoLINK 2015

An evaluation of the likelihood of occurrence and extent of impact to threatened flora, fauna, populations and ecological communities recorded within a 10 kilometre radius of the subject site from a search of the Office of Environment and Heritage (OEH) BioNet Wildlife Atlas (OEH 2015) and/or identified from the *Director General's Requirements for a Species Impact Statement: Demolition of the Existing Sportsmans Bridge, Lawrence, NSW* (ref DOC15/19486) is provided in Table D.1 and Table D.2 of Appendix D.

4 Survey

4.1 Requirement to survey

The biodiversity assessment for the proposed timber truss bridge removal prepared by GeoLINK (refer to Appendix E) provides a comprehensive assessment of subject species appropriate for habitat features within the site. Results of surveys conducted as part of the biodiversity assessment prepared by GeoLINK (2014a) for building of the new concrete bridge have also been summarised in Section 3.1.1.1 of this SIS.

The assessment of subject species, populations and ecological communities determined that Large-footed Myotis is the only threatened species likely to be significantly impacted by the proposal (refer to Appendix D and Appendix E). Large-footed Myotis is therefore the only subject species for this SIS.

Field surveys included targeted microbat surveys at Sportsmans Creek Bridge and surveys for other Large-footed Myotis breeding colonies within a 10 kilometre radius of the site. The surveys were carried out between December 2013 and February 2014.

4.1.1 Sportsmans Creek Bridge surveys

Direct inspections of the bridge for roosting microbats were carried out on 16 December 2013 and 3 February 2014. This involved torch and pole mounted camera inspection of the entire bridge for roosting microbats from a boat with scaffolding at spans/ piers over water; and a ladder at spans/piers over land. The two inspection periods were proposed to coincide with the two Large-footed Myotis breeding events in the north coast of NSW (October to mid-April inclusive). The following information was recorded:

- Potential microbat roosting features.
- Species present
- Location and size of any microbat colonies.
- Description of occupied roost sites.
- Breeding status of microbats recorded.

4.1.2 Surveys for other Large-footed Myotis breeding colonies

Surveys for other Large-footed Myotis breeding colonies within a 10 kilometre radius of Sportsmans Creek Bridge involved direct inspection (torch searches) of other accessible road drainage structures (bridges and culverts >500 millimetres diameter) on public land. The drainage structures were identified via GIS analysis (topographic maps and aerial photographs), targeting drainage structures adjacent to open water. The surveys were carried out on 3 and 4 February 2014, with the following information recorded at each site:

- Potential microbat roosting features.
- Species present
- Location and size of any microbat colonies.
- Description of occupied roost sites.
- Breeding status of microbats recorded.

While the Large-footed Myotis may also occupy tree hollows as breeding roost sites (Campbell, 2009), no hollow-bearing trees occur within the study area. Hollow-bearing trees are uncommon across the majority of the locality (particularly in proximity to waterways on the Clarence River floodplain). Such hollow-bearing trees were not surveyed because they are unlikely to support large populations (eg >30 bats).

4.1.2.1 Survey conditions

Weather conditions during the surveys were dry, warm and humid. No significant rainfall events (>50 millimetres in a single event) had been experienced since late November 2013, Bureau of Meteorology website: http://www.bom.gov.au/.

4.1.2.2 Survey limitations

The main limitation of this assessment is associated with microbat species behaviour/ecology. Microbat roosts are important for providing shelter, protection from predators and an appropriate microclimate for energy conservation and reproduction. To satisfy different seasonal and lifecycle requirements and to respond to ecological interactions with other species (eg parasites), microbats often make use of multiple roosting sites, shifting between roosts regularly (Evans, 2009), though this varies per species and is dependent on lifecycle periods. To counter these limitations, this assessment has used both desktop assessment and two seasonal surveys of Sportsmans Creek Bridge to maximise the validity of that information gathered for which the impact assessment is based.

4.2 Survey effort

A summary of survey effort carried out at Sportsmans Creek Bridge and the study area is provided within Table 4.1.

Table 4.1 Survey effort

Company	Target species	Date undertaken	Effort	Techniques utilised	Location	Surveyors
D and D Consultants	All flora and fauna	3 November 2002	Unknown	Anabat	Unknown	Unknown
Ecotone Ecological Consultants	Microbats	28-29 November 2007	Unknown	Anabat	Unknown	Unknown
GeoLINK	Microbats	16 December 2013	8 person hours	Targeted searches including subject species using torch and pole mounted camera inspection of the entire bridge from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land.	Sportsmans Creek Bridge	DSA, DGH
	Microbats	3 February 2014	16 person hours	Targeted searches including subject species using torch and pole mounted camera inspection of the entire bridge from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land.	Sportsmans Creek Bridge and drainage structures (bridges and culverts > 500 mm diameter) on public land within 10 km radius of Sportsmans Creek Bridge.	DSA, DGH
	Microbats	4 February 2014	8 person hours	Targeted searches including subject species using torch.	Sportsmans Creek Bridge and drainage structures (bridges and culverts > 500 mm diameter) on public land within 10 km radius of Sportsmans Creek	DSA, DGH

Company	Target species	Date undertaken	Effort	Techniques utilised	Location	Surveyors
					Bridge.	
	Fauna	8 July 2014	7 person hours	Habitat assessment (random meander).	Study area for new bridge and bridge removal.	DGH
	Flora	8 July 2014	3 person hours	Random meander including target threatened species searches.	Study area for new bridge and bridge removal.	DGH
	Birds	3 August 2015	2 person hours	Dawn/dusk spot count	North and south abutment of Sportsmans Creek Bridge.	VJS, DSA
	Birds	26 August 2015	2 person hours	Dawn/dusk spot count	North and south abutment of Sportsmans Creek Bridge.	DSA

4.2.1 Justification of reduced survey effort

The biodiversity assessment conducted by GeoLINK (2014a) focused on habitat assessment which is a conservative method that was considered adequate for the modified nature of the site. Bird surveys were conducted in August 2015 to specifically address the DGRs as many subject species were birds.

The survey methodology used and survey effort undertaken is believed to be adequate for the study area and the subject species likely to occur. The subject site is mostly maintained in a managed state with mown grass and is frequented by members of the public. The management regime has created an open landscape which lacks vegetation stratification and cover required by many fauna species.

It is acknowledged that the reports prepared by D and D Consultant in 2002 and Ecotone in 2007 are greater than five years old and therefore do not meet the requirements of the DGRs however they provide valuable information and therefore have been included for reference.

4.3 Survey results

4.3.1 Sportsmans Creek Bridge surveys

4.3.1.1 Potential microbat roosting habitat

Potential microbat roosting habitat occurs throughout Sportsmans Creek Bridge (refer to Plate 4.1) and includes:

- Split (two piece) stringers (refer to Plate 4.2). These features are common across the bridge.
- Decking gaps (ie below longitudinal decking, between transverse decking and most above or directly adjacent to the middle three stringers) (refer to Plate 4.3). These features are common across the bridge.
- Rotted timber features (primarily girder) (refer to Plate 4.4). Uncommon feature and generally in exposed locations or not well formed.

Bird nests (Welcome Swallow *Hirundo neoxena* and Fairy Martin *H. ariel*) and mud dauber wasp nest would also be expected to occur at least periodically and provide mostly non-breeding roosting opportunities.

No hollow-bearing trees, caves or mines occur within the study area. While local buildings may provide roosting opportunities for some microbat species, inspection of the dwelling proposed for removal as part of the new bridge construction failed to record any microbats. The potential for the dwelling affected by the proposal to provide significant threatened microbat roosting habitat is low.

Plate 4.1 View north showing underside of Sportsmans Creek Bridge

Plate 4.2 Two piece (split) stringer

Plate 4.3 Large-footed Myotis in bridge decking

Plate 4.4 Cavity at the end of a rotted girder

4.3.1.2 Potential microbat foraging habitat

The study area comprises a mostly cleared floodplain landscape. It offers potential aerial foraging habitat for microbat species capable of foraging in modified or non-forested coastal landscapes. Aquatic foraging habitat for the Large-footed Myotis is present locally, including Sportsmans Creek and the Clarence River. Aerial and aquatic microbat foraging habitat of similar value occurs throughout the locality.

4.3.1.3 Microbats at Sportsmans Creek Bridge

About 300 Large-footed Myotis (adults and juveniles) were recorded roosting at Sportsmans Creek Bridge during both the December 2013 and February 2014 surveys (numbering 308 and 301 respectively). No other microbat species were recorded. Twenty-one roost sites within the bridge were recorded (19 in December 2013 and nine in February 2014); all located above the water in spans 2 and 3. Occupied roosting habitat features included:

- Split (two piece) stringers: Six in total.
- Decking gaps: Twenty in total.

Occupied cavities ranged between 11 and 108 millimetres wide, with an average of about 39 millimetres. Other sections of the bridge supported similar structures, providing potential bat roosting habitat however were not occupied at the time of the survey. This included some areas showing signs of previous usage (stained/'polished' timber).

The Large-footed Myotis population comprised adults and young indicating a breeding population. Population fluctuations would be expected throughout the year with a peak in late February/March following the completion of the second seasonal birthing period (the number of new born bats during the second survey were low suggesting the second seasonal birthing period was not complete).

4.3.1.4 Surveys for other Large-footed Myotis breeding colonies within locality

The results of the surveys for other Large-footed Myotis breeding colonies within a 10 kilometre radius of the site are provided in Appendix C. Site visits were carried out at 66 drainage structures (five bridges and 61 culverts – refer to Illustration 4.1), of which 55 were able to be inspected for the presence of microbats. The remaining 11 drainage structures (all culverts) were unable to be inspected due to access constraints (eg inlet on private property; outlets with floodgates, etc). Most of these however were located in floodplain environments and at risk of complete inundation, reducing their potential to support Large-footed Myotis breeding colonies.

Microbats or evidence of microbats was recorded in ten drainage structures (three bridges and seven culverts). Three microbat species were recorded:

- Large-footed Myotis: Recorded at three drainage structures, with one non-breeding colony (Poverty Creek Bridge) and two breeding colonies recorded (pipe culvert – Pringles Way and Shark Creek Bridge – Pacific Highway). Evidence of microbat activity was also recorded at Coldstream Bridge (Pacific Highway) which is reported to also support a Large-footed Myotis colony.
- Chocolate Wattled Bat (*Chalinolbus gouldii*): Two non-breeding colonies were recorded at two culverts, numbering three and nine bats.
- Little Bentwing-bat: An individual was recorded at one drainage structure (pipe culvert).

Five microbats (likely to comprise a non-breeding colony) were also recorded at another pipe culvert, though were unable to be identified due to the depth of water in the channel inhibiting access. Small guano accumulations were present at another two culverts evidencing usage by a small number of microbats or irregular usage.

Most of the inspected drainage structures support potential microbat roost features (eg rough concrete, culvert cell joins and lift holes), however offered low suitability as important roost features for threatened microbats due to their high flood susceptibility and presence of only exposed roost opportunities etc.

4.3.1.5 Other local Large-footed Myotis breeding colonies

Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. Large breeding colonies are uncommon in the lower Clarence (with only two other known populations at McFarlane Bridge and Shark Creek Bridge of greater than 100 Large-footed Myotis) and are not in close proximity to the Sportsmans Creek Bridge (ie >10 kilometres along waterways which is how Large-footed Myotis would be expected to disperse).

Three additional Large-footed Myotis breeding colonies have been recorded or are known to occur within a 10 kilometre radius of Sportsmans Creek Bridge (refer to Table 4.2 and Illustration 4.1). Only three of the other drainage structures inspected (all culverts) were considered to provide potentially suitable Large-footed Myotis breeding habitat (refer to Appendix C), though were not occupied by this species during the survey and offer potential habitat only for small colonies (<30 bats). Three other known Large-footed Myotis breeding colonies in the lower Clarence River area are listed in Table 4.3.

Table 4.2 Known Large-footed Myotis populations within 10 km of Sportsmans Creek Bridge

Structure name	Structure type	Population size	Direct distance (km)	Along waterways (km)
Coldstream Bridge (Pacific Highway)	Concrete bridge	Unknown	7.4	13.8
Shark Creek Bridge (Pacific Highway)	Concrete plank bridge	300	8.8	16.8
Pipe culvert – Pringles Way (4 x 1,800 mm diameter pipes	Reinforced concrete pipe culvert	>20	4.1	6.1

Table 4.3 Other Large-footed Myotis populations in the Lower Clarence > 10 km from Sportsmans Creek Bridge

Structure name	Structure type	Population size	Direct distance (km)	Along waterways (km)	Details
McFarlane Bridge (Lawrence Road)	Timber bridge	Varies between 200 and >600	10.3	11.4	McFarlane Bridge Large-footed Myotis population was known to vary between >100 (most likely around 200) and peaking at well over 500 individuals (recorded on 26 March 2013). At the time of the population peak, the configuration of bats comprised 17 groups within span 10 and span 11, and about 30 bats within a bat box in span 9. The population fluctuations are likely to correspond with the inclusion of young in the population estimates during the breeding season, with large numbers of young dispersing at the end of the breeding season, resulting in overall lower bat numbers.
Mororo Bridge (Pacific Highway)	Concrete bridge	About 30	21.1	>23	Four bat boxes were installed under the south bound Mororo Bridge prior to bridge work on the neighbouring steel girder north bound Mororo Bridge, which had a history of usage by Large-footed Myotis. Surveys completed in November 2014 estimated 153 individuals including newborns inside the bat boxes. An estimation of 255 individuals was also recorded during the February 2015 surveys at the same location.
Oyster Creek Channel (Yamba Road)	Unknown	Unknown	22.2	>33	Four Large-footed Myotis were 'observed' in April 2003, and this site has been confirmed by Mr Paul Burcher (pers. comm. to A.Lloyd) as a Large-footed Myotis roost site.

A review of *M. macropus* records from the OEH Wildlife Atlas shows that six records of this species have been lodged within 10 kilometres of Sportsmans Creek Bridge. These records are roughly located within Woodford Island Nature Reserve, Gurranang State Conservation Area, Patemans Road and the subject site.

Large-footed Myotis was also detected at Harwood Bridge 16 kilometres north-east of Sportsmans Creek Bridge, via ultrasonic call detection in 2007 and an ‘observed’ record also exists from 2002, however Harwood Bridge is predominantly of steel construction and unlikely to be able to support roosting microbats of any species.

Additional Large-footed Myotis colonies have been observed by the authors however OEH’s Wildlife Atlas does not yet reflect these records. For example, four clusters of Large-footed Myotis have been recorded within a concrete plank bridge over Serpentine Creek, 17 kilometres north-east of Sportsmans Creek Bridge between November 2013 and February 2014. Surveys in February 2015 recorded ten Large-footed Myotis roosting in four different clusters in the gaps between the concrete planking.

There are no known cave or other subterranean (eg disused mines or tunnel) roosting opportunities within the locality for the Large-footed Myotis and the other threatened microbat species. Hollow-bearing trees are scattered throughout the locality as the local landscape is largely cleared. While Large-footed Myotis hollow-bearing tree breeding roosts may occur within the locality, they are unlikely to support large populations (eg >30 bats).

4.3.2 General species survey results

Despite the study area previously having been adequately surveyed for the purposes of building of a new bridge and removal of the existing bridge, additional flora and fauna surveys were carried out as part of the SIS process. This was done to boost the survey effort carried out within the specific subject site and to address the DGRs specific to this proposal.

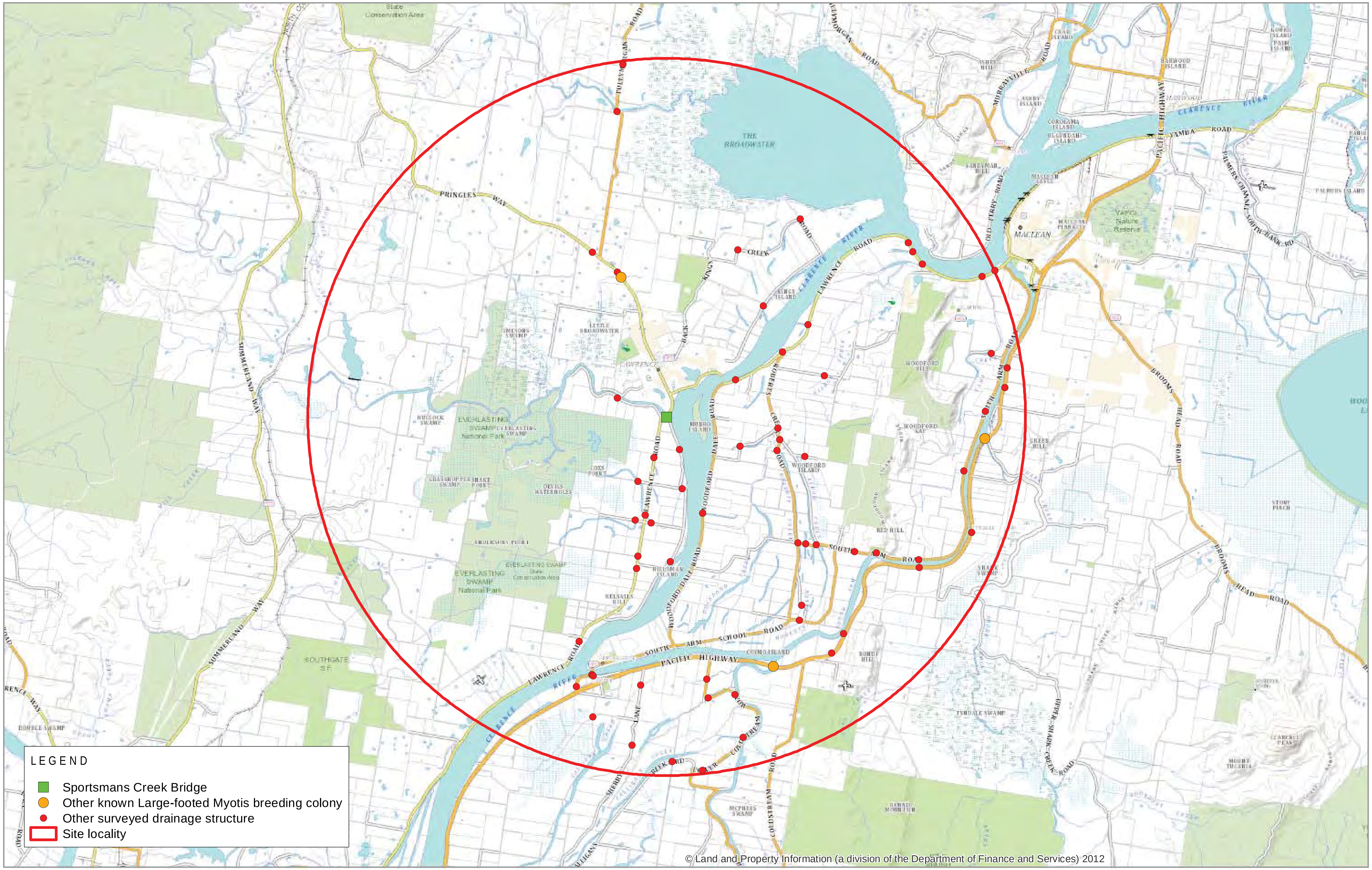
A list of birds observed during afternoon/ dusk surveys carried out on 3 and 26 August 2015 are provided within Appendix G. No threatened avifauna species were recorded or are considered likely to be significantly affected by the proposal (refer to Appendix D).

A description of vegetation communities and habitat types available within the study area has been provided within Section 2. One native vegetation community occurs in the study area within the far eastern portion of Sportsmans Park on the edge of the Clarence River, representing a poor condition form of the TSC Act EEC: *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (refer to Illustration 2.2). This community would not be directly or significantly indirectly affected by the proposal.

A list of flora recorded within the study area is provided within Appendix H. No endemic threatened flora species were recorded or are considered likely to be significantly affected by the proposal (refer to Appendix D).

Information shown is for illustrative purposes only

Drawn by: PJS Checked by: VJS Reviewed by: DSA Date: September 2015
Source of base data: SIX Maps



Surveyed Drainage Structures and Known Large-footed Myotis Breeding Colonies

Species Impact Statement: Sportsmans Creek Bridge Removal, Lawrence
2465-1008

Illustration 4.1

5 Assessment of likely impacts

5.1 Assessment of species likely to be affected

Results of the OEH BioNet Atlas of NSW Wildlife indicated records of 39 threatened fauna species and nine threatened flora species within the 10 kilometre radius search area centred on Sportsmans Creek Bridge. As previously noted, one threatened flora species; Durobby has been planted in the south-western corner of Flo Clark Park. This tree is well outside its natural range and habitat and is of low conservation significance. One vegetation community within the far eastern portion of Sportsmans Park on the edge of the Clarence River was considered to represent a low condition form of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC). With the exception of Large-footed Myotis, no other threatened species were detected during targeted surveys nor are they likely to be significantly impacted upon by the proposal.

The potential occurrence and likely impact of each of the subject species in the DGRs and BioNet wildlife atlas has taken into account a review of previous records in the study area and locality and the results of surveys to address the DGRs for the proposal. The assessment of subject species, populations and ecological communities undertaken within Section 3 and Appendix D, surveys carried out and analysis of likely impacts has determined that Large-footed Myotis is the only threatened species likely to be impacted by the proposal.

Potential impacts of the proposal on Large-footed Myotis are listed in Table 5.1. They are divided into ‘direct impacts’ (those that directly affect habitat and individuals) and ‘indirect impacts’ (occur when project-related activities affect habitat and individuals in a manner other than direct loss). Key potential impacts include habitat removal and disruption to the breeding cycles which are likely to have a significant impact on the subject Large-footed Myotis population and potential mortality/injury during bridge removal should no mitigation measures be taken. Safeguards and management measures to alleviate the identified potential impacts are detailed in the Microbat Management Plan (MMP – refer to Appendix J) and outlined in Table 5.1. The plan aims to:

- Provide advice for construction personnel on how to manage microbat conflicts during construction.
- Reduce potential for microbat injury or mortality.
- Avoid disturbances to breeding microbats.
- Provide exclusion techniques to gradually encourage microbats onto the new bridge habitat.
- Provide ongoing management techniques and monitoring of the microbat colony.

Table 5.1 Potential impacts of the proposal on Large-footed Myotis

Potential impact (risk)	Significance of impact	Safeguards and management measures*
Direct impacts		
Habitat removal (definite): The proposal would result in the removal of the existing timber Sportsmans Creek Bridge and replacement with a new concrete bridge about 100 m upstream. The removal is proposed to start at least three months after completion of the new bridge.	Significant – the proposal would remove habitat occupied by a large Large-footed Myotis breeding colony. The colony's response is unknown but may include adoption of alternative roosting habitat within the locality, either as a single unit or fragmented into smaller groups. Alternative roosting habitat locally is mainly provided by culverts, most of which are susceptible to flooding which poses a risk to the future breeding success of the population. The colony or part of the colony may also disperse and join part of other colonies in the broader region (eg McFarlane Bridge). The species ability to do this is however unknown.	• Build compensatory breeding roosting habitat on the new bridge based on known Large-footed Myotis breeding habitat structures in the region. Three different types of compensatory breeding roosting habitat would be provided on the new bridge: – Microbat habitat 1: Walkway Super-T join void. – Microbat habitat 2: Walkway void. – Microbat habitat 3: Pre-cast parapet. • One opportunistic alternative microbat roosting habitat feature would be provided on the new bridge: – Microbat habitat 4: Super-T girder joins. • Staged microbat exclusion from the timber truss bridge would be carried out following building of the new bridge and prior to removal of the timber truss bridge. This will ensure that no microbats are able to gain access to the underside of the timber truss bridge. The aim is to have the existing timber truss bridge completely free of roosting microbats prior to bridge removal. • Monitoring as per Section 6.
Disruption to breeding (mating or birthing) cycle (high): The proposal poses a high risk of disruption to the breeding cycle of Large-footed Myotis through removal of the location within which this currently occurs being Sportsmans Creek Bridge.	Potentially significant – the timber truss Sportsmans Creek Bridge supports a large breeding colony of Large-footed Myotis. Depending on the response to removal of habitat and building of the new roosting habitat, breeding may not occur within the local area. Loss of a local breeding site for a viable local population is potentially a significant impact.	• Provide compensatory breeding roosting habitat on the new bridge. • Bridge removal is proposed to start at least three months following completion of the new bridge to allow microbats to become accustomed to new available habitat. • Carry out staged exclusion of microbats from the timber truss bridge prior to bridge removal and outside the Large-footed Myotis breeding period, when juveniles are

Potential impact (risk)	Significance of impact	Safeguards and management measures*
		flightless and dependent. • May to September is the optimal time to exclude microbats to avoid impacts on the Myotis breeding population. • Monitoring as per Section 6.
Mortality or injury during bridge removal (high): The proposal poses a high risk of mortality and injury to microbats roosting at the bridge during removal. There is a particular risk to juvenile microbats if the removal or exclusion work were scheduled during the Large-footed Myotis breeding period or when juveniles are flightless and dependent.	Potentially significant – Sportsmans Creek Bridge supports a large breeding colony of Large-footed Myotis.	• Provide compensatory breeding roosting habitat on the new bridge. • Carry out staged exclusion of microbats from the timber truss bridge prior to bridge removal and outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. • May to September is the optimal time to exclude microbats to avoid impacts on the Myotis breeding population. • Exclusion installation programming would allow for flexibility to avoid torpor periods (during significant cold and/or wet weather). • Where > 20 microbats are present at the time of exclusion installation, install exclusion at nights after fly-out. • Check exclusion devices to avoid microbat entrapment or breaches. • Ecologist to be present during exclusion installation to ensure the welfare of animals is maintained; and available for call-outs during bridge removal.
Fly-way impacts (unlikely): The new bridge would be of a similar height above the water as the existing timber truss bridge, with similar distances between piers for the main	Unlikely	N/A

Potential impact (risk)	Significance of impact	Safeguards and management measures*
structure. No fly-way impacts are considered likely.		
Indirect impacts		
Foraging habitat degradation (low): No forest/woodland habitats would be affected. During removal of the bridge, there is a risk of water quality impacts which could reduce the foraging habitat values of local waterways including Sportsmans Creek for the Large-footed Myotis (eg from chemical spills, erosion and turbidity impacts, etc). After the removal of the bridge, it is unlikely that the flow of Sportsmans Creek would be modified such that foraging habitat values of Sportsmans Creek would be significantly impacted.	Low	Removal of the bridge would be carried out in accordance with Roads and Maritime QA *Specification G36 Environmental Protection* and *Specification G38 Soil and Water Management* ensuring the risk and the magnitude of potential indirect impacts that may affect the foraging carrying capacity of the study area is low.
Reduction in habitat connectivity: Removal of Sportsmans Creek Bridge may result in a break to the linkage of the network of roost sites.	Low – No direct habitat fragmentation/impacts to corridors would occur as a result of the proposal and barriers to fly-ways for microbats moving along Sportsmans Creek are unlikely to be created. Medium – Removal of Sportsmans Creek Bridge however would remove a roosting site within the lower Clarence located in nightly movement distance of other local roost. The relationship between roost	• Provide compensatory breeding roosting habitat on the new bridge. • Monitoring as per Section 6.

Potential impact (risk)	Significance of impact	Safeguards and management measures*
	sites in the locality is unknown particularly in relation to facilitating broad range dispersal.	

* Refer to Section 6 for further detail regarding safeguards and management measures.

5.2 Discussion of conservation status

5.2.1 Local, regional and state-wide conservation status

5.2.1.1 Local

Locally, Large-footed Myotis does not have any statutory conservation status.

5.2.1.2 Regional

Regionally, Large-footed Myotis does not have any statutory conservation status.

5.2.1.3 State

Myotis macropus is listed on the TSC Act as 'Vulnerable'. In NSW, this species is listed because:

- 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).

5.2.1.4 Commonwealth and international

Large-footed Myotis is listed as being of 'Least Concern' under the IUCN Red List (The IUCN Red List of Threatened Species, 2015-04, Myotis macropus) and is not listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

5.2.2 Key threatening processes

There are currently 38 Key Threatening Processes (KTP) listed by the NSW Scientific Committee. Those relevant to Large-footed Myotis include:

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
- Anthropogenic climate change.
- Clearing of native vegetation.
- Competition from feral honey bees, *Apis mellifera* L.
- Loss of hollow-bearing trees.

OEH (2014) identify the following threats to Large-footed 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.

Other threatening processes identified in Law & Anderson (1999) for this species include:

- Changes in water quality, including sedimentation, chemical pollution, physical pollution and altered flow regimes (affecting foraging ability and prey abundance).

- **Disturbance of breeding colonies and roosting sites.**
- Possibly introduced fish (eg carp *Cyprinus carpio* and plague minnow *Gambusia holbrooki*) affecting the ecology of inland waterways.

5.2.3 Habitat requirements

Roosting habitat for the Large-footed Myotis is often reported from old timber bridges, but also within tree hollows (Schedvin, pers. comm. in Lumsden and Menkhorst, 1995), caves (holes in limestone rock overhang 2 metres above water, Kirkley, 1996), tunnels (eg aquaducts, Gratin pers. comm., Campbell, 2009), mines (Richards *et al*., 2008), culverts (author pers. obs.), fairy martin nests (Schulz, 1998 and pers. obs.) and similar well-insulated cavernous habitats. Cavities used by this species are generally small (compared with obligate cave-dwelling bats such as the Eastern Bent-winged Bat). Animals can roost alone, but are usually found in small groups, or, less frequently, within colonies comprising up to several hundred. During breeding, males collect harems of up to 12 females, whom they defend from other males (Churchill, 2008). Solitary males sometimes roost together.

5.2.4 Applicable recovery/threat abatements plans

No draft or approved recovery plans have been prepared under the TSC Act for Large-footed Myotis. A set of Priority Action Statements (PAS) have been prepared for Large-footed Myotis. Two of these (PAS 5 and 10) relate directly to the proposal:

PAS 5 *Identify, protect and enhance roost habitat beneath artificial structures (eg bridges), especially when due for replacement, and assess effectiveness of the actions.*

PAS 10: *Promote roosting habitat in new artificial structures within the species range*.

In addition to this, Large-footed Myotis has been identified as a 'landscape' species under the *Saving our Species* conservation program. The proposal aims to be consistent with the site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program by promoting roosting habitat in new artificial structures within the species' range and monitoring their use. Monitoring of the new bridge for uptake by Large-footed Myotis is also proposed (refer to Section 6.6 and the Microbat Management Plan).

The proposal is consistent with the aims or proposed actions of the threat abatement plan for Large-footed Myotis.

5.2.5 Reservation within conservation reserves

The adequacy of representation of Large-footed Myotis within conservation reserves in the region is generally unknown. Four conservation reserves are located within the locality (refer to Table 5.2 and Illustration 5.1). Two of the six records from OEH BioNet are located within Woodford Island Nature Reserve.

Table 5.2 Conservation reserves within the locality

Conservation Reserve	Located on waterway	Distance and direction from Sportsmans Creek Bridge
Munro Island Nature Reserve	Yes	700 m east
Everlasting Swamp State Conservation Area	Yes	3.4 km south-west
Warragai Creek Nature Reserve	Yes	9 km south-west
Woodford Island Nature Reserve	No	5.2 km east

Roosting and foraging habitat areas located outside of conservation reserves are important for Large-footed Myotis conservation in the Northern Rivers Region as:

- Most conservation reserves in the region are located in upper catchment areas, away from large waterways/water bodies.
- Potential cave roosting structures in proximity to permanent waterways/water bodies are uncommon within the region (including conservation reserves).
- Potential artificial roosting structure such as bridges and culverts are more prevalent outside of conservation reserves. Artificial structures appear to provide suitable roosting and breeding habitat for large colonies.

The number of hollow-bearing trees within conservation reserves in proximity to permanent waterways/water bodies is unknown. Individual hollow-bearing trees are likely only to support small colonies (eg <30 Large-footed Myotis).

5.2.6 Distribution

Myotis macropus is the only representative of its genus in Australia, having been clarified as a distinct species from the Indonesian *M. adversus* and Papua New Guinean *M. moluccarum*, although *M. macropus* could also possibly occur in Papua New Guinea (Cooper *et al.* 2001).

Large-footed Myotis is distributed in the coastal band from western Victoria, up the eastern coastline, along the north-west of Australia and west across the top-end into the Kimberly region of Western Australia (A. Burbidge pers. comm. in Reardon and Thomson, 2008), and also along the Murray River into South Australia (Duncan *et al*., 1999; Churchill, 2008). This species is known from 0 to 840 metres above sea level, but most records are below 300 metres in Victoria (L. Lumsden pers. comm. in Reardon and Thomson, 2008), whilst in north-eastern NSW records from OEH Wildlife Atlas and Forests NSW, show that observations and trapping of Large-footed Myotis has occurred at elevations up to 450 metres.

The Large-footed Myotis population at the subject site is not at the limit of the species known distribution.

Information shown is for illustrative purposes only

Conservation Reserves within the Locality

Illustration 5.1

5.3 Discussion of local and regional abundance

5.3.1 Discussion of other known local populations

Large breeding colonies of Large-footed Myotis are uncommon in the lower Clarence and are not in close proximity to the Sportsmans Creek Bridge (>10 kilometres along waterways which is how Large-footed Myotis would be expected to disperse), as described within Appendix C. Surveys of drainage structures in the locality found that unoccupied potential breeding roost drainage structures within the locality are uncommon and likely to have a lower roost carrying capacity than occupied sites. Sportmans Creek Bridge is one of only three large (>100) breeding colonies known within 10.3 kilometres of the site (the other two being McFarlane Bridge and Shark Creek).

While some Myotis genetic exchange is likely to occur between the Sportsmans Creek Bridge and other Large-footed Myotis populations in the lower Clarence, the Sportsmans Creek Bridge population must be considered a single population for the purposes of this SIS. This is based on the findings of Campbell *et al.*, (2009) who found:

- Significant genetic structuring between Large-footed Myotis populations 15 kilometres apart (along waterways) in a modified agricultural landscape with degraded riparian zones (Campbell *et al*., 2009), similar to that in the locality.
- While the Large-footed Myotis can travel up to 22 kilometres between foraging and day roost sites within a single night (Caddle, 1998, cited in Campbell *et al*., 2009), distances covered while foraging may not be a good indicator of dispersal capabilities.

Other potential important roost values of Sportsmans Creek Bridge for the Clarence region Large-footed Myotis population include:

- Refuge during permanent or temporary loss of other roost sites (eg flood inundation).
- Forms part of a network of roosts within the lower Clarence in nightly movement distance of each other to facilitate broad range dispersal.

The long-term security of roosting habitat for the Large-footed Myotis in the locality (and probably the broader region) is not provided. The key type of roosting habitat in the locality (and probably the broader region) appears to be artificial structures. Colonies in other bridges/culverts are similarly vulnerable to disturbance from bridge/culvert maintenance and repair projects as well as flooding. While hollow-bearing trees are scattered throughout the locality due to past clearing associated with agriculture, these trees are unlikely to support substantial, breeding Large-footed Myotis populations (>30 bats).

The subject site is significant in terms of habitat as it provides important roosting habitat for the subject Large-footed Myotis population; it provides a range of potential roosting opportunities within the one structure and supports a large breeding colony. Overall, the existing timber truss Sportsmans Creek Bridge is considered important to the long-term survival of the species in the locality.

5.3.2 Discussion of habitat utilisation

Estimate of Large-footed Myotis numbers at Sportsmans Creek Bridge and other known populations within the locality is provided in Section 4.3.1.5. About 300 Large-footed Myotis (adults and juveniles) were recorded roosting at Sportsmans Creek Bridge during surveys in December 2013 and February 2014. These individuals are known to utilise the bridge as a breeding roost and the habitat is therefore highly significant to the viability of the population in the locality.

Over 320 Large-footed Myotis are known to roost at three other known roost sites within the locality. A colony of Large-footed Myotis at McFarlane Bridge, about 10.3 kilometres over land from the subject site, is also known to fluctuate between 200-600 individuals. In mid-August 2015, 173 Large-footed Myotis were counted at McFarlane Bridge in bat boxes hung under the bridge decking of spans 8-11. No microbats were observed within the bridge decking.

5.3.3 Description of vegetation

Refer to Section 2.5.

5.4 Assessment of habitat

5.4.1 Description of habitat values

Key habitat features for the Large-footed Myotis within the study area includes:

- Aquatic foraging habitat which is provided by Sportsmans Creek and the Clarence River. These waterways provide significant foraging habitat for the Large-footed Myotis and are likely to comprise key foraging habitat for the species within the locality.
- Roosting habitat which is provided by Sportsmans Creek Bridge. Refer to Section 2.4 for a description of Sportsmans Creek Bridge. Refer to Section 4.3.1 for a description of Large-footed Myotis roosting values of the Sportsmans Creek Bridge.

5.4.2 Extent of habitat removal

The proposal would result in the entire removal of the timber truss Sportsmans Creek Bridge (except for the northern abutment). Removal of the existing bridge would result in a loss of breeding habitat known to be occupied by Large-footed Myotis and capable of supporting dispersing microbats along the lower Clarence River system. Breeding sites are critical and limited due to the requirement for Large-footed Myotis to be able to maintain warmth and humidity for developing young. Sportsmans Creek Bridge is one of only three large (>100) breeding colonies known within 10.3 kilometres of the site (the other two being McFarlane Bridge and Shark Creek Bridge).

It is expected that the average foraging foray by Large-footed Myotis is 6 to 12 kilometres per night (Caddle, 1998 in Campbell, 2009, Barclay *et al*., 2000, Anderson *et al*., 2006). It is thought that Large-footed Myotis forms stable populations that have a number of roosting sites available or known to the group and that they switch between these roosting sites as required or desired (eg to avoid detection by prey, as a response to weather or season or perhaps as required based on breeding requirements). Structures such as Sportsmans Creek Bridge provide multiple roost sites within a single structure and it is unclear of the relationship of such populations/roost sites with other known/potential roost sites within the locality. Removal of Sportsmans Creek Bridge may also result in a break to the linkage of the network of roost sites.

Other known Large-footed Myotis colonies in the locality are subject to similar pressures (as part of bridge and culvert maintenance) experienced at Sportsmans Creek Bridge and the loss of breeding habitat from Sportsmans Creek Bridge contributes to the cumulative loss of habitat for the species. It is difficult to quantify cumulative loss however Sportsmans Creek Bridge is known to have a carrying capacity of at least 300 Large-footed Myotis which utilise the site as core breeding habitat.

Large-footed Myotis prefer artificial roost structures, therefore cumulative impacts for this species arise from road related upgrade or maintenance work. Projects within the Roads and Maritime Northern Region that have or have potential to impact upon Large-footed Myotis that GeoLINK are aware of in addition to those previously mentioned (ie Binna Burra, Marom Creek culvert, McFarlane Bridge and Mororo Bridge) include:

- Woolgoolga to Glenugie Pacific Highway Upgrade (Sections 1-2): five of the eight drainage structures that have been assessed by GeoLINK (2014c) as medium or high conservation/habitat value would be directly impacted.
- Woolgoolga to Ballina Pacific Highway Upgrade (Sections 3-11): three of the eleven drainage structures assessed by GeoLINK (2015a) as medium or high conservation/habitat value would be directly impacted.

It is not possible to provide a comprehensive list of work that has or may impact upon Large-footed Myotis however, as noted above, the removal of the timber truss Sportsmans Creek Bridge contributes to cumulative impacts on a breeding colony of about 300 Large-footed Myotis.

Unmitigated, the resulting impacts of the proposed habitat removal within the subject site and study area are likely to be significant for the viability of the local population. The resulting impacts of the proposed habitat removal within the locality are likely to be negative and are likely to contribute to cumulative impacts however may not have a significant impact on the viability of the population within the locality as other sub-populations would be largely unaffected (eg Shark Creek, McFarlane Bridge, Pringles Way and Coldstream Bridge).

Overall, there is reasonable evidence to indicate that, provided that the proposed compensatory roosting habitat is installed, there is high potential for the subject Large-footed Myotis colony to take-up the compensatory roosting habitat provided on the new bridge. The new habitat would be located only about 100 metres from the existing bridge and would also be located above the same water body. The new bridge deck would only be about 1.5 metres higher than the existing timber bridge therefore external conditions are expected to be similar. Elsewhere within the region, exclusion and provision of compensatory Large-footed Myotis breeding roosting habitat as part of bridge and culvert maintenance projects (for example at Marom Creek and Binna Burra culverts) have proven to be successful. It is therefore expected that the resident Large-footed Myotis population would move to the habitat installed within the new Sportsmans Creek Bridge or one/several of the other drainage structures known to provide suitable habitat (refer to Section 4.3.1.5).

5.4.3 Consideration of corridors

The study area comprises a mostly cleared area utilised for open space and agriculture. Recorded large movements (Caddle, 1998, cited in Campbell *et al*., 2009) indicate that areas of habitat are unlikely to become fragmented or isolated from other areas of habitat as a result of the proposal. No direct habitat fragmentation/impacts to corridors would occur as a result of the proposal and barriers to fly-ways for microbats moving along Sportsmans Creek are unlikely to be created.

Removal of Sportsmans Creek Bridge would remove a roosting site within the lower Clarence located in nightly movement distance of other local roost. The relationship between roost sites in the locality is unknown particularly in relation to facilitating broad range dispersal.

5.5 Description of feasible alternatives

A description of feasible alternatives is provided within the REF (refer to KBR 2016). In summary, seasonal sugarcane haulage activities rely on crossing Sportsmans Creek. As there is no available alternative should the current bridge be load limited, there is a need for a new bridge to be built to ensure the ongoing viability of this industry.

Upgrading the existing bridge is not viable as geometry and design limitations of the existing structure are such that it is unable to be safely upgraded to cater for future haulage requirements of local surrounding agricultural industries, two-way traffic and pedestrian access. The existing bridge has no designated pedestrian path.

A multi stage options development and assessment process was initiated with a workshop and site visit in Lawrence in June 2013. At the workshop a significant number of diverse options were identified and categorised into three corridors (Western, Grafton Street and Bridge Street). Six options were selected and further developed.

A subsequent internal technical workshop was held in August 2013 to assess the six preliminary options using a Multi Criteria Analysis (MCA) process. The options were assessed and ranked in order of preference and short-listed to three options. Following the internal technical workshop, the shortlisted options were reviewed by Roads and Maritime in conjunction with Transport for NSW.

This review concluded that a new bridge west of the existing Sportsmans Creek Bridge and boat ramp was the recommended option to be taken forward for community display. This new bridge would connect the Grafton – Lawrence Road with Grafton Street and re-join Bridge Street near the Lawrence General and Liquor Store. This was announced as the preferred option for the new bridge in July 2014.

Several options regarding microbat habitat were also assessed and rejected during the process of the SIS:

- Keep all or part of the existing bridge. This option was not considered feasible due to asset management and public liability issues.
- Alternative roosting habitat on the river bank. This option was rejected as it was considered unlikely to be as effective as alternative habitat below the new bridge. Management issues were also a concern due to the flood sensitivity of the local landscape.
- Alternative roosting habitat on the new bridge within bat boxes only. Despite use of multiple-chambered (Hollow Log Home designed) microbat boxes and usage as breeding roosting habitat by the Large-footed Myotis at McFarlane Bridge (GeoLINK, 2014d), Mororo Bridge (GeoLINK, 2014e) and Binna Burra (GeoLINK 2014f), bat boxes do not provide the same amount of habitat and do not provide 'like for like' replacement when compensating for the habitat loss imposed by the proposal. Bat boxes provide only a short to medium term compensatory habitat option and would require ongoing maintenance/replacement. This option was not considered appropriate due to ongoing maintenance/liability for Council.

6 Ameliorative measures

6.1 Long term management strategies

Key components of impact amelioration for the local Large-footed Myotis population include:

- Inclusion of permanent compensatory microbat roosting habitat on the new concrete Super-T bridge prior to removal of the existing bridge (refer to Table 6.1).
- Staged microbat exclusion outside the Large-footed Myotis breeding season from the existing Sportsmans Creek Bridge prior to removal.

The proposed exclusion methods have been effective on other similar bridge and culvert work projects involving breeding Large-footed Myotis colonies (Ecotone, 2001; Hoye and Hoye, 1999; Marshall, 2011; GeoLINK 2014d, 2014e, 2014f). Monitoring pre, during and post exclusion is also proposed to ensure any issues can be identified and addressed at the earliest possibility.

Compensatory microbat roosting habitat has been effective on other bridge and culvert projects involving breeding Large-footed Myotis colonies where habitat has been permanently removed or altered such as at Binna Burra (GeoLINK, 2014f) and Marom Creek (GeoLINK, 2015b) or where habitat has been temporarily removed such as at Mororo Bridge (GeoLINK, 2014e) and McFarlane Bridge (GeoLINK, 2014d). Provision of habitat at Marom Creek culvert has involved provision of cavities and roughened depressions into the obvert of the re-lined concrete box culvert. Provision of habitat at Binna Burra concrete pipe culvert involved provision of two recessed chambers which house four timber bat boxes in each. Other projects have largely involved retrofitting habitat onto these structures (ie bat boxes or other timber lattice style boxes). As mentioned in Section 5.5, provision of bat boxes are regarded as a temporary measure and utilised as a management tool whilst work is carried out. Preliminary monitoring results for Marom Creek culvert from November 2015 indicate that the cavities have been utilised for breeding (evidenced by newly furred pups) during the first breeding event (pers. obs. V.Silver).

The proposed impact amelioration measures have been developed by the Roads and Maritime project manager, bridge designers, construction managers, GeoLINK ecologists, Roads and Maritime environmental (including biodiversity) officers and Council 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 long term management, compensatory strategies and proposed exclusion methodology/timing is provided in the MMP provided within Appendix J.

6.2 Compensatory strategies

The design criterion for the compensatory microbat roosting habitat included:

- Maximise potential for Large-footed Myotis usage as breeding roosting habitat.
- Durability
- Minimal maintenance requirements.
- No compromise to bridge structure longevity.
- No compromise to 'Health and Safety in Design'.
- Avoid public safety issues.
- A minimum carrying capacity equivalency of 30 four-chambered bat boxes (Hollow-log Homes design).

To achieve the design criterion, it was determined that incorporating microbat habitat into the new concrete bridge structure was preferred over retrofitting the bridge with 'add-on' features post-construction.

Other factors considered when identifying and designing potential microbat roosting opportunities included:

- Constructability and longevity.
- Avoiding future conflicts between microbats and workers during future bridge maintenance.
- Similar characteristics of other known Large-footed Myotis breeding habitat on concrete bridges and culverts in the region.

The proposed microbat roost habitat to be incorporated into the new bridge is discussed below.

It should be noted that two types of long-term compensatory microbat roosting habitat are discussed:

- Targeted microbat breeding habitat: Comprises permanent microbat roosting habitat that aims to provide breeding habitat for the Large-footed Myotis.
- Opportunistic alternative microbat roosting habitat: Comprises permanent bridge features that provide potential Large-footed Myotis roosting habitat, however offer limited potential as significant breeding habitat.

Four microbat roosting habitat features are proposed to be incorporated into the new bridge:

- Three targeted microbat breeding habitat features:
  - Microbat habitat 1: Walkway Super-T join void.
  - Microbat habitat 2: Walkway void.
  - Microbat habitat 3: Pre-cast parapet.
- One opportunistic alternative microbat roosting habitat feature:
  - Microbat habitat 4: Super-T girder joins.

Descriptions of these roosting habitat features are provided in Table 6.1 below and shown in Appendix I. A hold point may be required at this stage to obtain 'release' by the Principal for compensatory microbat habitat being installed as per standard drawings. An ecologist would be involved during installation of the compensatory roosting habitat to provide advice to ensure the habitat constructed maximises the potential for Large-footed Myotis usage.

The inclusion of a variety of roosting habitat design features and replication within the bridge has been adopted to maximise opportunities and the potential for Large-footed Myotis to inhabit the new bridge. It also increases Roads and Maritime understanding of how to manage this vulnerable species on future bridge projects. Based on the similar characteristics of other known Large-footed Myotis breeding habitat on concrete bridges and culverts in the region (refer to GeoLINK 2015c and Appendix F), the proposed microbat roosting habitat features offer good opportunities for Large-footed Myotis usage as breeding sites.

Table 6.1 Proposed compensatory microbat roost habitat

Reference	Bridge feature	Materials	Bat habitat description	Location	Numbers	Comment
Targeted microbat breeding habitat						
Microbat habitat 1	Walkway super-T join void	Concrete	A vertical circular based prism (diameter: 50 mm; height: 150 mm) void would be created in the insitu concrete slab above the 30 mm wide x 75 mm high Super-T join gap below the walkway on the eastern/southern side of the bridge. The concrete within the void and Super-T join gap would be rough to provide grip for the microbats.	Span 4 and 5 over the water with about a 3 m buffer from the pier. Spaced at 2 m.	13 in both Span 4 and 5 (26 in total).	• The void (recess) could be created using polystyrene/polypipe with hessian when pouring the insitu concrete slab, then removed. • A 3 m buffer from the piers may help avoid bat conflicts during any future pier maintenance work. • Roughened surfaces would have a minimum texture variation of 1-2 mm (on a random or horizontal plane).
Microbat habitat 2	Walkway void	Concrete	A 225 mm deep vertical void would be created in the insitu concrete slab and Super-T flange on the far eastern/southern side of the bridge. The void dimensions would be: • In the insitu concrete slab, a vertical circular based prism (diameter: 90 mm; height: 150 mm). • In the Super-T flange directly below the insitu concrete slab void, a vertical circular based prism void (diameter:	Span 4 and 5 over the water with about a 3 m buffer from the pier. Spaced at 3 m.	9 in both Span 4 and 5 (18 in total).	• The void (recess) in the insitu concrete slab could be created using polystyrene when pouring the slab, then removed. • Void in the Super-T flange could be created when poring the pre-cast Super-T or later (eg drilling). • A 3 m buffer from the piers may help avoid bat conflicts during any future pier maintenance work. • Roughened surfaces would have a minimum texture

Reference	Bridge feature	Materials	Bat habitat description	Location	Numbers	Comment
			min.65 mm; height: 75 mm). The concrete at the entrance and within the void would be rough to provide grip for the microbats.			variation of 1-2 mm (on a random or horizontal plane).
Microbat habitat 3	Pre-cast parapet	Concrete	• The bridge designs include a wedge shaped cavity (upside-down 'V') between the pre-cast parapet and insitu concrete slab along the western/northern side of the bridge. • The concrete would be roughened on the concrete faces of the Super-T, insitu slab and parapet at the wedge.	On the western side for the full length of the bridge. The most likely habitat is within spans 4 and 5, where they bridge is over the water.	Minimum 10 m in the centre of span 4 and 5 (minimum 20 m in total).	• A 3 m buffer from the piers may help avoid bat conflicts during any future pier maintenance work. • Roughened surfaces would have a minimum texture variation of 1-2 mm (on a random or horizontal plane).
Opportunistic alternative microbat roosting habitat						
Microbat habitat 4	Super-T girder joins	Concrete	• Super-T girder joins would remain unsealed to create a cavity about 75 mm deep and 30 mm wide. • Roughen the concrete surface to allow bats to grip. Create a lip/step if possible (eg retain concrete lip that may form from the pre-cast mould).	Span 4 and 5 (over the water) at the eastern/southern **four** Super-T joins (ie roughening the concrete elsewhere at Super-T joins is not essential).	• Roughen concrete the entire length of the Super-T join in spans with the Walkway Super-T Join Void (Microbat Habitat 1) except within pier buffer (about 48 m in	• About a 3 m buffer from the piers may help avoid bat conflicts during any future pier maintenance work. • Roughened surfaces would have a minimum texture variation of 1-2 mm (on a random or horizontal plane).

Reference	Bridge feature	Materials	Bat habitat description	Location	Numbers	Comment
					total). • Minimum 10 m in the centre of the remaining three central Super-T joins at span 4 and 5 (minimum 60 m in total).	

6.2.1 Biodiversity offsets

In accordance with the Roads and Maritime *Guideline for Biodiversity Offsets* (Roads and Maritime 2011), biodiversity offsets are not considered necessary for the proposal as:

- No native vegetation that is habitat for any threatened species would be removed or modified.
- Reasonable and feasible mitigation measures such as providing compensatory breeding and roosting habitat for the Large-footed Myotis in the design and construction of the new bridge have been included to mitigate the impact.

Also, in accordance with Section 9 of the Biobanking Assessment Methodology (BBAM) the Large-footed Myotis is a threatened species that can withstand a loss within the major catchment area (State of NSW and OEH 2014) and therefore the assessor is not required to determine an offset.

Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use, is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program.

The proposed mitigation measures are also consistent with current PAS for Large-footed Myotis being:

- *PAS 5: Identify, protect and enhance roost habitat beneath artificial structures (eg bridges) especially when due for replacement and assess for effectiveness of the actions.*
- *PAS 10: Promote roosting habitat in new artificial structures within the species range*.

The compensatory roosting habitat within the new bridge aims to provide new breeding habitat opportunities for this species within the locality.

6.3 Roost exclusion

Staged microbat exclusion from the existing timber truss bridge would be carried out in accordance with the Microbat Management Plan (refer to Appendix J) following building of the new bridge to ensure that no microbats are able to gain access to the underside of the timber truss bridge. The aim is to have the timber truss bridge completely free of roosting microbats prior to bridge removal. An ecologist would be engaged to help manage and provide advice throughout the exclusion and bridge removal process. If microbats are present within the timber truss bridge, staged exclusion of the whole bridge is required.

6.3.1 Exclusion timing

Exclusion must be carried out outside the breeding season for the Large-footed Myotis (October to mid-April inclusive). Exclusion may therefore occur only from May to September (inclusive). Exclusion installation programming would allow for some flexibility (ie 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.

Ten bat boxes with four chambers each would be installed below the timber truss bridge decking a minimum of one month prior to exclusion.

Staged microbat exclusion would be employed if >50 microbats are present. If <50 microbats are present, exclusion could be carried out to the whole bridge concurrently after dusk fly out. Depending on the distribution of microbats within Sportsmans Creek Bridge and the number of individuals present immediately prior to removal, exclusion would affect:

- A maximum of 35% of the population at a time if >150 individuals are present, with a minimum week period between these exclusion events.

- A maximum of 50% of the population at a time if >50 to 150 individuals are present, with a minimum week period between these exclusion events.

The potential for injury and death to microbats would be much higher during the breeding period due to the presence of dependant young and/or juveniles. Dependant young are less likely to vacate the roost and there is a high risk that juveniles would be abandoned in the roost by adults. There is a high risk that attempts to remove juveniles from the roost are more likely to result in death or injury due to stress. Exclusion of microbats outside of the breeding season therefore reduces potential impacts on dependant young and/or juveniles.

6.3.2 Exclusion methodology

The exclusion process would include the following stages:

1 Install temporary microbat roosting habitat below the timber truss bridge decking in the form of ten bat boxes with four chambers each, a minimum of one month prior to exclusion.

2 Install exclusion devices on sections of the bridge without roosting microbats (eg approach spans, rotted timber girder ends, potential roost sites in pier cavities). This would occur following inspections by an ecologist to confirm no microbats are present. The ecologist would ensure the exclusion is impenetrable for microbats before starting further exclusion work.

3 Exclude microbats from the remainder of the bridge potentially in stages depending on the number of microbats present (refer to Section 6.3.1).

   The ecologist would inspect the subject section of the bridge from a barge with scaffolding prior to installing the exclusion. Installation of exclusions in areas with no microbats or small groups of bats (<20) may occur during the day following removal of the microbats by the ecologist. Installation of exclusions in areas with larger groups of bats (>20) or where smaller groups were not able to be removed would be carried out at night. Once the microbats have flown-out or are removed by the ecologist and the subject section of the bridge is confirmed to be bat free (following inspection with an inspection camera, torch and/or thermal imagery device), the exclusion can be installed, accompanied by ongoing inspection by the ecologist to ensure no microbats enter the exclusion area.

   After the first night of exclusion when roosting microbats have been displaced, the ecologist would return to the site at least one 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 removed and released if still dark, or held until they could be placed into the bat boxes on the existing timber truss bridge, the bat habitat on the new bridge, or held for release the following evening.

   When exclusion installation is carried out at night, the exclusion would be removed the following morning to allow inspection to ensure no microbats were trapped or were able to penetrate the exclusion. The exclusion would then be re-instated.

   By the end of this stage, the below deck area of the bridge should be effectively impenetrable for microbats, with only the temporarily installed bat boxes remaining accessible to the bats. The bat boxes may be moved around the bridge during the exclusion process and be used as a tool to manage the location of bats while the exclusion is being installed.

4 Transfer occupied bat boxes from the timber truss bridge to the new bridge. The rate and timing of the transfer would follow advice from the ecologist and depend on the rate of microbat uptake on the new bridge. Should small numbers (<20 per bat box) of microbats be occupying the bat boxes, the base would be covered and sealed with a non-transparent breathable material (eg fabric), removed and installed directly onto the new bridge provided the process does not result in significant harm or stress to resident bats (eg from significant noise and vibrations).

Should large numbers (>20 per bat box) of microbats be present, the relocation would occur at night once the bats have flown out. If temporary bat boxes are used during the relocation process, the ecologist would assess the need to relocate the temporary bat boxes onto the new bridge.

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 bats in torpor and the need for the exclusion to be delayed, etc.

The ecologist would also need to identify if individual bridge structures (eg with deep cavities that would not be able to be confidently inspected to ensure they are free of bats) need to be fitted with a one-way exclusion device that allows bats to escape but not re-enter, prior to installing the non-penetrable exclusion which covers large sections of the bridge (*note: based on existing information of microbat usage at the site, this is unlikely to be necessary*).

Exclusion would aim to effectively seal/ wrap the underside of the bridge to prevent microbat access using predominantly industrial plastic which bats are unable to grip onto (refer to Plate 6.1 and Plate 6.2), with only the temporarily installed roosting habitat remaining accessible. Other materials such as expandable foam and timber may also be used. If expandable foam is used (particularly at night), exposed areas would be covered 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 in place throughout the exclusion/ bridge removal period.

Systematic inspection of both bridges would be carried out the morning prior to starting exclusion installation and the morning following each exclusion stage where >20 bats have been displaced to document microbat numbers and roost locations. Both bridges would be re-inspected prior to starting removal and, prior to the start of the Large-footed Myotis breeding season (October to mid-April inclusive) if removal is proposed during the breeding season, to ensure no microbats are roosting on the timber truss bridge. The need for an ecologist to inspect the existing timber truss bridge and bridge timber sections during bridge removal would be determined upon completion of the exclusion process.

Plate 6.1 Effective plastic microbat exclusion installation at McFarlane Bridge, a similar structured timber bridge

Underneath is a single sheet of plastic with small holes to allow drainage. At the piers, smaller sheets of plastic hang down from the decking between the corbels and stringers to 'seal' the exclusion.

Plate 6.2 McFarlane Bridge microbat exclusion viewed from side-on

Timber was placed to cover the gaps between the stringers and transverse decking. This could be undertaken in preparation for installation the plastic exclusion sheeting.

6.4 Roles and responsibilities

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 the MMP.

Roads and Maritime 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. Roads and Maritime or the construction contractor would undertake daily bat checks prior to the starting work to ensure that microbats had not penetrated the exclusion devices. Any resident bats would be captured by the ecologist by hand and released into the bat boxes on the timber truss bridge or held during the day for release that evening. Roads and Maritime and the ecologist would communicate proactively with the work supervisor and Roads and Maritime environmental officer if work needs to cease, be modified and/or to report all observations.

The ecologist is to provide guidance to Roads and Maritime such that the aims of the MMP are achieved and impact to microbats is minimised. Any decision relating to Roads and Maritime 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 Roads and Maritime's work supervisor, project manager and environmental officer immediately.

6.5 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 Roads and Maritime environmental officer for the project. The Roads and Maritime project manager and work supervisor would be informed throughout the implementation of the safeguards of this report. A log would be maintained of the decisions made and installation of exclusion devices to be included in formal monitoring reporting.

6.6 Monitoring

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

- Gathering data during pre-exclusion to accurately define a baseline population number for the species on the existing timber truss bridge. Baseline data would also include establishing data for McFarlane Bridge pre-exclusion of the timber truss bridge at Sportsmans Creek.
- Determining whether the proposal has been successful in relocating the subject Large-footed Myotis breeding colony from the existing timber truss bridge to the new bridge and thus avoiding a significant impact on the local population.
- Identifying whether and how the microbat management safeguards of this report have been implemented and their success.
- Identifying the need to implement additional contingency measures in consultation with Roads and Maritime and OEH to minimise impacts to the subject Large-footed Myotis colony should relocation to the new bridge not be successful.
- Providing further recommendations for consideration on future projects with similar impacts on threatened microbats.

The proposal would be considered successful if a significant proportion of Large-footed Myotis relocate to the new bridge and utilise the compensatory habitat as a breeding site. A significant proportion is regarded as 65% of the Large-footed Myotis numbers present from the baseline data collected at Sportsmans Creek Bridge recorded throughout the year pre-exclusion. The exact numbers are difficult to define as the estimated local population of about 300 bats previously observed is only based on two surveys in December 2013 and February 2014. Environmental variability and natural fluctuations would be considered when establishing baseline population numbers as well as quantifying the overall success of the project.

During removal of the timber truss bridge and throughout the monitoring period, the ecologist would be responsible for identifying the need to trigger and implement contingency/corrective measures, as outlined in Table 6.2. The monitoring strategy focuses on uptake by Large-footed Myotis of the new bridge with monitoring of alternative roosts within 10 kilometres (refer to drainage structures nominated for contingency monitoring in Table C.3 in Appendix C of the SIS) as a contingency measure only triggered if the new bridge is not occupied by a significant proportion (>65%) of the subject Large-footed Myotis colony once exclusion has taken place on the existing timber truss bridge, and further information is required to determine success of the project.

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

Table 6.2 Monitoring schedule

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
Pre exclusion	Develop baseline data of the Large-footed Myotis population numbers over the 12 month period prior to exclusion at the existing timber truss Sportsmans Creek Bridge. Identify any uptake of the compensatory roosts on the new bridge prior to excluding the colony on the existing timber truss bridge.	Direct inspection of the entire existing timber truss bridge using torch and pole mounted camera from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land; documenting: • Species present • Locations of roosting microbats. • Total number of individuals and groups per occupied roost site. • Locations of roosting microbats. • Description of occupied roost sites. • Breeding status of the colony, including approximate adult to juvenile ratios. Monitoring during this period would extend to the new bridge, if constructed, using the same methodology. Where alternative monitoring methodologies are proposed, the feasibility and practicality of them would be assessed and approved by Roads and Maritime in consultation with OEH.	• Key seasonal times (winter, spring, summer/autumn) prior to exclusion. • For one monitoring event per season. • A total of three monitoring events.	N/A

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
Pre exclusion	Develop baseline data of Large-footed Myotis numbers in other local drainage structures prior to exclusion.	Drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge (plus McFarlane Bridge) would be monitored to record baseline data of microbat numbers within the locality prior to starting exclusion.	• Key seasonal times (winter, spring, summer/autumn) prior to exclusion. • For one monitoring event per season. • A total of three monitoring events.	N/A
During exclusion	Monitor Large-footed Myotis roosting behaviour response to exclusion activities. Document exclusion activities and outcomes to identify the effectiveness of exclusion activities.	Direct inspection of the entire existing timber truss bridge and new bridge (targeting the compensatory habitat). Methodology as for pre exclusion monitoring or otherwise approved by Roads and Maritime in consultation with OEH.	• Prior to starting exclusion installation. • The morning prior to installing each exclusion stage where >20 bats are displaced. • The morning following installing each exclusion stage where >20 bats are displaced.	Following initial displacement of microbats from the bridge, if >20 microbats or 65% (based on pre-exclusion numbers) are not locatable in the compensatory roosting habitat on the new bridge or remaining available habitat in the timber truss bridge, the ecologist is to investigate the whereabouts of the microbats (breaches in the exclusion, inspect other drainage structures within a 10 kilometre radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C) as well as additional management measures. This may include: • Modifying the compensatory roosting habitat. • Installing additional compensatory roosting habitat on the new bridge. • Reviewing and modify the exclusion method (eg reducing the rate and extent of bridge excluded

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
				during each exclusion stage).
During exclusion	Record Large-footed Myotis numbers in other local drainage structures during exclusion if >20 microbats or 65% of microbat numbers (based on pre-exclusion numbers) are not locatable in the compensatory roosting habitat on the new bridge or remaining available habitat in the existing timber truss bridge.	Inspect the drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C) via direct inspection and document Large-footed Myotis roosts and bat numbers.	• As required during exclusion. • Prior to starting exclusion installation. • The morning following installing each exclusion stage where >20 bats are displaced.	Contingency measures as listed above.
Post exclusion	Document Large-footed Myotis population numbers within the new bridge over the 12 month period post exclusion.	Direct inspection of the new bridge (targeting compensatory roosting habitat). Methodology as for Pre-exclusion Monitoring or otherwise approved by Roads and Maritime in consultation with OEH.	Year 1 post Exclusion: • Key seasonal times (winter, spring, summer/ autumn) for 12 months post exclusion. • For one monitoring event per season. • A total of three monitoring events.	Should <65% of microbats be present in the new bridge the ecologist is to investigate the whereabouts of the bats (inspect other drainage structures within a 10 km radius of Sportsmans Creek Bridge, refer to Table C.3 in Appendix C), as well as additional management measures. This may include the following measures: • Modifying the compensatory roosting habitat. • Installing additional compensatory

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
			Year 2 and 3 post exclusion: • One monitoring event during the breeding season (summer/autumn).	roosting habitat on the new bridge. • Extend monitoring.
Post exclusion	Record Large-footed Myotis numbers in other local drainage structures post exclusion.	Inspect the drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge refer to Table C.3 in Appendix C) via direct inspection and document Large-footed Myotis roosts and bat numbers.	• One event within one week of completion of exclusion installation and seasonal basis ONLY **if required** (see trigger). Note: Event is to take place at the same time as other monitoring at Sportsmans Creek.	Should <65% of microbats be present in the new bridge, the ecologist is to investigate the whereabouts of the microbats. If 65% of the microbats are not recorded within the drainage structures within a 10 radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C), then surveys would also be carried out on McFarlane Bridge.

7 Assessment of significance

7.1 Seven-part test

Species background

The *Threatened species assessment guidelines: the assessment of significance* (DECC 2007) was reviewed when determining if a significant impact is likely on state-listed threatened species, populations or ecological communities.

As per Section 8 of the DGRs (page 26), the assessment of significance is provided based on including relevant information from Section 5.1 to 7 of the DGRs. This includes incorporation of relevant mitigation measures (refer to Section 6) and compensatory strategies (refer to Section 6.2). The assessment of likelihood of occurrence for subject species, populations and ecological communities listed in the DGR's (refer to Appendix D) found that the proposal may potentially impact upon one threatened fauna species being the Large-footed Myotis listed under the TSC Act. An assessment of significance under Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) was therefore completed for this species using the detailed information collected during the targeted surveys conducted for the SIS.

For this assessment, the proposed 'activity' constitutes removal of Sportsmans Creek Bridge and associated work carried out in accordance with the safeguards provided in Section 6.

The Large-footed Myotis (*Myotis macropus*) gleans prey from the surface or near surface of smooth water by trawling with its disproportionately large feet, hooking aquatic insects on the surface of pools of water and small fish just below the surface with its claws and assisting the prey to its mouth by scooping with its tail membrane (Jones and Rayner, 1991; Dwyer, 1970; Thompson and Fenton, 1982; Robson 1984). Foraging habitat for this species includes large and small wetlands, estuaries, forest streams, lakes, dams and reservoirs (Richards *et al*., 2008). The Large-footed Myotis has been recorded travelling up to 22 kilometres in one night, presumably for foraging purposes (Caddle, 1998 in Campbell, 2009) with other studies recording regular feeding distances of 10 kilometres (Barclay *et al*., 2000) and 3.0 kilometres (Anderson *et al*., 2006). It is expected that the average foraging foray by this species is 6.0 to 12 kilometres per night. It is unclear how far the Large-footed Myotis travel to shift roosting sites. It is thought that this species forms stable populations that have a number of roosting sites available or known to the group and that they switch between these roosting sites as required or desired (eg to avoid detection by prey, as a response to weather or season or perhaps as required based on breeding requirements). However it is possible that some groups may be reliant on a small number of roosting sites. Structures such as Sportsmans Creek timber truss Bridge provide multiple roost sites within a single structure and it is unclear of the relationship of such populations with other known/potential roost sites within the locality.

The Large-footed Myotis is a polyestrus species that breeds up to three times per breeding season across its northern range. In south-eastern Queensland (Dwyer, 1970) and north-eastern NSW (pers. obs, Hoye pers. comm.), Large-footed Myotis has two breeding events, whilst in Victoria, only one breeding event occurs per season. Observations made by Mr Glenn Hoye with regard to breeding cycles for Large-footed Myotis north of the Hunter are as follows:

- 1 October – 28 October; pregnant.
- 27 October – 26 January; lactating.
- 15 January – 10 February; pregnant.
- 10 February – 12 April; lactating.
- 9 March – 29 May; post-lactation.

This indicates that, whilst the first breeding event is relatively synchronous, the second is not. Also perhaps not all females produce two young per season, explaining the detection of post-lactation and non-pregnant females in March.

The Sportsmans Creek Bridge population is considered the subject population of this assessment.

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

Potential impacts of the proposal on the Large-footed Myotis are provided in Section 5.1.

The proposal would result in the removal of the existing timber truss Sportsmans Creek Bridge which supports a large breeding colony, with about 300 individuals. It is considered to be the core roosting habitat occupied by the subject population. Breeding sites are critical and limited due to the requirement for Large-footed Myotis to be able to maintain warmth and humidity for developing young. Existing alternative potential breeding roosting habitat in the locality is uncommon. The main alternative roosting habitat within 10 kilometres of Sportsmans Creek Bridge comprise flood susceptible culverts associated with table drains (refer to Section 4.3.1.4). In addition to this, McFarlane Bridge (located 10.3 kilometres north-east) and Shark Creek Bridge (located 8.8 kilometres east) are known to support large breeding colonies of Large-footed Myotis.

The colony's response to the loss of roosting habitat is unknown. Safeguards however would be implemented to minimise potential impacts, including installation of compensatory roosting habitat on the new bridge and staged exclusion from the existing bridge outside the breeding period. The methods proposed have been successful on other similar bridge and culvert work projects involving breeding Large-footed Myotis colonies (Ecotone, 2001; Hoye and Hoye, 1999; Marshall, 2011; GeoLINK 2014d, 2014e, 2014f). Records of Large-footed Myotis colonies in artificial structures (such as concrete bridges like Shark Creek Bridge Pacific Highway), demonstrate the species ability to locate and occupy new roosting opportunities. Mortality or injury during removal or entrapment during bridge exclusion poses the other main potential impact, though these threats would be immediately reduced or avoided, because work would follow the safeguards described in Section 6.3. Should mortality or injury occur, only small numbers of bats are likely to be affected. Hence, a significant impact from direct mortality or injury is highly unlikely, and a viable local population would not be placed at risk of extinction.

Fly-way and foraging habitat degradation are low risk potential impacts and unlikely to significantly affect the foraging habitat values of the study area (refer to Table 5.1). Removal of Sportsmans Creek Bridge however would remove a roosting site within the lower Clarence with few alternatives within the average nightly foraging range. The relationship between roost sites in the locality is unknown particularly in relation to facilitating broad range dispersal. It is expected that the provision of compensatory habitat would alleviate this potential impact.

Disruptions to the breeding (mating or birthing) cycle are high risk potential impacts which would be mitigated by proposing to carry out staged exclusion of microbats from the existing timber truss bridge outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. May to September is the optimal time to exclude microbats to avoid impacts on the Myotis breeding population.

Overall, there is reasonable evidence to indicate that, provided that the proposed compensatory roosting habitat, as described in Table 6.1 and Appendix, I is installed, there is high potential for the subject Large-footed Myotis colony to take-up the compensatory roosting habitat provided on the new bridge. The new habitat would be located only about 100 metres from the existing and would also be located above the same water body. The new bridge deck would be about 1.5 metres higher than the existing timber bridge therefore external conditions are expected to be similar.

Elsewhere within the region, exclusion and provision of compensatory Large-footed Myotis breeding roosting habitat as part of bridge and culvert maintenance projects (for example at Marom Creek and Binna Burra culverts) has proven to be successful.

Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use (in this case, in the new bridge), is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program.

If the mitigation measures are not implemented, the proposal has the potential to have an adverse effect on the life cycle of the species such that the viable subject Large-footed Myotis local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No consideration under this part of the assessment is required for the subject threatened species being Large-footed Myotis.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

No consideration under this part of the assessment is required for the subject threatened species being Large-footed Myotis.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal would result in the removal of the existing timber truss Sportsmans Creek Bridge which supports a large breeding colony with about 300 individuals and comprises the core roosting habitat for the subject population.

Permanent compensatory roosting habitat is proposed within the new concrete bridge about 100 metres to the west along Sportsmans Creek. This bridge would incorporate microbat breeding habitat features as well as opportunistic roosting habitat features. Four microbat roosting habitat features are proposed to be incorporated into the new bridge:

- Three targeted microbat breeding habitat features:
  - Microbat habitat 1: Walkway Super-T join void.
  - Microbat habitat 2: Walkway void.
  - Microbat habitat 3: Pre-cast parapet.
- One opportunistic alternative microbat roosting habitat feature:
  - Microbat habitat 4: Super-T girder joins.

Potential impacts on foraging habitat ie water quality of waterways for Large-footed Myotis which eat aquatic insects, small fish and prawns etc of the study area and locality would be managed through best practice and general safeguards such as erosion and sediment control outlined within the REF for the proposal (refer to KBR 2016) including RMS QA *Specification G36 Environmental Protection* and *G38 Soil and Water Management*.

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

The study area comprises a mostly cleared area utilised for open space and agriculture. No direct habitat fragmentation would occur as a result of the proposal and barriers to fly-ways for microbats moving along Sportsmans Creek are unlikely to be created.

Removal of the existing bridge would see the loss of breeding habitat known to be occupied by the Large-footed Myotis and capable of supporting dispersing bats along the lower Clarence River system. Permanent compensatory roosting habitat would be provided on the new bridge (refer to Section 6.2). This and recorded large movements (Caddle, 1998, cited in Campbell *et al*., 2009) indicates that areas of habitat are unlikely to become fragmented or isolated from other areas of habitat as a result of the proposal.

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

The existing timber Sportsmans Creek Bridge provides important roosting and breeding habitat for the subject Large-footed Myotis population. It provides a range of potential roosting opportunities within the one structure and supports a large breeding colony. Other known breeding Large-footed Myotis colonies in the locality are uncommon and are not in close proximity to the site (refer to Section 4.3.1.5). Those colonies are similarly vulnerable to disturbance from bridge/culvert maintenance and repair projects. As the locality comprises a mostly cleared landscape, hollow-bearing trees are not common and unlikely to support large Large-footed Myotis populations. Overall, the existing Sportsmans Creek Bridge is considered important to the long-term survival of the species in the locality. Permanent compensatory habitat would be provided on the new bridge which should alleviate impacts of the proposal on the subject population.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat are listed under the TSC Act for Large-footed Myotis.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Part 4 of the TSC Act states '*The object of a recovery plan is to promote the recovery of the threatened species, population or ecological community to which it relates to a position of viability in nature*.' Any action which adversely affects threatened species or their habitat, or contributes to relevant key threatening processes (KTP) may be interpreted as being inconsistent with this general objective.

No draft or approved recovery plans have been prepared under the TSC Act for Large-footed Myotis.

The following Priority Action Statements (PAS) have been prepared for Large-footed Myotis:

LOW PRIORITY

1 Ensure the largest hollow-bearing trees in riparian zones are given highest priority for retention in PVP assessments or other land clearing assessment tools.

2 Identify the spatial population structure, including genetic isolation, movement and persistence across the species range.

3 Prepare environmental impact assessment guidelines which address the retention of hollow-bearing trees maintaining diversity of age groups, species diversity, and structural diversity. Give priority to largest hollow-bearing trees.

4 Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes.

5 Identify, protect and enhance roost habitat beneath artificial structures (eg bridges), especially when due for replacement, and assess effectiveness of the actions.

6 Better regulate pollution of waterways eg sewage and fertilizer run-off (eutrophication) and pesticide/herbicide leakage (chemical pollution) and thermal pollution.

MEDIUM PRIORITY

7 Research to identify important foraging range and key habitat components for this species. Identify the importance of riparian vegetation to the species.

8 Determine susceptibility to logging.

9 Investigate the effectiveness of logging prescriptions.

10 Promote roosting habitat in new artificial structures within the species range.

11 Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation.

HIGH PRIORITY

12 Survey large inland waterways for this species to determine distribution in Murray Darling Basin.

13 Resolve species taxonomy by morphology/genetics and reassess conservation status.

14 Assess the importance by survey of estuaries and other tidal waterways for the species across its range.

15 Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species.

Two PAS (PAS 5 and 10 highlighted **bold**) relate directly to the proposal. The proposal aims to be consistent with these actions by installing alternative artificial roosting habitat for the Large-footed Myotis within the new bridge, based on designs of artificial roosting habitat that is known to be used as breeding habitat.

Proposed amendments to the NSW Threatened Species PAS include draft recovery and threat abatement strategies (*Saving our Species* conservation program). Large-footed Myotis has been assigned to the 'landscape species' management stream under the *Saving our Species* conservation program. Actions listed within Table 7.1 are proposed for Large-footed Myotis. These proposed actions generally duplicate the proposed PAS.

Table 7.1 Action toolbox

Action description	Scale
Retain and protect live and standing dead trees likely to contain suitably sized hollows, or that have the potential to develop these in the future (eg through the loss of limbs) particularly in riparian zones. Ensure the largest hollow-bearing trees, including dead trees, are given highest priority for retention in property vegetation plan assessments. Offsets should include remnants in high productivity and riparian zones. Raise public awareness of the importance of hollow-bearing trees and promote strategies for retaining these in the landscape.	Area
Identify sites, particularly in riparian zones, where hollows are limiting due to exotic species inhibiting recruitment and changing the vegetation structure. Ensure the future replacement of large old trees by facilitating regeneration or undertaking replanting at sites where they presently occur. Protect recruit trees that will be able to provide hollows in the future.	Site
Liaise with the Roads and Maritime Authority and other relevant authorities and land managers regarding wooden bridges, wharves, tunnels, aqueducts and other structures acting as bat habitat. When undertaking any major work, replacing wooden bridges with concrete bridges or upgrading wharves, this be done at a time outside of the breeding (October-February) and overwintering period. A wooden structure should be placed under new bridges or wharves where bats	State

Action description	Scale
are known to provide a roost.	
Encourage land managers to enter into land management agreements that protect and restore key areas such as riparian habitat and including the retention of suitable hollow-bearing trees and recruitment trees in these areas.	Site
Check that in caves utilised by bats, entrances are not blocked in a way that prevents easy continual access by bats. Monitor the density of vegetation (native or exotic) at the entrance to any active or potential maternity or hibernation roost cave and manually remove (do not use chemicals) as necessary to ensure bats have ready access year-round.	Site
Discourage recreational users from roosting areas such as caves, culverts, and storm water drains by erecting signs or blocking preventing human access whilst still allowing access to bats. In caves where public access is permitted, restrict access during breeding season (November-March) and winter to approved management and scientific research only. Provide information to users in the form of brochures and signage about appropriate care and behaviour whilst at the site. Provide this information to caving, climbing, abseiling and bushwalking groups.	State
Promote roosting habitat in new artificial structures within the species' range and monitor their use.	Site
Raise awareness amongst landholders in close proximity (about 15 kilometre radius) to maternity or roost sites, of the potential impacts of using harmful pesticides and other chemicals and discourage their use in or adjacent to foraging habitat, particularly in riparian zones around waterways such as rivers, creeks, lakes and dams.	Site, Area
Liaise with agricultural landholders to promote land management that minimises disturbance to waterways likely to be foraging habitat (eg restore riparian vegetation and carefully manage stormwater and polluted run-off). Monitor and maintain adequate water quality in water systems known to be used for foraging. Liaise with relevant authorities with respect to limiting the impacts of waste disposal and runoff in these systems.	Site, Area
Control or remove exotic weeds, particularly in riparian zones, that degrade habitat and alter the structure of the vegetation community in areas of the species' distribution. Ensure that such weed control work be undertaken in a staged manner and minimises disturbance to the habitat of the species. Develop and implement a bush regeneration strategy (which includes monitoring and reporting requirements) targeting the removal of weeds significantly compromising habitat values such as the repression of future hollow-bearing trees. Care should be taken to avoid widespread removal of vegetation without replacement. Manual weed removal is preferable and the use of herbicides should avoid non-target impacts. Leave dead trees standing. Encourage land managers and bushcare groups to undertake weed control.	Site
Undertake restoration and augmentation planting and/or direct seeding, including species from the ground layer and understorey in areas of degraded and/or potentially suitable habitat particularly in riparian zones. Revegetation should focus on expanding existing smaller areas of suitable habitat and connecting areas of suitable habitat to create corridors for movement. A diversity of local native species should be planted. Dead trees	Site

Action description	Scale
should not be removed.	
Manually remove and appropriately dispose of invasive aquatic weeds in waterways in foraging areas (weeds inhibit the species' ability to forage over water).	Site
Liaise with relevant authorities and/or land managers to discourage the destruction of caves. If mine sites are to be closed or previously abandoned mines reopened, they should first be checked for the presence of bats (during summer) and access should still be provided for the bats to safely enter and leave. Closure technique should be discussed with relevant microbat experts to ensure that possible habitat for bats is maintained. If gates are used, they should be bat friendly with horizontal bars at least 15 centimetres apart and preferably with a larger gap across the top. Bats should be excluded prior to closure (and this should not occur during the breeding season from October to February or in winter). The impact of closure on bat usage should be monitored for several seasons.	Site, Area

The Action Plan for Australian Bats recommends the following actions for the Large-footed Myotis (Duncan et al., 1999):

1 Complete the review of taxonomy and distribution of this species and its congeners. In particular confirm the placement of northern New South Wales specimens. Morphological parameters of New South Wales specimens should be incorporated into the study of Kitchener et al. (1995). Genetic studies are currently underway at the South Australian Museum.

2 Conduct targeted surveys to clarify the status of the inland populations along the Murray River and in northern New South Wales.

3 Assess whether this species is adequately represented in conservation reserves and ensure the security of known maternity sites.

4 Carry out ecological research to determine:

- Habitat requirements
- Roost and maternity site selection, particularly the relative dependence on caves versus tree hollows.
- Sensitivity to changes in water quality.
- Population dynamics
- Threatening processes.

5 Encourage State and local government authorities with responsibility for construction and maintenance of roads to inspect bridges/culverts prior to demolition to reduce impact on colonies utilising these structures.

Those in bold relate directly to the proposal. The proposal aims to be consistent with these actions by:

- Installing compensatory roosting habitat for Large-footed Myotis within the new bridge, based on designs of artificial roosting habitat that is known to be used as breeding habitat.
- Excluding microbats from the existing bridge outside the breeding season prior to removal and after installation of the new bridge containing compensatory roosting habitat.

(g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposal was assessed with regards to the potential contribution towards or operation of KTP listed under Schedule 3 of the TSC Act as provided in Table 7.2.

Table 7.2 Key threatening processes

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic climate change			✓
Bush rock removal			✓
Clearing of native vegetation			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition and habitat degradation by feral goats (*Capra hircus*)			✓
Competition from feral honeybees (*Apis mellifera*)			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants (*Solenopsis invicta*)			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Infection of native plants by *Phytophthora cinnamomi*			✓
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Rhinella marina*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*)			✓
Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)			✓
Invasion of native plant communities by exotic perennial grasses			✓
Invasion of the yellow crazy ant (*Anoplolepis gracilipes* (Fr. Smith)) into NSW			✓
Loss of hollow-bearing trees			✓
Loss or degradation (or both) of sites used for hill-topping by butterflies			✓
Predation and hybridisation of feral dogs (*Canis lupus familiaris*)			✓
Predation by the European red fox (*Vulpes vulpes*)			✓
Predation by the feral cat (*Felis catus*)			✓
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)			✓
Removal of dead wood and dead trees			✓

7.2 Conclusion

Based on the detailed assessment carried out through the SIS process and consideration of alternatives and/or ameliorative measures proposed in this SIS, it is considered that the impact upon the Large-footed Myotis population has been minimised.

Overall, there is reasonable evidence to indicate that, provided that the proposed compensatory roosting habitat as described in Table 6.1 and Appendix I is installed, there is high potential for the subject Large-footed Myotis colony to take-up the compensatory roosting habitat provided on the new bridge. The new habitat would be located only about 100 metres from the existing bridge and would also be located above the same water body. The new bridge deck would only be about 1.5 metres higher than the existing timber bridge therefore external conditions are expected to be similar. Elsewhere within the region, exclusion and provision of compensatory Large-footed Myotis breeding roosting habitat as part of bridge and culvert maintenance projects (for example at Marom Creek and Binna Burra culverts) has proven to be successful.

Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use, is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program.

It is expected that the local population to be impacted by removal of the existing timber truss bridge would occupy the compensatory roosting habitat provided within the new concrete bridge and avoid a significant impact. However, a level of uncertainty warrants application of the precautionary principle. If a significant impact is identified from the post exclusion monitoring results, Roads and Maritime would consult with OEH with regard to the implementation of appropriate contingency measures.

8 Additional information

8.1 Qualifications and experience

Qualifications and experience of the primary author, technical reviewer and contributing author for this SIS are provided in Table 8.1 and Appendix K. A list of projects providing evidence of experience in threatened species conservation of the primary author is provided in Appendix L.

Table 8.1 Qualifications and experience

Name	Qualification	Years of experience	Role
Veronica Silver	Bachelor of Environmental Science (Environmental Management) Graduate Diploma of Urban and Regional Planning	13	SIS report content
David Andrighetto	Bachelor of Applied Science (Environmental Resource Management)	9	SIS technical review
David Havilah	Bachelor of Science (Biology)	12	Co-author of Microbat Impact Assessment (GeoLINK 2014b) content of which was used to inform the SIS

8.2 Other approvals required

Clause 94 of SEPP Infrastructure 2007 permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent of local government.

As the proposal is for road infrastructure facilities and is to be carried out by Roads and Maritime it can be assessed under Part 5 of the EP&A Act. Development consent from Council is not required.

A REF for the proposed bridge removal was prepared by Kellogg Brown and Root (KBR 2016) in accordance with Part 5 of the EP&A Act. Additional information regarding approvals not specifically related to ecology are addressed within the REF (refer to KBR 2016).

8.3 Licences

GeoLINK currently holds a Scientific Licence (Licence Number S11722) under Section 132C of the *National Parks and Wildlife Act 1974*. This licence authorises harm/release: protected fauna and pick native plants for identification purposes.

GeoLINK also holds a current Animal Research Authority Licence (TRIM 11/5175) and has approval from the Animal Care and Ethics Committee of the Director-General of NSW Department of Primary Industries to undertake fauna surveys throughout NSW, including microbat surveys that involve animal capture, handling and release (including mist-netting and radio-tracking).

8.4 Assumptions

GeoLINK has prepared this report on the basis of information provided by Roads and Maritime and KBR, 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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Certification

	Name	Signature	Date
Prepared by	Veronica Silver	V. Silver	07/09/2015
Reviewed by	David Andrighetto	DAndrighetto	07/09/2015

UPR	Description	Date Issued	Issued By
2465-1004	Version 1	07/09/2015	Veronica Silver
2465-1014	Version 2	12/10/2015	Veronica Silver
2465-1023	Version 3	06/01/2016	Veronica Silver
2465-1026	Version 4	03/03/2016	Veronica Silver
2465-1031	Version 5	12/03/2016	Veronica Silver
2465-1035	Version 6	21/03/2016	Veronica Silver

Appendix A

Director Generals Requirements

NSW GOVERNMENT | Office of Environment & Heritage

Our reference: DOC15/19486
Contact: Krister Waern, (02) 6640 2503

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PO Box 546
Grafton NSW 2460

Dear Mr Nunn

RE: REVISED DIRECTOR GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT DEMOLITION OF THE EXISTING SPORTSMANS BRIDGE, LAWRENCE, NSW

Thank you for your letter (including attached microbat impact assessment) received 21 January 2015 requesting the Office of Environment and Heritage (OEH) provide Director General's requirements (DGRs) for a Species Impact Statement (SIS) for the above mentioned proposal at Lawrence within Clarence Valley Council local government area. I appreciate the opportunity to provide input.

Please note that this OEH response supersedes the previous OEH letter and SIS DGR's sent 23 February 2015. I apologise for revising these SIS DGR's, however the previous version had errors. Thank you for bringing these errors to my attention.

OEH understands that Roads and Maritime Services (RMS) is assessing the proposal under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). RMS is both the proponent and the determining authority for the project.

OEH's DGRs for a SIS to address all known and potential threatened species, populations and ecological communities (including their habitats) are provided in **Attachment A** to this letter.

OEH notes that RMS has formed the opinion that the removal of the existing bridge is likely to have a significant impact on the Large-footed Myotis (*Myotis macropus*), a species listed as vulnerable under the NSW *Threatened Species Conservation Act 1995*. Please note however that the SIS must also address all likely species, populations, ecological communities and their habitats that may be directly or indirectly impacted by the proposal.

The SIS must be submitted to OEH 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, OEH must be consulted to determine whether the DGRs 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 DGRs is a statutory requirement for OEH and should not be considered as support or endorsement of the proposal. It is the determining authority's responsibility to ensure that a SIS complies with the requirements issued by the Director General, prior to forwarding it to OEH for concurrence. Checklists to assist the determining authority in complying with the DGRs for the SIS are provided in **Attachment B** to this letter.

If you require any further information regarding this matter, please contact Senior Operations Officer, Mr Krister Waern, on (02) 6640 2503.

Yours sincerely

Dimitri Young 26 February 2015

DIMITRI YOUNG
Senior Team Leader Planning, North East Region
Regional Operations

Enclosures:
Attachment A – Director-General's Requirements for Sportsman's Bridge, Lawrence SIS
Attachment B – SIS Checklist

ATTACHMENT A

REVISED DIRECTOR GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT- DEMOLITION OF THE EXISTING SPORTSMANS BRIDGE, LAWRENCE, NSW

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

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal
- assist consent and determining authorities in the assessment of a development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act)
- assist the Chief Executive of the Office of Environment and Heritage in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act
- assist the Chief Executive of the Office of Environment and Heritage or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act
- assist the Chief Executive of the Office of Environment and Heritage in the assessment of Section 91 Licence applications lodged under the *Threatened Species Conservation Act 1995* (TSC Act).

DEFINITIONS

The definitions given below are relevant to these requirements:

- ***abundance*** means a quantification of the population of the species or community.
- ***activity*** has the same meaning as in the EP&A Act.
- ***affected species*** means subject species likely to be affected by the proposal.
- ***conservation status*** is regarded as the degree of representation of a species or community in formal conservation reserves.
- ***DA*** number means Development Application number.
- ***development*** has the same meaning as in the EP&A Act.
- ***Director General*** means the Director General of OEH.
- ***Direct impacts*** are those 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. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.
- ***DP*** means Deposited Plan which is the **plan** number given to a subdivision that is registered by the Land Property Information.
- ***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. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.
- ***Life cycle***: the series or stages of reproduction, growth, development, ageing and death of an organism.

- ***LGA*** means Local Government Area.
- ***Local occurrence***: the ecological community that occurs within the study area. However the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community 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 assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions.
  - 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 same meaning as ascribed to local population of a species or local occurrence of an ecological community.
- ***OEH*** means the Office of Environment and Heritage (within the Department of Premier and Cabinet).
- ***region*** has the same meaning as that contained in the TSC Act.
- ***Risk of extinction***: the likelihood that the local population will 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.
- ***significant species*** means species not listed in the TSC Act but considered to be of regional or local significance.
- ***study area*** is the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
- ***subject site*** means the area which is proposed for development/activity.
- ***subject species*** means those threatened and significant species, populations 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 TSC Act; the definition is not limited to key threatening processes.
- ***Viable***: the capacity to successfully complete each stage of the life cycle under normal conditions.

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

MATTERS WHICH HAVE BEEN LIMITED OR MODIFIED

The following Section 110 matters of the TSC Act need not be addressed by the subject SIS:

- Section 110(2)(g) and 110(3)(d).

The matters raised in these sections of the TSC Act have been clarified by the requirements below.

The following Section 110 matters need only be addressed where relevant:

- all reference to threat abatement plans
- all reference to recovery plans
- all reference to key threatening processes
- all reference to critical habitat. At the time of printing, the areas of declared critical habitat are not relevant to this proposal.

The proponent should be aware that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these requirements and the granting of consent. If this occurs, these additional matters will need to be addressed in the SIS and considered by the consent, determining or concurrence authority.

MATTERS TO BE ADDRESSED

The TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the TSC Act with the exception of those matters limited above. The requirements outlined in Sections 109 and 110 (excluding the matters limited above) have been repeated below (italics) along with the specific Director General Requirements (DGRs) for your proposal. Previous surveys and assessments that are relevant to the locality may be used to assist in addressing these requirements.

Section 111 (1) of the TSC Act states that an applicant must comply with the DGRs concerning the form and content of the SIS. Failure to fully comply with the DGRs is therefore a potential breach of the legislation, and may result in OEH being unable to grant concurrence to a request by the consent authority to carry out the activity. Accordingly, the SIS must be formatted to follow the sections and subsections provided in the DGRs.

1 FORM OF THE SPECIES IMPACT STATEMENT

1.1 A species impact statement must be in writing (Section 109 (1));

1.2 A species impact statement must be signed by the principal author of the statement and by:

(a) the applicant for the licence, or

(b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2)).

The applicant or proponent must sign the following declaration:

> "I...[insert name], of ..[address], being the applicant for the development consent...[insert DA number, 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 proposal".

2. CONTEXTUAL INFORMATION

2.1 Description of proposal, subject site and study area

A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout (Section 110 (1))

2.1.1 Description of the proposal

A full description of the action 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 as a result of the proposal 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 Definition of SIS study area

The SIS study area must be defined. The study area will generally be larger than the development site as it includes any adjacent areas that will be directly or indirectly affected by the proposal. In defining the study area consideration shall be given to possible indirect effects of the proposed action on the area surrounding the subject site, for example habitat fragmentation, vegetation corridors, altered hydrology regimes, soil erosion, pollution, and increased human presence or associated impacts. These may include adjacent parcels of land containing suitable habitat for threatened species. It is therefore important to recognise that these parcels may need to be investigated along with the development site. The location, size and dimensions of the study area shall be provided.

The study area should be established before the list of likely impacted threatened species, populations, ecological communities (including their habitat) is determined so species etc. that are less obviously affected are also included. The study area must be clearly defined, marked on a geo-referenced map / aerial photograph (or equivalent), clearly showing the development site boundary and any additional areas facing indirect impact, and included in the final report.

Direct impacts are those that directly affect individuals or their habitat. Examples of direct impacts include:

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

If the proposal involves the clearing of vegetation and/or removal / damage to habitat the environmental assessment must clearly articulate the size of this impact, and where applicable delineate this on the basis of vegetation / habitat type.

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Examples of indirect impacts include (but 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, such as Dieback fungus (*Phytophthora*) and Myrtle Rust (*Uredo rangelii*),
- noise,
- dust,
- light pollution (i.e. increasing skyglow from uncontrolled urban uplight),
- fire (such as changes to intensity and frequency),
- fertilizer drift, and
- increased human activity (including litter) within or directly adjacent to sensitive habitat areas.

Indirect impacts should not be just limited to the terrestrial habitats. In stances where a development site adjoins marine, estuarine and/or riparian / riverine environs / habitat, impacts on these must be considered.

(Note: Indirect impacts may lead to direct loss, and as such must be adequately quantified and assessed. Both impacts within the proposed development footprint and on adjacent / surrounding lands must be taken into account, and where appropriate adequately considered and addressed).

<u>2.1.3 Description of SIS study area</u>

The description of the study area must include (but not limited to):

- a general description of the study area, including size of the development area / area of impact (both direct and indirect) and total area of clearing (all vegetation), and the site in relation to general locale. A 'general locale' map should be provided. If the proposal has of-site indirect impacts these areas must also be included and quantified;
- the vegetation communities (including secondary, derived, disturbed and exotic) and habitat types, including identification of the classification system used in the SIS. This section of the SIS must include: (i) Details of the methodology adopted to delineate vegetation communities on site (e.g. random stratified sampling) and a description of how this was undertaken, (ii) Full floristic description of all vegetation communities present (including disturbed and undisturbed), including any analyses undertaken to help delineate such communities (e.g. PATN), (iii) A listing of the amount (in hectares) of each vegetation community in the study area, including a list / table comparing the amount (in hectares) of each community to be cleared verses that being retained, (iv) A geo-referenced map / aerial photograph (or equivalent) showing the location of the vegetation communities, and (v) A full floristic list in tabular format of all taxa (both native and exotic) recorded on the subject site, indicating which communities they occur in, their cover / abundance and frequency, conservation (including taxa of conservation significance) and comparisons to previous vegetation studies / mapping (if applicable);
- an examination of previous land uses and events, and the effect of these land uses and events on the study area. Examples of such land uses and events are clearing, timber felling, draining, recreational use and agricultural activities (including grazing);
- an examination of the fire history, or at least the time since the last fire, for the subject site is to be provided. Ideally, information on the frequency, season and intensity of fire events on the subject site will be provided. To adequately address this requirement, it may be necessary to consider fire events in the surrounding landscape;
- the local government land zoning and any proposed rezoning, and an examination of the degree of protection that current zoning and any proposed rezoning provides or will provide to native

vegetation and threatened species, populations and ecological communities on the subject site and in the study area and the locality;

- the land tenure and any proposed changes (e.g. acquisition by OEH as a Nature Reserve, National Park, Regional Park etc.), and an examination of the degree of protection that current land tenures and any proposed land tenures provides or will provide to native vegetation and threatened species in the study area;
- State Environmental Planning Policies (e.g. SEPP 14 Coastal Wetlands, SEPP 44 Koala Habitat Protection, and SEPP 71 Coastal Protection) and an examination of the degree of protection these policies provide to native vegetation and threatened species on the subject site and in the study area.
- relevant Local Government planning instruments, including Local Environmental Plans and Development Control Plans.

2.2 Provision of relevant plans and maps

A plan of the subject site, including the scale of the plan should be provided. An aerial photograph (preferably colour) of the locality (or reproduction of such a photograph) shall be provided, if possible. This aerial photograph should clearly show the subject site and the scale of the photograph. It should be geo-referenced and show the date of the photograph.

A geo-referenced topographic map or equivalent of the subject site and immediate surrounds at an appropriate scale should be provided. This map should detail the location of the proposal and location of works on site (including areas of indirect impact). Additionally, to provide an overview of the natural landscape in the general locality, the map should show or be overlain with details of vegetated (i.e. woody [e.g. forests, woodland, shrubland and heath] and non-woody native vegetation [e.g. grassland, sedgeland and saltmarsh]) vs. cleared areas, as well as indicating the current activities/usage of this land, such as rural, agricultural, industrial and residential. OEH expects a separate map will be provided to indicate what specific vegetation communities are on subject site (as detailed above in Section 2.1.3).

A map of the locality, showing any locally significant areas for threatened species (such as know regional corridors, key habitats, conservation parks and reserves), and areas of high human activity such as townships, regional centres and major roads will also be provided as an overview. The location, size and dimensions of study area must also be provided.

2.3 Land tenure information

Information about the land tenure across the study area. Any limitations to sampling across the study area (e.g. denied access to private land) shall be noted.

3 INITIAL ASSESSMENT

A general description of the threatened species or populations 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 (Section 110 (2)(a)).

3.1 Identifying subject species, populations and/or ecological communities

3.1.1 Assessment of available information

In determining these species (the subject species), populations and ecological communities, consideration shall be given to the habitat / vegetation types present within the study area, recent and historic records of threatened species, populations or communities in the locality, the known distribution of threatened species, and the known and predicted use of habitat for all potential species.

Databases such as OEH's: 'Atlas of NSW Wildlife', 'BioBanking Credit Calculator' (details of which can be obtained from www.environment.nsw.gov.au/biobanking/calculator.htm) and the 'Threatened Species Profile Database' (details which can be obtained from http://www.environment.nsw.gov.au/threatenedSpeciesApp/), the Australian Museum and Royal Botanic Gardens should be consulted to assist in compiling the list. It should be noted that if the OEH Atlas is the only database that is referred to, due to data exchange agreements, the data provided by OEH will only include that for which OEH is a custodian. In many cases, this may only be a small subset of the data available. Other databases must also be consulted to create a comprehensive list of subject species. Vegetation mapping for the region may assist on identifying potential ecological communities.

The following threatened species and ecological communities shall be considered for inclusion in the list of subject species, as they have either been recorded in the general area (i.e. 10 kilometre radius based on the 'Atlas of NSW Wildlife' data base), are within the species' known geographic limits or their broad habitat preferences may be present on site (*NOTE: OEH does not necessarily consider this an exhaustive list):

Flora:

For targeted surveys please note the following known flowering / fruiting times for each species to time surveys appropriately. Surveying at these times is required for species that are not readily detectable (and/or are cryptic), where flowers and/or fruits are necessary for their positive identification. If targeted flora surveys for these species are conducted outside a species known phenology then justification must be provided as to why; if this is not provided or considered inappropriate, then all such species will be considered to be present on all available habitat and in viable numbers, and as such will require suitable biodiversity offsets or their habitat avoided. For species which do not require flowers / fruits for positive identification (e.g. large trees / shrubs), then survey as appropriate (though appropriate justification on methods used is still required).

Targeted flora surveys must also adequately sample / cover all suitable habitat on the study area, and utilise suitable detection techniques such as belt transects (at appropriate widths to spot cryptic species) or random meanders (that sufficiently cover all known / potential habitat areas [i.e. not just the tracks or readily accessible areas]). If targeted flora surveys are poorly conducted and/or surveyed then appropriate justification must be provided as to why; if this is not provided or considered inappropriate, then all such affected species will be considered to be present on all available habitat and in viable numbers, and as such will require suitable biodiversity offsets or their habitat avoided.

Flora

Maundia triglochinoides
Slaty Red Gum (*Eucalyptus glaucina*)
Square-fruited Ironbark (*Eucalyptus tetrapleura*)
Weeping Paperbark (*Melaleuca irbyana*)

Mason's Grevillea (*Grevillea masonii*)
Thorny Pea (*Desmodium acanthocladum*)

Fauna:

For Fauna species please be aware of: (i) habitat preferences and known distribution for each of the species as an indication as to whether they may occur in the study area, and (ii) the best times of year these species may be detected if subject to surveys. If animals are captured with an uncertain taxonomy, species should be forwarded to the Australian Museum by a suitably qualified scientific licence holder.

Amphibians:
Wallum Froglet (*Crinia tinnula*)
Green and Golden Bell Frog (*Litoria aurea*)*
Green-thighed Frog (*Litoria brevipalmata*)

Reptiles:
Pale-headed Snake (*Hoplocephalus bitorquatus*)
Stephen's Banded Snake (*Hoplocephalus stephensii*)

Birds:
Magpie Goose (*Anseranas semipalmata*)
Freckled Duck (*Stictonetta naevosa*)
Marbled Frogmouth (*Podargus ocellatus*)
Australasian Bittern (*Botaurus poiciloptilus*)
Black Bittern (*Ixobrychus flavicollis*)
Brolga (*Grus rubicunda*)
Bush Stone-curlew (*Burhinus grallarius*)
Comb-crested Jacana (*Irediparra gallinacean*)
Glossy Black Cockatoo (*Calyptorhynchus lathami*)
Brown Treecreeper (*Climacteris picumnus* subsp. *victoriae*)
Barred Cuckoo-shrike (*Coracina lineata*)
Varied Sittella (*Daphoenositta chrysoptera*)
Black-necked Stork (*Ephipporhynchus asiaticus*)
Little Lorikeet (*Glossopsitta pusilla*)
Little Eagle (*Hieraaetus morphnoides*)
Square-tailed Kite (*Lophoictinia isura*)
Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)
Powerful Owl (*Ninox strenua*)
Osprey (previously *Pandion haliaetus* now *Pandion cristatus*)
Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis* subsp. *temporalis*)
Wompoo Fruit-dove (*Ptilinopus magnificus*)
Speckled Warbler (*Pyrrholaemus sagittatus*)
Masked Owl (*Tyto novaehollandiae*)

Mammals:
Rufous Bettong (*Aepyprymnus rufescens*)
Spotted-tailed Quoll (*Dasyurus maculatus*) *
Little Bent-wing Bat (*Miniopterus australis*)
Eastern Freetail bat (*Mormopterus norfolkensis*)
Hoary Wattled Bat (*Chalinolobus nigrogriseus*)
Southern Myotis (*Myotis macropus*)
Yellow-bellied Glider (*Petaurus australis*)
Squirrel Glider (*Petaurus norfolcensis*)

Brush-tailed Phascogale (*Phascogale tapoatafa*)
Koala (*Phascolarctos cinereus*)
Common Planigale (*Planigale maculata*)
Grey-headed Flying-fox (*Pteropus poliocephalus*)*
Eastern Long-eared Bat (Nyctophilus bifax)
Greater Broad-nosed Bat (*Scoteanax rueppellii*)
Eastern Cave Bat (*Vespadelus troughtoni*)

Endangered Populations

- Emu population in the NSW North Coast Bioregion and Port Stephens LGA.

Endangered ecological communities

- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Lowland rainforest on floodplain of the NSW North Coast Bioregion.
- Subtropical coastal floodplain forest of the NSW North Coast Bioregion.
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Swamp Oak Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The above lists are not necessarily exhaustive. The applicant must carry out their own process of determining the subject species. This process should incorporate consideration of:

- the vegetation communities present within the study area;
- the presence, quantity, quality and degree of fragmentation of likely habitat for individual threatened species;
- recent (within the last ten years) records of threatened species, populations and ecological communities in the locality;
- the known distribution of threatened species, populations and ecological communities; and
- the known and predicted use of habitat for all potential species.

OEH's Atlas of NSW Wildlife, Threatened Species Profile database, Australian Museum and Royal Botanic Gardens databases, the Birds Australia and NSW Bird Atlas databases (for birds) and other relevant databases should be used to assist in compiling or assessing the list. The Data Licensing Officer at OEH's Head Office should be contacted on (02) 9585 6684 to obtain information on the Atlas database.

Threatened species, populations and ecological communities on the above list may be excluded from further consideration as subject species only if a fully documented justification, robust to external examination, is provided. This documentation must address, as a minimum, the criteria for determining subject species that are listed above. In particular, threatened species that are cryptic, mobile or little surveyed (or possess combinations of these parameters (e.g. bats)), and for which the study area provides suitable habitat and falls within the species' range, must not be excluded solely on the basis of a lack of records in the locality. Furthermore, threatened species that occur in a range of habitats must not be excluded on the basis that their core habitat is not present in the study area or locality.

The proponent should be aware that additional species, populations, and ecological communities could be added to the schedules of the TSC Act between the issue of these requirements and the granting of consent. If this occurs, these additional matters will need to be addressed in the SIS and considered by the consent, determining, or concurrence authority.

Preliminary Listed Species, Populations and/or Ecological Communities

Any 'final determination' to list a species, population or ecological community as 'critically endangered' or 'endangered' made after lodgement of a development application or activity proposal needs to be included in the consideration of impacts and the application of the assessment of significance. Vulnerable species listed after lodgement are not subject to impact assessment as long as the application is determined within 12 months of lodgement.

OEH would expect the proponent to address the OEH 'offset principles' (OEH 2011). In order to achieve this, the SIS will need to clearly demonstrate how the impacts can be avoided first by using prevention and mitigation measures. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent impacts. In instances where this can not be attained and impacts can not be avoided then offsets will need to be provided that address the remaining impacts or the impacts in general. Offsets or provision of compensatory habitat must lead to the overall maintenance or improvement of biodiversity values on site (i.e. 'improve or maintain' principle), and as such must be in accordance with 'offset provision' principles, as outlined OEH website (2014), or via a biodiversity assessment under the 'BioBanking Assessment Methodology' (OEH 2014).

4 SURVEY

4.1 Requirement to survey

A fauna and flora survey must be conducted in the study area. Targeted surveys should be conducted for all subject species determined in accordance with Section 3.1. Recent (less than five years old) surveys and assessments may be used, but surveys greater than five years will not be accepted. However, previous surveys will not be considered to have addressed this requirement if they have:

- been undertaken in seasons, weather conditions or following extensive disturbance events when the target subject species are unlikely to be detected or present (e.g. outside known flowering / fruiting periods, adverse drought conditions, flooding, bushfire [though some species are 'fire obligates' requiring fire to germinate], slashing and overgrazing etc.); or
- utilised methodologies, survey sampling intensities, timeframes or baits that are not the most appropriate ones for detecting the target subject species unless these differences can be clearly demonstrated to be likely to have had an insignificant impact upon the outcomes of the surveys.

Surveys must be undertaken by appropriately experienced and qualified persons. A recognised expert, from institutions such as the Australian Museum (Sydney), the National Herbarium of NSW at the Royal Botanic Gardens (Sydney) or the Queensland Herbarium (Brisbane), or who is otherwise considered acceptable by OEH, must be used to determine or confirm the identification of species that are unknown or which have been only provisionally identified.

Survey methods adopted must be those considered by experienced wildlife surveyors to be the ones most likely to detect the targeted subject species (more than one survey method must be utilized for those subject species for which complementary methods have the potential to result in a significant increase in detection). Survey effort (including intensity, repetition and coverage) must be at a level that can be reasonably expected to detect the subject species if present in the study area. Surveys must be undertaken at the time of year when the subject species are most likely to be detected (e.g. targeted threatened flora should be carried out when a species is flowering and/or fruiting, as these features are typically required to positively identify species) and, where possible, in appropriate weather conditions. OEH expects the 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 to be recorded for each day of survey (including dates) to be documented and included in the report.

Survey procedures and assessment of results should be consistent with those procedures and assessment approaches contained within the OEH publications:

- 'Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities' (DEC – November 2004)'. (*Note: Section 6.1 Assessment of Significance has now been amended by DECC 2007b);
- 'Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC – April 2009a)'; and
- 'Threatened Species Assessment Guidelines: The Assessment of Significance' (DECC – August 2007b).

(Note that OEH has recently produced new survey guidelines to cover Amphibians (frogs), which replaces the amphibian section in the DEC (2004) guidelines. However, the survey requirements for all other species (flora and fauna) are still found in the DEC (2004) guidelines).

The above documents can be located on the OEH's website under the 'Threatened species survey and assessment guidelines' at:

- www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm

If a proposed survey methodology is likely to vary significantly from widely accepted methods, the proponent should discuss the proposed methodology with the OEH prior to undertaking the SIS, to determine whether OEH considers that it is appropriate.

In addition to the above guidelines, OEH has recently posted new information on the OEH website to ensure appropriate surveys are completed, with particular reference to fauna surveying. Below is a summary of this information as well as other clarifying points, often relating to vegetation survey. This updated information can be accessed from:

- www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm

False absences and imperfect detection

While the presence of a target species can often be confirmed at a site relatively easily, it is generally impossible to confirm a species is absent. Unless a species has a 100 per cent chance of being detected on a single visit (i.e. it has a probability detection of 1) non-detection does not necessarily mean the species is absent (MacKenzie *et al.* 2002). Very few species are so conspicuous that they are always detected in each survey (MacKenzie *et al.* 2002).

A species' detectability is influenced by several factors (Tyre *et al.* 2003). Such factors include:

- the species in question – fauna species with large home ranges are especially likely to go undetected in an area, as at any given time they may be in another part of their range
- climatic conditions (e.g. temperature, rainfall)
- experience of the surveyor/s
- the survey methodology used.

An observed absence may be due to an observer failing to detect a species that is actually resident at the site, for example, a bird that was elsewhere in its home range at the time of the survey or failed to call during a point count (MacKenzie 2005). False absences have serious consequences for habitat modelling and monitoring studies as well as impact assessments. When fauna surveys are conducted for the purpose of impact assessment, false absences may result in inadequate conservation measures and an increased risk of local extinction (Wintle *et al.* 2005).

Hence, the SIS should be conservative when determining whether a species, population and/or community (including their habitat) are potentially present (i.e. precautionary approach).

Stratifying the site

When designing a field survey, firstly stratify the study area (i.e. divide the area into relatively homogenous units – often referred to as 'environmental sampling units' or 'stratification units'). Stratified sampling provides a logical, objective and efficient method of undertaking surveys and ensures that the full range of potential habitats and vegetation types will be systematically sampled and mapped. For the mapping of vegetation and delineation of habitat types, the study area / subject site should be initially stratified on biophysical attributes (e.g. landform, geology, elevation, slope, soil type, aspect, climate, rainfall etc.) that best delineate likely vegetation changes across the landscape. Vegetation structure or type(e.g. OEH Plant Community Type [VIS Classification System 2.1 website: http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx?ReturnUrl=%2fNSWVCA20PRapp%2fdefault.aspx], Biometric vegetation type or other acknowledged vegetation mapping / classification), condition and disturbance history may be used to better define the boundaries of stratification units.

Once the stratification units have been identified, they should be recorded on a survey map. Remote sensing such as aerial or satellite photograph interpretation coupled with ground-truthing will help better refine and determine the spatial vegetation patterns and habitat types across a study area.

For further information on stratification and the use of Biometric tool (BioBanking Credit Calculator) in this process (particularly for fauna) refer to the new information posted on the OEH website:

http://www.environment.nsw.gov.au/biobanking/

Visiting the site

Conduct a preliminary site visit to refine the initial stratification units, determine the broad vegetation types (i.e. OEH Plant Community Types / Biometric Vegetation Types) present at the site, assess the vegetation condition and conduct a broad habitat assessment to help delineate specific features suitable for sampling.

Taking a copy of the OEH Plant Community Types and/or Biometric vegetation types for the relevant Local Land Services (LSS; formerly Catchment Management Authority [CMA]) area or equivalent (e.g. existing vegetation mapping) into the field during the preliminary site visit, may be useful in determining the likely vegetation types present. However, for some LLS areas this should only be used as a guide as some vegetation types / communities have not been captured or delineated in the NSW Plant Community Types database (VIS Classification System 2.1 website: http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx?ReturnUrl=%2fNSWVCA20PRapp%2fdefault.aspx).

Survey Design

Once the site has been stratified, an adequate survey design (e.g. stratified random sampling for vegetation / flora) should be developed which adequately samples all stratification units and habitat types. Vegetation survey sites should be selected randomly and be based on the variation inherent in the stratification, while fauna sites are likely to be selected on the basis of vegetation change and specific habitat types present (e.g. hollow bearing trees, feed trees, rock outcrop, presence of water etc.). Additional targeted surveying will be required for threatened species that are dependant on specific vegetation types and/or habitats or require specific sampling because of seasonality (e.g. flowering season for some plants, warmer months for fauna etc.).

To sample vegetation, for example, a standard plot should be adopted to ensure the structural and floristic character of all vegetation types on site is adequately captured (e.g. 0.04 hectare [20m × 20m] quadrat).

Targeted Surveys - Flora

For targeted flora surveys please note the known flowering / fruiting times for each species to time surveys appropriately (as listed above for potential 'subject species'). Surveying at known flowering times is required for all potential species that are not readily detectable (and/or are cryptic), where flowers and/or fruits are necessary for their positive identification. If targeted flora surveys for potential species are conducted outside a species known phenology then justification must be provided as to why; if this is not provided or considered inappropriate, then all such species will be considered to be present on all available habitat and in viable numbers, and as such will require suitable biodiversity offsets or their habitat avoided. For species which do not require flowers / fruits for positive identification (e.g. large trees / shrubs), then survey as appropriate (though appropriate justification on methods used is still required).

Targeted flora surveys must also adequately sample / cover all suitable habitat on the study area, and utilise suitable detection techniques such as belt transects (at appropriate widths to spot cryptic species) or random meanders (that sufficiently cover all known / potential habitat areas [i.e. not just the tracks or readily accessible areas]). If targeted flora surveys are poorly conducted and/or surveyed then appropriate justification must be provided as to why; if this is not provided or considered inappropriate, then all such affected species will be considered to be present on all available habitat and in viable numbers, and as such will require suitable biodiversity offsets or their habitat avoided.

Targeted Surveys – Fauna

When undertaking targeted fauna surveys you must be aware of: (i) habitat preferences and known distribution for each of the species as an indication as to whether they may occur in the study area, (ii) the best times of year these species may be detected if subject to surveys, and (iii) suitable survey techniques to adequately detect a potential species. If targeted fauna surveys are poorly conducted, inappropriately surveyed and/or undertaken outside known detection periods, then appropriate justification must be provided as to why; if this is not provided or considered inappropriate, then all such affected species will be considered to be present on all available habitat and in viable numbers, and as such will require suitable biodiversity offsets or their habitat avoided.

If animals are captured with an uncertain taxonomy, species should be forwarded to the Australian Museum by a suitably qualified scientific licence holder.

Habitat assessment

Habitat assessment is recommended for all sites and should be used to supplement surveying and survey design. In instances where intensive or species specific surveys have not been carried out due to either timing or seasonality constraints, habitat assessment may be used as a surrogate for intensive surveys. However, in this instance threatened species should be assumed present if their habitat requirements are met. Ensure all impact assessments include a thorough habitat assessment.

Undertaking a habitat assessment of the study area will assist with predicting the occurrence of threatened species in the study area and will guide the location of targeted surveys. A comprehensive habitat assessment should be conducted across the whole site, identifying key habitat features for both flora and fauna.

You should be familiar with the habitat requirements of each threatened species identified as possibly occurring in the study area. This information can be obtained from recovery plans, threatened species profiles and scientific literature. Threatened species profiles are available on the OEH website:

http://www.environment.nsw.gov.au/threatenedSpeciesApp/

The habitat assessment should include information on:

- landscape features in the study area (e.g. river banks, rocky outcrops, dry slopes, wetlands, undulating terrain);
- any other features that could provide habitat such as hollow-bearing trees or culverts; and
- the vegetation types present (such as OEH's Plant Community Types and/or Biometric vegetation types and/or appropriate vegetation mapping).

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, such as those of the Hastings River Mouse
- large trees with basal cavities
- logs
- wetlands, streams, rivers, dams and other water bodies
- nests and roosts
- wombat burrows
- dens used by yellow-bellied gliders, squirrel gliders and brush-tailed phascogales
- yellow-bellied glider and squirrel glider sap feed trees
- distinctive scats (e.g. those of the spotted-tailed quoll or koala)
- latrine and den sites of the spotted-tailed quoll
- Allocasuarina spp.
- flying-fox camps
- Microchiropteran bat tree roosts
- Microchiropteran bat subterranean roosts (caves, culverts, tunnels and disused mineshafts)
- swift parrot and regent honeyeater feed or nest trees
- winter-flowering eucalypts
- mistletoes
- permanent soaks and seepages
- areas that can act as corridors for plant or animal species.

Another important factor to consider is the connectivity value of the site. If the proposal site forms an important corridor in the area, the development is likely to have an effect on threatened species in the region.

A geo-referenced map / aerial photograph (or equivalent), of the study area detailing key habitat features, including the vegetation types, must be included in the report.

Flora / Vegetation Survey and Mapping

Typically a floristic quadrat / transect will be used for vegetation based surveying. This should record the vegetation structure and cover of all structural layers, all species present, including their cover and abundance, and general location (e.g. Global Positioning System (GPS) co-ordinates etc.) and physiographic details (e.g. condition, position in landscape, soils etc.). These techniques are described in the OEH guideline and are generally the accepted national (NVIS – National Vegetation Inventory System) standard. Each stratification unit must be adequately sampled.

All quadrats / transects should be adequately assessed to determine a suitable vegetation classification which accurately reflects the site. This may be done manually, or through the aid of appropriate statistical software / numerical analysis, such as cluster analysis and ordination analysis computer packages (e.g. PATN [Belbin 1989]). The latter will be dependant on how detailed the survey was, the size of the area sampled, the inherent diversity / complexity of vegetation on site and the amount of plot data collected. Details of the classification and how it was determined must be supplied in the report.

To complement and better refine the vegetation classification, ground-truthing and aerial photograph or satellite imagery interpretation should be used. This will be used to generate the vegetation map and enable greater definition / delineation of vegetation communities present, and ensure a more accurate map. Ground-truthing and/or Aerial Photograph Interpretation (API) should be conducted at a level which captures all the obvious vegetation changes / communities on the subject site (particularly those that are noticeable at the ground-level) and ensure that all vegetation communities are adequately delineated on a geo-referenced map (the 'vegetation map'). Floristic quadrats / transects and any associated analysis will help define and describe the communities shown on the vegetation map. Recognition and delineation of native vegetation patterns on aerial photography may be based on combinations of:

- texture (crown size and shape)
- vegetation height and density
- vegetation and background tone and colour
- landuse pattern (non-woody areas).

Determining Plant Community Types and/or Biometric vegetation types

The classification of native vegetation in NSW follows the system described by Dr David Keith in 'Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT' (Keith 2004). This classification scheme divides native vegetation into 17 broad vegetation formations. Each formation consists of a number of vegetation classes. There are 99 vegetation classes. These classes are further divided into vegetation types (referred to here as 'OEH Plant Community Types and/or Biometric vegetation types'), which are the finest scale of vegetation classification used in NSW.

OEH has developed a NSW Plant Community Types via the 'VIS Classification System 2.1' database for use with the BioMetric tool, which is designed to assist in assessing biodiversity values when preparing property vegetation plans under the *Native Vegetation Act 2003* and BioBanking agreements under the TSC Act. This database also provides links to all the LLS (formerly CMA) area's 'Biometric Vegetation Types'. This database is located on OEH's website at (Note: You will need to register to become a user of the database):

> http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx?ReturnUrl=%2fNSWVCA20PRapp%2fdefault.aspx

If you are proposing to conduct a biodiversity assessment using BioBanking Assessment Methodology under Biodiversity Banking and Offsets Scheme, as outlined in the 'BioBanking Assessment Methodology 2014' (OEH 2014), to determine the offset requirements of the proposal, then it is advisable and advantageous that during the survey component of the SIS that you collect the relevant data in the appropriate format for the Biometric tool (i.e. BioBanking Credit Calculator) (*Note: this may reduce duplication or further surveying at a later date). This process can provide details of the required ecosystem and species (threatened) credits that need to be retired to offset the impacts of the development. Under this scenario all vegetation types in the study area should be identified and matched to an OEH BioMetric vegetation type.

For details on the use of Biometric, the 'BioBanking Assessment Methodology 2014' (OEH 2014) and BioBanking in general refer to the following OEH website (Note: - the new information posted on the OEH website, as detailed above, includes details on site selection, survey intensity and methodology, and vegetation condition measurements):

- www.environment.nsw.gov.au/biobanking/

If a BioBanking assessment is conducted using the Credit Calculator then OEH requests that the proponent provide an explanation of how the local vegetation communities were assigned to Biometric vegetation types, copies of BioBanking Credit Reports, copies of all field data sheets, an explanation of the underlying assumptions used at every step of the BioBanking Credit Calculator (see Section 4.5 below), and the submission of the credit calculator files via the OEH portal.

4.2 Documentation of survey effort and technique

4.2.1 Description of survey techniques and survey sites

Survey technique(s) must be described and a reference given, where available, outlining the survey technique employed. Specific subject species targeted by each survey technique should be listed.

Survey site(s) and stratification units must be identified on a geo-referenced map / aerial photograph (or equivalent), with a clear legend, at the same scale as previous maps where possible. The size, orientation and dimensions of a quadrat or a length of transect should be clearly noted for each type of survey technique undertaken. Full Australian Map Grid (AMG) grid (Geocentric Datum of Australia (GDA) compliant) references for the survey site(s) should be noted.

4.2.2 Documenting survey effort

The time invested in each survey technique applied must be summarised (preferably in tabular format) in the SIS (e.g. - number of person hours per transect / quadrat, duration of call playback, number of nights traps set etc...). It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed for each separate survey technique and each separate vegetation community. Survey, quadrat and transect sites must be schematically shown on a geo-referenced map and/or photograph. Targeted surveys also need to specify method adopted (e.g. belt transects, random meander [Cropper 1993]), habitats searched (e.g. type / features), duration, effort, prevailing weather conditions and location. Environmental conditions during the survey should be noted at the commencement of each survey technique.

Personnel details including name of all surveyor(s), contact phone number and relevant experience should be provided. The person who identified records (e.g. Anabat, hair tubes, scat analysis and flora samples) must be identified.

4.3 Survey results

4.3.1 Subject species survey results

The report should provide a full list of all flora and fauna recorded in the study area / subject site. Copies of all survey data sheets (both flora and fauna) must be provided as part of the SIS.

Subject species recorded in the study area shall be identified, and the vegetation community in which they were recorded noted. Information concerning all records of threatened species made during the survey is to be provided in an appendix to the SIS. This information is to be in a form consistent with Atlas of NSW Wildlife data recording cards and include information for all fields listed on these cards.

The limitations of survey techniques employed (including survey intensity, detectability of species, seasonality, weather conditions and adverse disturbance conditions) must be considered and discussed with respect to the results of the survey, and additional subject species considered to potentially occur in the study area identified. This assessment must be robust to external evaluation.

4.3.2 General species survey results

The SIS must provide details of all the vegetation communities (including disturbed and undisturbed / modified), habitat types, and all fauna and flora recorded on the subject site and study area in general.

A full list of the protected fauna and native plant species (as defined by the *National Parks and Wildlife Act 1974*) found during the course of surveys must be included. Such information is indicative of the habitat quality of the site. This list must indicate the significance of each species, whether the species is introduced, and the habitat in which each species was recorded.

4.4 Subject species habitat mapping

Areas identified as known or potential habitat in the study area are to be mapped on a geo-referenced map / aerial photograph (or equivalent) separately for each of the subject species. These maps should be at the same scale as previous maps where feasible, and are to include any point locality records of the relevant subject species recorded from the SIS survey in the study area. Note: Records obtained from the 'Atlas of NSW Wildlife' database can be used in determining likely habitat, but they are not to be schematically mapped in the SIS, as this is considered a breach of licence conditions for such records.

While in some circumstances the task of identifying potential habitat can be problematic, the SIS should provide the best expert estimate of the habitat of each threatened species, populations and ecological communities known or considered likely to occur in the study area. This is necessary in order to clearly support conclusions concerning the quantitative significance of habitat loss associated with the proposal. Information which can be used in preparing these maps includes records of threatened species in the local area, maps of vegetation communities and broad habitat types in the study area, information on the habitat requirements of threatened species and site-specific knowledge gained through field survey and inspection during preparation of the SIS.

4.5 General report structure

In summary, the report must include details on the following (but not be limited to):

- a description of the subject site, study area and its regional context; including a geo-referenced map / aerial photograph (or equivalent) indicating their location;
- details of the survey methodology and design adopted, including:
  - the number and location of traps (e.g. cage, Elliott, hair sampling tubes etc.), call playback sites, diurnal searches, random meanders, quadrats and transects,
  - the number of repetitions (Note: – you will need to provide a justification if this differs from the recommendations in these guidelines),
  - details of all floristic plots and/or transects,
  - details of the stratification,
  - identification of the classification system used (e.g. Specht *et. al.* (1974), Walker & Hopkins (1998) [Note: the classification must have regard to both structural and floristic composition elements]),

  - timing of surveying, climatic (weather) conditions and phases of the moon during survey,
  - details of how the vegetation classification for the site was developed, including details and associated products (e.g. dendrograms / two-way tables) of any analyses used, if applicable,
  - copies of any analyses used (e.g. PATN or other statistical files) and all field data sheets, and
  - geo-referenced maps / aerial photographs (or equivalent) showing the location of all survey points, quadrats and transects, and stratification units.
- detailed description of all vegetation communities / types (both undisturbed and disturbed) on the site and study area (it is preferable to link them to, OEH's Plant Community Types / Biometric vegetation types – in which case a step by step summary of how the site vegetation was matched with available Biometric vegetation types should also be included), including a geo-referenced map / aerial photograph (or equivalent) showing their location. The descriptions should include: - a general description, characteristic features (e.g. lacks a mid-storey, restricted to a particular geomorphic / edaphic feature etc.), their distribution and size (e.g. hectares), their vegetation structure (including cover), their condition, key diagnostic species, relationship to other communities, species richness and any significant species present (e.g. threatened species, Rare or Threatened Australian Plants (ROTAP: Briggs & Leigh 1996), regionally significant taxa);
- details of all habitat features / types should be included and mapped (where appropriate), 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 (e.g. winter-flowering eucalypts, *Acacia* and *Banksia* trees, *Casuarina* / *Allocasuarina* and areas of native grasses], crevices, caves, drainage lines, soaks etc.;
- if a BioBanking assessment is conducted for the development site and any offset sites then the proponent must provide:
  - copies of any BioBanking Credit Reports and BioBanking Agreement Credit Reports generated,
  - copies of all field data sheets,
  - copies of a checklist that includes the data and underlying assumptions used at every step of the BioBanking Credit Calculator, and
  - submission of the credit calculator files via the OEH portal.
- a list of all flora and fauna detected on the study area / subject site during the surveys, including threatened species. All threatened species, populations and ecological communities must be clearly marked on geo-referenced map / aerial photograph (or equivalent);
- details of how the proposal will impact (both direct and indirect) and affect known and potential threatened species, populations and ecological communities (including their habitat). This is likely to include a revised 5A assessment of significance;
- details of the habitat assessment;
- details of how the proposal may impact on corridors, connective links and fragmentation;
- details of how the proposal will impact (both directly and indirectly) on adjacent and/or nearby OEH conservation estate and/or if applicable, other internationally / nationally important areas, (e.g. Ramsar wetlands, wetlands listed in the Directory of Important Wetlands, SEPP14 mapped wetlands and Forestry flora reserves);
- details of any impacts on or relevance of other environmental policies and/or guidelines (as outlined in Section 2.1.3);
- details of mitigation and offset / compensatory habitat measures;
- details of any other approvals required under any other State and/or Federal legislation;
- names, qualifications and experience of all personnel involved in the field surveys, analysis of results and report writing;
- paper copies of any maps of proposed biodiversity offset areas at A0 or A1 scale that clearly show the location and boundaries of any proposed offset area. These maps must be prepared by a registered surveyor and be proper survey plans that are acceptable to local Councils;

- an assessment of how the project meets the principles of Ecologically Sustainable Development, as defined in section 6(2) of the *Protection of the Environment Administration Act 1991*;
- a discussion of the likely social and economic consequences of granting or of not granting concurrence; and
- any other information outlined elsewhere in these guidelines, such as background and comparisons to previous studies (e.g. vegetation mapping reports), mitigation and offset measures etc. that should be included in the report.

5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS

Section 5 need only be addressed if threatened species or endangered populations 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 threatened species and/or populations must be addressed as part of the impacts of the overall proposal. Proponents should also consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of perimeter roads as an option in providing fuel free zones and reducing impacts on retained bushland.

5.1 Assessment of species likely to be affected

An assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action (Section 110(2)(b)).

This requirement is asking you to refine your list of subject species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected and the nature of the impact.

The remaining requirements in this section need only be addressed for those species that are likely to be affected by the proposal.

5.2 Discussion of conservation status

For each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it (Section 110 (2)(c)).

An assessment of whether those species or populations are adequately represented in conservation reserves (or other similar protected areas) in the region (Section 110 (2)(e)).

An assessment of whether any of those species or populations is at the limit of its known distribution (Section 110 (2)(e1)).

Assessment should include reference to the threatening processes that are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include reference to any approved or draft recovery plans which may be relevant to the proposal; including those prepared by other state Governments of the Commonwealth Government.

5.3 Discussion of local and regional abundance

An estimate of the local and regional abundance of those species or populations (Section 110 (2)(d)).

5.3.1 Discussion of other known local populations

A discussion of other known populations in the locality shall be provided. The long-term security of other habitats shall be examined as part of this discussion. The relative significance of the subject site for threatened species or endangered population in the locality shall be discussed.

5.3.2 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) and discussion of the significance of these individuals to the viability of the threatened species or endangered population in the locality.

5.3.3 Description of vegetation

The vegetation present within the study area and the area covered by each vegetation community should be mapped and described, as previously stated in Section 4.3.2.

5.4 Assessment of habitat

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f)).

5.4.1 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 (e.g. winter-flowering eucalypts, Acacia and Banksia trees, *Casuarina* / *Allocasuarina*, Mistletoes and 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.

5.4.2 Extent of habitat removal

The location, nature and extent of habitat removal or modification (e.g. including impacts of APZs) which may result from the proposed action including the cumulative loss and fragmentation (isolation) of habitat from the study area (including all Development Applications and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the threatened species or endangered population in the locality.

This shall include an assessment of the proportion of the habitat of the affected species to be affected by the proposal, in relation to the total extent of the habitat in the study area and subject site, and the impact of this on the viability of the affected species in the locality.

5.4.3 Consideration of corridors

Areas within the subject site which may act as local or regional corridors (or part thereof) for affected species must be identified and described. A geo-referenced map showing identified corridors must be provided, and the impact of the proposal on these areas shall be discussed. If relevant, this section should include consideration of 'Key Habitats and Corridors for Forest Fauna' (NPWS Occasional Paper 32: Scotts 2003) and regional linkages, as identified within 'Regional Conservation Assessment, Lower Hunter and Central Coast Region' (Morison & House 2004), or other appropriate studies (e.g. Council specific LES, LEP documents and structure plans).

5.4.4 Impacts on Threatened Species and/or Populations in National Parks Estate

This section only needs to be addressed when threatened species and/or populations in National Parks 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 OEH 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.

5.5 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 (Section 110(2)(h)).

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

This section must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

6 ASSESSMENT OF LIKELY IMPACTS ON ECOLOGICAL COMMUNITIES (ENDANGERED AND CRITICALLY ENDANGERED)

Section 6 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 and/or critically endangered ecological communities must be addressed as part of the impacts of the overall proposal. Proponents should also consider recommendations in 'Planning for Bushfire Protection' (NSW Rural Fire Service 2006) and consider the use of perimeter roads as an option in providing fuel free zones and reducing impacts on retained bushland.

6.1 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 (Section 110(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.

6.2 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, its habitat requirements and any recovery plan or any threat abatement plan applying to it (Section 110(3)(b)).

An assessment of whether those ecological communities are adequately represented in conservation reserves (or other similarly protected areas) in the region (Section 110(3)(b1)).

An assessment of whether any of those ecological communities is at the limits of its known distribution (Section 110(3)(b2)).

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 proposal. The assessment should also include reference to any approved or draft recovery plans which may be relevant to the proposal.

6.2.1 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 other localities 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.

6.2.2 Discussion of corridor values

The potential of the proposal 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.

6.2.3 Discussion of regional significance

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

6.2.4 Impacts on Ecological Communities in OEH Estate

This section only needs to be addressed when endangered and/or critically endangered ecological communities in OEH 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 OEH estate.

6.3 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 (Section 110 (3)(c)).

6.3.1 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.

6.3.2 Extent of habitat removal

The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area 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 proposal, 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.

6.4 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 (Section 110(3)(e)).

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

This condition must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

7 AMELIORATIVE MEASURES

7.1 Description of ameliorative measures

A full description and justification of the measures proposed to avoid or mitigate any adverse effect of the action on the species and populations and ecological community including a compilation (in a single section of the statement) of those measures (Section 110 (2)(i) and Section 110 (3)(f)).

<u>7.1.1 Long term management strategies</u>

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, endangered populations or endangered / critically endangered 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.

<u>7.1.2 Compensatory strategies</u>

OEH notes that its 'offset provision' principles state that impacts must be avoided first by using prevention and mitigation measures (DECC 2007a). Where significant modification of the proposal to minimise impacts on threatened species, populations or endangered / critically endangered ecological communities is not possible then compensatory strategies should be considered. These should include offsite or local area proposals that contribute to long term conservation of affected threatened species, population or ecological communities. If on or off-site compensatory habitat is not considered appropriate, justification must be provided. OEH is of the opinion that where a proposal which involves the clearing of threatened species habitat (i.e. native vegetation) and ecological communities that can not be avoided or mitigated against, then appropriate offsets which compensate for the clearing of the habitat must be provided. In this instance the proposal should clearly indicate the scale / size of the impact so that appropriate comparisons can be made to any offset packages, including a specific breakdown of the vegetation / types being impacted upon and/or cleared. The proponent must provide proper survey plans of any biodiversity offsets with the SIS, as described in sections 2.2 and 4.5 above.

Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.

The tenure of lands, land use and the future use of lands proposed to support compensatory habitat must be considered.

Justification for any area(s) proposed as compensatory habitat / offsets is to include an assessment of the threatened species / biodiversity values impacted on by the proposed works (i.e. those of the subject site) and a comparison of whether the proposed offset area(s) provides equivalent or greater values – 'improve or maintain important biodiversity values'.

To determine the adequate biodiversity offset required to compensate the loss of threatened species, populations, ecological communities and/or their habitat (e.g. vegetation communities) either one of the following methodologies are to be used:

- OEH's *Principles for the use of biodiversity offsets in NSW*, which are available at: www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm), can be used as guide for offsetting and compensatory habitat requirements, or
- a biodiversity assessment using BioBanking Assessment Methodology under Biodiversity Banking and Offsets Scheme, as outlined in the '*BioBanking Assessment Methodology 2014*' (OEH 2014). This would provide details of the required ecosystem and species (threatened) credits that need to be retired to offset the impacts of the development.

Although the '*BioBanking Assessment Methodology (BBAM) 2014*' (OEH 2014) under the Biodiversity Banking and Offsets Scheme represents an alternative pathway to that of the SIS for Part 4 matter, OEH is of the opinion that a biodiversity assessment using process provides a transparent framework and a quantitative alternative to the principles-based approach (i.e. 'offset provision' principles as outlined in the biodiversity accreditation guideline - DECC 2011). OEH acknowledges that in this instance BBAM is a voluntary process and not a requirement under the SIS DGRs, but believes it provides a valuable insight and quantitative appraisal into what would be an acceptable offset package to compensate the likely impacts of the development. OEH notes that under the *Principles for the use of biodiversity offsets in NSW* – Principle 9 states that '*offsets must be quantifiable – the impacts and benefits must be reliably estimated*', in that offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. OEH is of the opinion that the BBAM represents the only currently recognised quantitative methodology that ensures offsets are quantifiable.

Note: On 1 October 2014, a new version of the BioBanking Credit Calculator (BioBanking Assessment Methodology 2014 [OEH 2014]) has become the compulsory version of the tool to use for BioBanking assessments (see www.environment.nsw.gov.au/biobanking/calculator.htm for more details). The credit calculator is now web-based and no longer produces 'xml' files. Instead a copy of the assessment can be sent electronically to OEH. The requirement of submitting background files for OEH to use in checking the BioBanking assessment still stands.

The following principles are relevant to areas without an existing biodiversity offsets program. Offsets will require the proponent to consider adequate conservation in perpetuity, appropriate management regimes (including other habitat enhancement or mitigation measures) and financial security with respect to ongoing management. OEH would typically consider suitable measures to ensure conservation in perpetuity, such as:

- the establishment of BioBanking sites with BioBanking agreements under the TSC Act
- the retirement of BioBanking credits (where appropriate credits are available)
- the dedication of land as a public reserve under the NPW Act
- a Conservation Agreement in-perpetuity registered on title under s69A-KA of the NPW Act
- a Trust Agreement in-perpetuity registered on title under the *Nature Conservation Trust Act 2001*
- a Planning Agreement under s 93F (soon to be s116T) of the EP&A Act.
  Note:
  - OEH preferred method of securing an offset is under the BioBanking provisions of the *Threatened Species Conservation Act 1995* (i.e. a registered BioBanking Agreement site).
  - OEH no longer supports public positive covenant under s88E of the *Conveyancing Act 1919* as an appropriate conservation mechanism to secure and/or manage biodiversity offsets.

- Although OEH supports the use of conservation agreements under the NPW Act as one of the acceptable offsetting mechanisms, we are reviewing this approach and it is advisable that if you are considering this mechanism you contact OEH's Conservation Partners Program (ph: 9995 6761) about its applicability.

The principles do not apply where there is legislation defining requirements for biodiversity offsets (e.g. under the *Native Vegetation Act 2003*).

To appropriately manage any proposed compensatory offsets, any retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs), OEH would require that an appropriate Management Plan (such as vegetation or habitat) be developed as a key amelioration measure. These plans should be prepared prior to any potential approval of the development. Management Plans should clearly document how any retained vegetated areas or habitat features will be managed with respect to long-term conservation and viability, including clear details on how they will be funded. They should cover (where applicable), but not be limited to, the following issues:

- weed management (both control and suppression) and monitoring
- management of retained native vegetation and habitat (including buffer zones)
- feral animal control
- fire management (including asset protection zones [APZs])
- public access (including restriction of, increased traffic, and associated impacts, such as increased refuse and pets)
- size and management of buffer zones
- minimisation of edge effects and fragmentation
- stormwater control and changes to hydrology (including stormwater / runoff control and sediment / erosion control measures)
- management of specific habitat enhancement measures (e.g. hollow / habitat trees, animal fencing to facilitate movement, artificial hollows and nest boxes etc.)
- fauna displacement and if appropriate translocation (including any licence requirements)
- proposed surveys, such as pre-extraction baseline, pre-clearance and rehabilitation surveys
- details of long-term monitoring (including proposed timing)
- details of any rehabilitation program, including details of timing (including proposed staging details), rehabilitation measures (including details of proposed revegetation and species mix), and post-rehabilitation monitoring
- measures to ensure conservation in perpetuity (e.g. transfer to OEH [NPWS] estate, conservation agreements or covenants)
- funding details of long-term financial commitment to any proposed conservation measures, including any mechanisms to be implemented to achieve this.

7.1.3 Ongoing monitoring

Any proposed pre-construction flora, fauna or vegetation monitoring plans or on-going monitoring of the effectiveness of the mitigation measures shall be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not previously been proved effective should be undertaken under experimental design conditions and appropriately monitored. Objectives of any monitoring plans are to include identifying any modifications needed to improve the effectiveness of ameliorative measures. These aspects should also be covered in any relevant management plans. Additionally a review of management plans should be undertaken at regular interviews (e.g. five years) to ensure adaptive management, where required, is undertaken.

8 ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

An 'Assessment of Significance' (s5A EP&A Act) is to be provided for each of the affected species (threatened species, populations or ecological communities) identified in the SIS, incorporating relevant information from sections 5.1 to 7 of the SIS. On the basis of these assessments a conclusion is to be provided concerning whether, based on more detailed assessment through the SIS process and consideration of alternatives and/or ameliorative measures proposed in the SIS, the proposal is still considered likely to have a significant effect on threatened species, populations or ecological communities or their habitats.

The threatened species 'Assessment of significance' should be consistent with those procedures and assessment approaches contained within the OEH publication:

- 'Threatened Species Assessment Guidelines: The Assessment of Significance' (DECC – August 2007b). This document is available from OEH's website:

  www.environment.nsw.gov.au/surveys/BiodiversitySurveyGuidelinesDraft.htm

9 ADDITIONAL INFORMATION

9.1 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 (Section 110(4)).

You should have extensive experience in conducting field surveys and should be able to identify threatened species and their habitats relevant to the study area, as well as any similar species that may be confused with them. You should familiarise yourself with herbarium or museum specimens of any threatened species you are not already familiar with, before you conduct field surveys.

9.2 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 or population or ecological community (Sections 110(2)(j) and 110(3)(g)).

In providing a list of other approvals the following shall be included:

- where a consent is required under Part 4 of the EP&A Act, the name of the consent authority and the timing of the development application should be included; or
- where an approval(s) is required under Part 5 of the EP&A Act, the name of the determining authority or authorities, the basis for the approval and when these approvals are proposed to be obtained should be included;
- where an approval(s) is required under *Native Vegetation Act 2003*, the name of the determining authority or authorities, the basis for the approval and when these approvals are proposed to be obtained should be included.

Environment Protection and Biodiversity Conservation Act 1999

An action will require the approval of the Federal Minister for the Environment (in addition to any State or Local Government approval or determination) if that action will have, or is likely to have, a significant impact on a matter of national environmental significance. Threatened species and communities listed in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are considered to be a matter of national environmental significance.

Many of the species and ecological communities listed in the TSC Act (NSW) are also listed in the Commonwealth EPBC Act. Further information regarding the operation of the EPBC Act (including Federally-listed threatened species and communities) may be obtained from the Department of the Environment (DoE) www.environment.gov.au or by contacting DoE on (02) 6274 1111.

9.3 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 listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).
- Scientific Licence (Section 132C) to authorise the carrying out of actions for scientific, educational or conservation purposes.

Threatened Species Conservation Act 1995:

- Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

Typically you will require a licence under section 132C of the NPW Act to undertake an activity (e.g. survey) for scientific, educational or conservation purposes that is likely to result in one or more of the following:

- harm to any protected fauna, or to an animal that is a threatened species or is part of an endangered population or an endangered ecological community
- harm to any protected native plant, or any plant that is a threatened species or is part of an endangered population or an endangered ecological community. You will need a licence if you plan to collect voucher specimens for identification purposes, pick cuttings or whole plants, or collect seed
- damage to critical habitat
- damage to a habitat of a threatened species, an endangered population or an endangered ecological community.

Information pertaining to section 132C licences can be obtained from the following website:

- www.environment.nsw.gov.au/wildlifelicences/ScientificResearchLicences.htm

Section 132C licences came into effect in January 2003 and replaced the previous need for separate licences under other provisions of the NPW Act and the TSC Act.

It is a condition of all licences that you submit a report of the work carried out under the licence, including any results and specific details / locations of all flora and fauna, to OEH within two months of the expiry of the licence.

Also, be aware of the requirements relating to animal care and ethics when conducting wildlife surveys. The handling and capture of animals is regulated by the NSW *Animal Research Act 1985* and the *NSW Animal Research Regulation 1995*, which are administered by Department of Trade and Investment, Regional Infrastructure and Services. The Act requires that every person undertaking animal research must hold an Animal Research Authority. Under the Act, animal research includes the 'use' (e.g. handling, trapping etc.) of animals in field surveys. Details on animal ethics can be obtained from the following website:

- www.animalethics.org.au/home

All surveys must be carried out in accordance with the NSW Department of Trade and Investment, Regional Infrastructure and Service's Guidelines for wildlife surveys located at:

- www.animalethics.org.au/policies-and-guidelines/wildlife-research/wildlife-surveys

9.4 Section 110 (5) reports

Section 110(5) of the TSC Act has the effect of requiring the OEH to provide that information regarding the State-wide conservation status of the subject species that it has available, in order to satisfy ss.110(2)&(3) of the Act. These documents are available on the internet at:

- www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx

This website provides basic profiles for the majority of species listed as threatened, as well as links to the Scientific Committee determinations, more detailed profiles, environmental impact assessment guidelines and recovery plans, where these documents are available. OEH is unable to provide any further information for section 110(5) reports.

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ATTACHMENT B

CHECKLIST FOR DETERMINING IF AN SIS HAS MET THE REQUIREMENTS OF THE DIRECTOR GENERAL OF THE OFFICE OF ENVIRONMENT AND HERITAGE

Under the *Environmental Planning and Assessment Act 1979*, where a significant effect on threatened species, populations or ecological communities is likely, a development application must be accompanied by concurrence from the Office of Environment and Heritage (OEH). A species impact statement prepared in accordance with Division 2 of Part 6 of the *Threatened Species Conservation Act 1995* must accompany the application.

The development is taken not to significantly affect threatened species, populations or ecological communities, or their habitats if:

(a) the development is to be carried out on biodiversity certified land (within the meaning of Part 7AA of the *Threatened Species Conservation Act 1995*), or

(b) a BioBanking statement has been issued in respect of the development under Part 7A of the *Threatened Species Conservation Act 1995.*

Before deciding to issue consent or approval and consequently requesting the concurrence of the Chief Executive of OEH, it is required of the consent or determining authority to determine whether the SIS meets the Director General's requirements (DGRs).

This checklist has been drawn up to assist consent and determining authorities in this matter. A comments column has been included to allow authorities to provide, among other things, reasons for their decisions or comments on whether an omission is significant.

Note that this is a generic checklist and some items may not be relevant to the application being reviewed or the Director General's requirements issued. If the requirements do not specify one of the matters below, then it is recommended that this be noted in the comments column. Consultants preparing an SIS may also use this checklist as a brief guide to preparing the SIS.

Matter	Yes /No	Comments
Has the SIS been signed by both its author and the applicant for consent/approval?		
Has the description of the proposal included all associated activities and works, such as hazard reduction zones, access roads and road upgrades, utilities, etc.?		
Have all requested plans, maps and aerial photographs been provided? This includes any A1 or A0 sized proper survey plans prepared by a registered surveyor that clearly show the location and boundaries of any proposed offsets.		
Has the SIS determined the subject species by reviewing the suggested list in the DGRs, other available information and survey results and assessing which species, populations and ecological communities are to be impacted by the development?		

Matter	Yes /No	Comments
Has the survey undertaken provided sufficient information to determine the likely impacts of the proposal on threatened species, populations and ecological communities?		
Have surveys been undertaken during the appropriate season(s) for the detection of the species that may possibly occur on site?		
Have surveys been undertaken during appropriate weather conditions?		
Have climatic conditions preceding the surveys (eg, drought c/f. wet) affected the possibility of subject species being detected?		
Have all specific survey methods, techniques and intensities requested in the DGRs been followed completely?		
Has the documentation of survey effort, locations and techniques provided sufficient information to determine the above?		
Has the assessment of impacts included the impacts of ALL activities associated with the development, including fire hazard reduction requirements, access road upgrades, downstream and downslope impacts, detention basins, severing of fauna movement corridors, etc.		
Has the SIS discussed the extent, conservation significance and security of other occurrences of the subject species' in the locality (locality is defined in the DGRs)?		
Has the SIS discussed the significance of the population/remnant to be affected, relative to others within the locality?		
Has the SIS discussed the extent, conservation significance and security of other occurrences of the subject species in the region (region is defined in the *Threatened Species Conservation Act 1995*).		
Has the SIS discussed the significance of the population/remnant to be affected, relative to others within the region?		
Have alternatives to the proposal been discussed? Alternatives may include relocation of infrastructure or, for example, reducing minimum lot size so that a similar number of lots may be realised whilst retaining a larger conservation lot within a subdivision, or changing mining techniques.		
Has the discussion of alternatives included assessment of the social and economic (not merely financial) aspects of these alternatives (particularly, of not proceeding)?		

Matter	Yes /No	Comments
Does the proposal use biodiversity offsets to compensate for loss or impact to threatened species, populations, ecological communities and their habitat? Have these offsets been determined in accordance with either (i) OEH's *Principles for the use of biodiversity offsets in NSW*, or (ii) a biodiversity assessment using BioBanking Assessment Methodology under Biodiversity Banking and Offsets Scheme, as outlined in the 'BioBanking Assessment Methodology 2014' (OEH 2014)?		
Has the discussion included an assessment of how the project meets the principles of Ecologically Sustainable Development, as defined in section 6(2) of the *Protection of the Environment Administration Act 1991*?		
Have all proposals for compensatory actions (eg purchase of similar vegetation / habitat or revegetation of habitat, where appropriate) been discussed with the relevant landowners/manager?		
Is there documented agreement for sale or revegetation activities?		
Is there agreement to change zoning or enter into a covenant on title in order to secure the conservation of the properties being purchased or revegetated?		
If translocation is proposed, has the impact of the translocation on the recipient site(s) been assessed?		
Is there a 'Plan of Management' or similar titled document?		
Has the SIS utilised relevant information from published draft and final recovery plans? If no plan has been published, but it is known that one is being prepared, has the SIS utilised advice from the NPWS as to the likely contents of that recovery plan (liaison to obtain this advice may have been specified in the DGRs)? For example, would the proposal result in the loss of a local population or remnant that a recovery plan describes as being of particular importance to the conservation of the species, population or ecological community?		

Matter	Yes /No	Comments
If a BioBanking assessment has been done for the proposal have the following been provided: copies of BioBanking Credit reports, copies of field datasheets, copies of a checklist that includes all data used in the credit calculator and the underlying assumptions, such as how local vegetation communities were assigned to Biometric vegetation types / Plant Community Types?, and has the Credit Calculator files been submitted via the OEH portal?		
Has the SIS discussed the relationship of the proposal to any listed Key Threatening Processes (eg, does the proposal result in the need for High Frequency Fire as a fire hazard reduction measure, or does it result in the Clearing of Native Vegetation)?		
Has the SIS discussed the relationship of the proposal to any published Threat Abatement Plan (eg, does the proposal result in an increased threat in a manner that is specifically at odds with a published plan)?		
Has a revised Part 5A assessment of significance been included?		
Has the 'Additional Information' specified in section 9 of the DGRs been provided?		
Have the qualifications and experience of those involved in the surveys been included?		
Have other approvals which are required for the development or activity been documented?		
Any licensing requirements (e.g. s91 under TSC Act).		

Appendix B

Sportsmans Creek Bridge original design plans

R[illegible]UCTION RATIO

30 x

[illegible]UBLIC WORKS

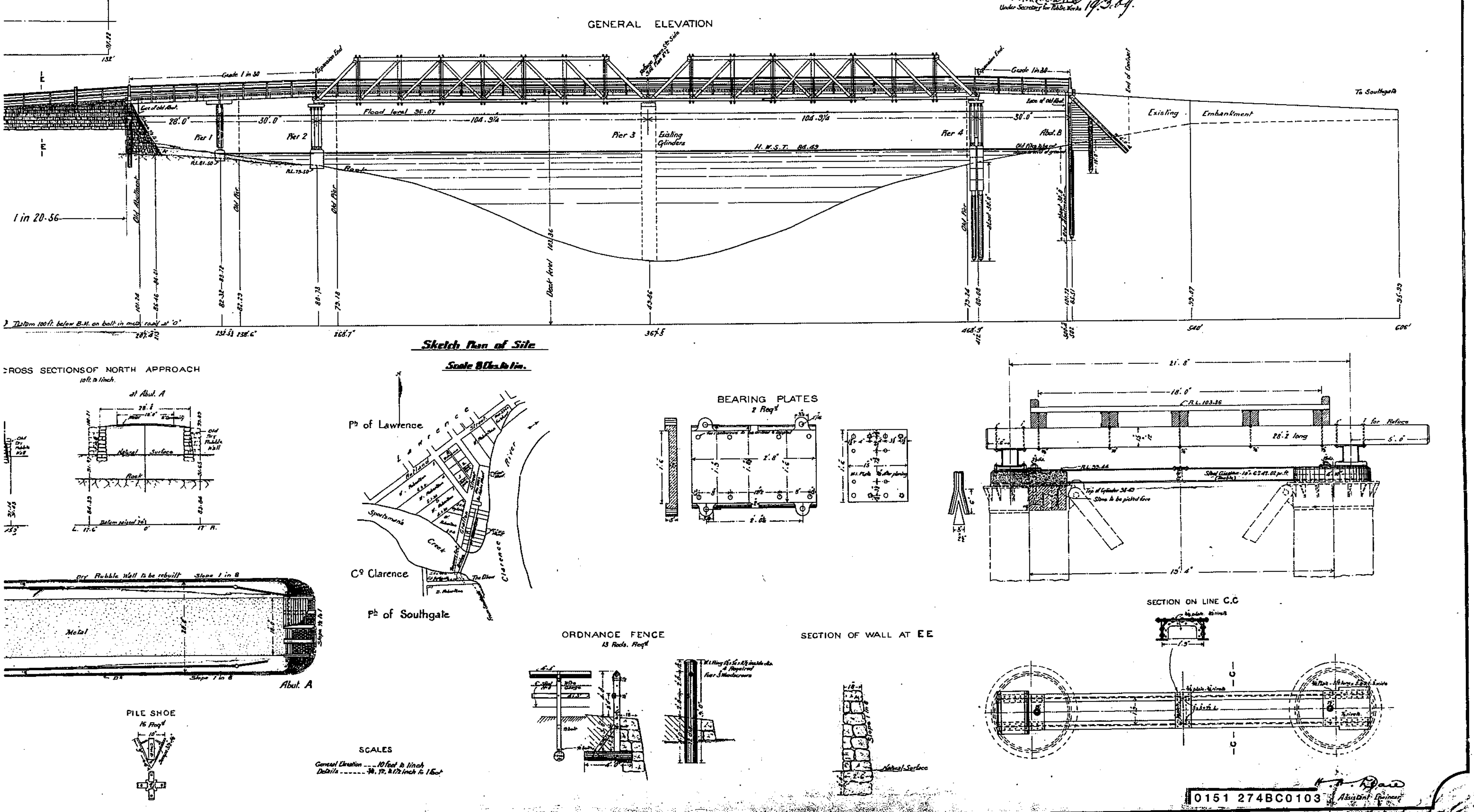
[illegible]ERING PLACES BRANCH

BRIDGE OVER SPORTSMAN'S CREEK

ROAD SOUTHGATE TO BROADWATER

PLAN Nº 1

Under Secretary for Public Works 19.3.09



Assistant Engineer

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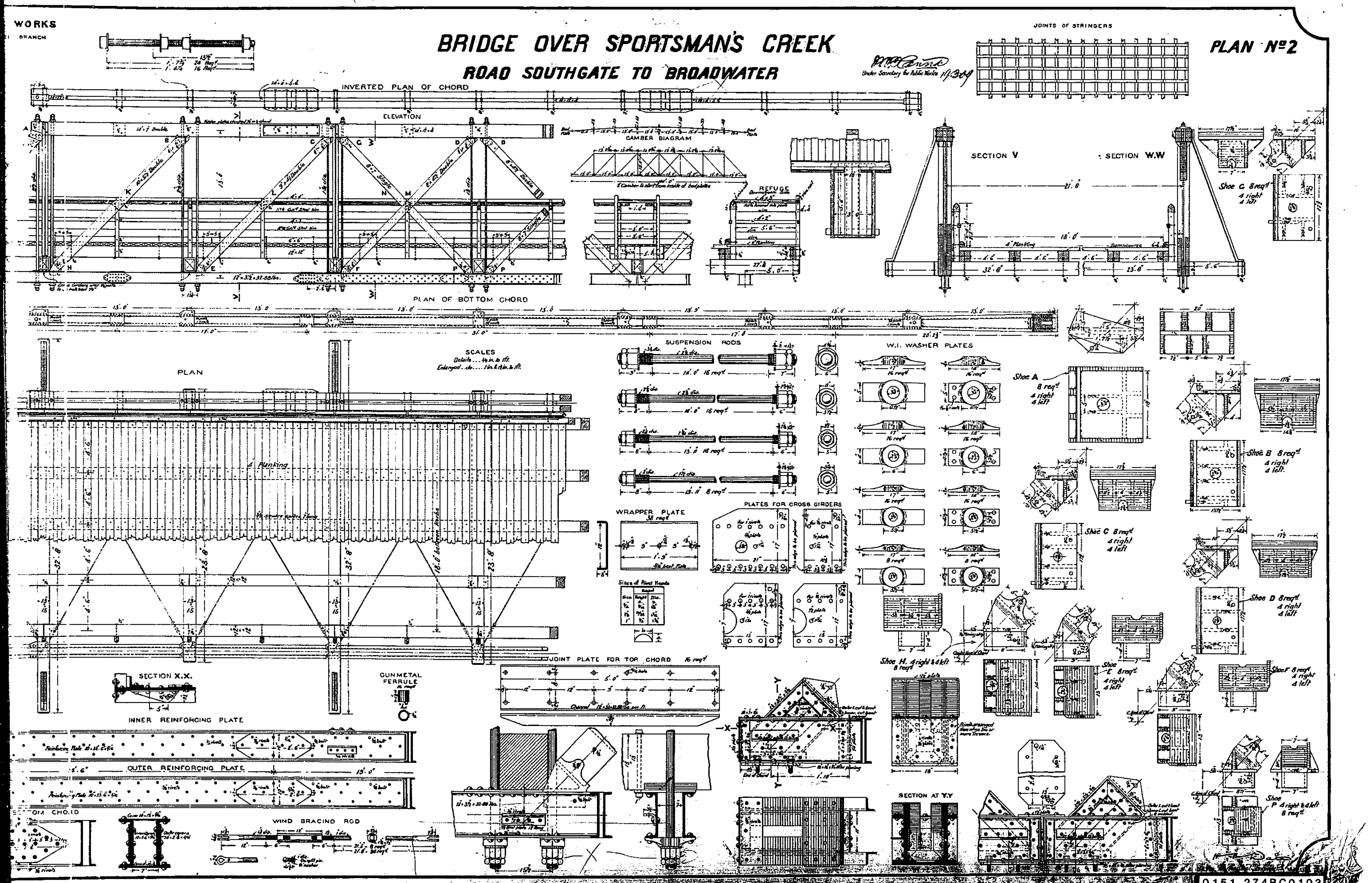
SHEET 1 OF 4

FRAME 2 OF 2

REDUCTION RATIO 30x



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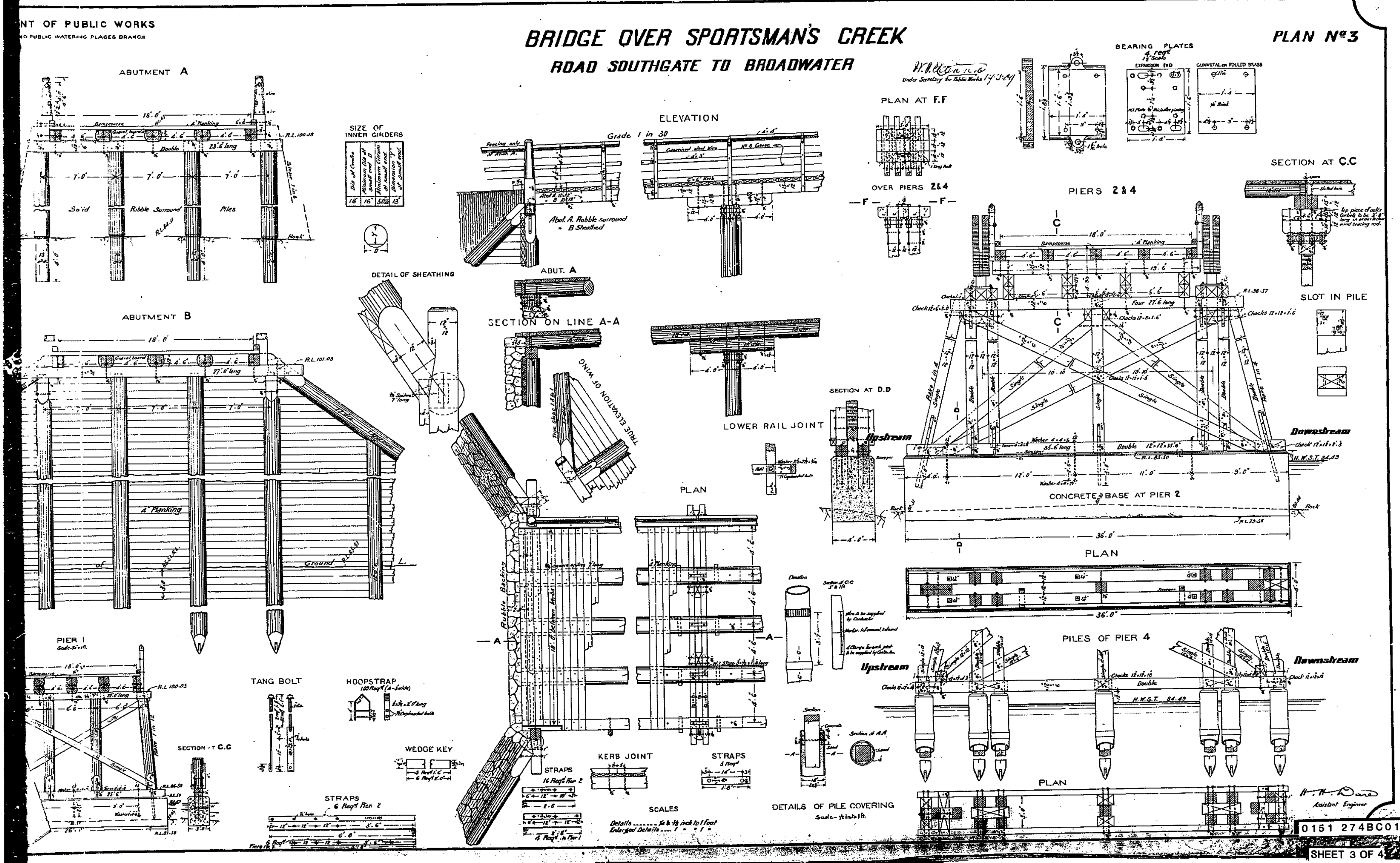
SHEET 2 OF 4 FRAME 2 OF 2

REDUCTION RATIO
30 x



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SHEET 3 OF 4

FRAME 2 OF 2

Appendix C

Microbat survey results

Table C1 Sportsmans Creek Bridge field survey results – 16/12/2013

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comment
C1	1	7	Large-footed Myotis	Adults (no obvious juveniles)	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	-	47	-
C2	1	18	Large-footed Myotis	Adults (no obvious juveniles)	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Near stringer 69	27-30	-
C3	1	3	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 88	36	-
C4	1	20	Large-footed Myotis	Adults and juveniles	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 88	32	Signs of heavy wear on timber at access on stringer below.
C5	2	23	Large-footed Myotis	Adults (no obvious juveniles)	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 26 mm; decking 32 mm	-
C6	1	9	Large-footed Myotis	Adults and juveniles	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 89	35	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comment
C7	3	100	Large-footed Myotis	Adults and juveniles	2	Split (two-piece) stringer and two bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 34 mm; both decking gaps = 55 mm	Signs of heavy wear on timber. Also large guano deposits on top of stringer.
C8	1	2	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Above Stringer 180 near pier 2	37 mm	-
C9	2	10 in total (1 in stringer; 9 in decking)	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 259 near pier 3	Stringer = 22 mm; decking gap = 80 mm	-
C10	3	29 in total (number 10, 13 and 6)	Large-footed Myotis	Adults and juveniles in middle gap/ group with 13 bats	3	Bridge decking - three gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 256	Group of 10 bats = 45 mm; group of 13 bats = 35 mm; group of 6 bats 35 mm	-
C11	1	1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 288	30 mm	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comment
C12	3	4 in total (numbering 3 the 1)	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	3	Split (two-piece) stringer with two groups.	Stringer 2XX, south of girder 45.	Stringer = 20 to 35 mm	-
C13	1	13	Large-footed Myotis	Adults (no obvious juveniles)	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Girder 42 (no adjacent stringer number).	35 mm	-
C14	1	1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 191	37 mm	-
C15	3	46 in total (numbering 23, 17 and 6)	Large-footed Myotis	Adults and juveniles in group of 23 and 17	3	Bridge decking - three gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 292	Group of 23 bats = 70 mm; group of 17 bats = 43 mm; group of 6 bats 36 mm.	-
C16	2	11 in total (numbering 6 and 5)	Large-footed Myotis	Adults (no obvious juveniles)	3	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 193	Both 40 mm	-
C17	1	2	Large-footed Myotis	Adults (no obvious juveniles) - probably males	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 181	34 mm	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comment
C18	2	7 and 1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	2	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 88	Group of 7 bats = 34 mm; one bat = 41 mm	-
C19	2	15 in stringer; 3 in decking	Large-footed Myotis	Adults and juveniles; separate group of three probably a group of males	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 71	Stringer = 11 to 24 mm; decking = 30 mm	-

Table C2 Sportsmans Creek Bridge field survey results – 03/02/2014

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comment
C1	Not occupied	-	-	-	2	-	-	-	-	-
C2	Not occupied	-	-	-	2	-	-	-	-	-
C3	Not occupied	-	-	-	2	-	-	-	-	-
C4	Not occupied	-	-	-	2	-	-	-	-	-
C5	5	57 in total (12 in decking [2,6, 4]; 45 in stringer)	Large-footed Myotis	Mainly adults size bat; Two obvious juveniles about one week old	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 15 to 25 mm; Decking 34 to 40 mm	Temp: 27.2°c; Humidity: 61% Same as ambient conditions below bridge.	Signs of heavy wearing on stringer and decking.
C6	2	11 (10 and 1)	Large-footed Myotis	Adult sized bats only	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 89	33 to 42 mm	Temp: 27.2°c; Humidity: 60.2% Same as ambient conditions below bridge.	-
C7	3	About 100 in total (25 in decking [10,15]; 95 in stringer)	Large-footed Myotis	Adults and juveniles	2	Split (two-piece) stringer and two bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 21 to 36 mm; decking gaps = 42 and 55 mm	Temp: 25.8°c; Humidity: 61.0% Same as ambient conditions below bridge.	-
C8	Not occupied	-	-	-	2	-	-	-	-	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comment
C9	Not occupied	-	-	-	3	-	-	-	-	-
C10	Not occupied	-	-	-	3	-	-	-	-	-
C11	Not occupied	-	-	-	3	-	-	-	-	-
C12	2	30 in total (numbering 5 and 25)	Large-footed Myotis	Adults (no obvious juveniles)	3	Split (two-piece) stringer with two groups.	Stringer 2XX, south of girder 45	30-32 mm	Temp: 26.4°c; Humidity: 61.8% Same as ambient conditions below bridge.	-
C13	3	48 in total (14 in decking [2, 12]; 34 in Stringer)	Large-footed Myotis	Adults (no obvious juveniles)	3	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Girder 42 (no adjacent stringer number)	Stringer = 25 to 33 mm; decking gaps = 108 and 23 mm	Temp: 25.6°c; Humidity: 60.3% Same as ambient conditions below bridge.	-
C14	Not occupied	-	-	-	3	-	-	-	-	-
C15	2	20 in total (numbering 15 and 5)	Large-footed Myotis	Adults and juveniles	3	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 292	43 and 65 mm	Temp: 24.8°c; Humidity: 60.4% Same as ambient conditions below bridge.	-
C16	Not occupied	-	-	-	3	-	-	-	-	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comment
C17	Not occupied	-	-	-	2	-	-	-	-	-
C18	2	17 in total (numbering 15 and 2)	Large-footed Myotis	Adult sized bats only	2	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above or near a stringer.	Stringer 88	32 and 25 mm	Temp: 27.0°c; Humidity: 63.4% Same as ambient conditions below bridge.	-
C19	2	About 130 in total (90 in stringer; 40 in decking)	Large-footed Myotis	Adult sized bats only	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer). Part of the group in the decking was not above the stringer, midway between the edge and first stringer.	Stringer 71	Stringer = 15 to 25 mm; decking 30 to 62 mm	Temp: 26.0°c; Humidity: 62.0% Same as ambient conditions below bridge.	-
C20	1	4	Large-footed Myotis	Adult sized bats only	2	Bridge decking - between two transverse decking planks, below longitudinal decking and above or near a stringer.	Stringer 70	41 mm	Temp: 27.7°c; Humidity: 62.4% Same as ambient conditions below bridge	-
C21	1	4	Large-footed Myotis	Adult sized bats only.	3	Bridge decking - between two transverse decking planks, below longitudinal decking and above or near a stringer.	Stringer 2796	33 mm	Temp: 26.0°c; Humidity: 60.9% Same as ambient conditions below bridge.	-

Table C3 Alternative drainage structure survey results – 03/02/2014 and 04/02/2014

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1692	-29.488003	153.19244	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1693	-29.502588	153.19073	Pipe culvert	2	2000	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	No	Yes
1694	-29.517585	153.1846	Box culvert	2	2000 x 2000	No	No	Low	Highly susceptible to inundation.	No	Yes
1695	-29.539961	153.17162	Pipe culvert	1	1800	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1696	-29.538319	153.1594	Pipe culvert	1	900	Cell joins and lift holes	Yes - minor guano deposits present	Low	No permanent water directly adjacent to culvert.	No	Yes
1697	-29.537942	153.15314	Pipe culvert	3	1600	Cell joins and lift holes	Yes - minor guano deposits present	Low	No permanent water directly adjacent to culvert.	No	Yes
1698	-29.555301	153.1373	Pipe culvert	1	750	Cell joins	No	Low	Highly susceptible to inundation; barbed wire fence along outlet; overgrown vegetation at inlet; no open permanent water.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1699	-29.568973	153.07768	Wingfield Bridge over the Clarence River South Arm at Brushgrove/ Cowper	-	-	Exposed roosting opportunities mainly provided by rough concrete and bird nests.	No	Low - moderate	Not able to be comprehensively inspected. Ability to support a large Myotis breeding colony (>100 individuals) appears low.	No	Yes
1700	-29.569362	153.07811	Pipe culvert	1	2000	Cell joins; rough concrete	Yes - 3 x Chocolate Wattled bats (C. gouldii). Moderate guano accumulations throughout.	Moderate	Floodgate at outlet. Flooding susceptibility may reduce suitability.	No	Yes
1701	-29.572031	153.07314	Pipe culvert	2	1500	Cell joins and lift holes	No	Low	Highly susceptible to inundation and no deep cavities.	No	Yes
1702	-29.551485	153.13796	Pipe culvert	2	600	Cell joins	No	Low	Highly susceptible to inundation; no open water; dense vegetation at inlet and outlet.	No	Yes
1703	-29.535751	153.13693	Pipe culvert	2	1200	Cell joins; Fairy Martin nests	No	Low	Highly susceptible to inundation; open water present.	No	Yes
1704	-29.536089	153.13911	Pipe culvert	1	600	Cell joins; Fairy Martin nests	No	Low	Highly susceptible to inundation; no open water	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
									present.		
1705	-29.536228	153.14221	Pipe culvert	2	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1706	-29.512485	153.13082	Pipe culvert	1	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1707	-29.509843	153.13161	Pipe culvert	1	2200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1709	-29.514074	153.13877	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1711	-29.506937	153.13106	Pipe culvert	2	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1712	-29.511571	153.12019	Box culvert	2	1400	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1713	-29.528436	153.1095	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on	Unknown	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
									private property.		
1714	-29.494808	153.1189	Box culvert	1	2000	Cell joins; rough concrete	Yes - 9 x Chocolate Wattled bats (C. gouldii).	Moderate	Floodgate at outlet. Flood susceptibility may reduce suitability.	No	Yes
1715	-29.493684	153.14439	2 x pipe culvert; 2 x box culvert	4	900 pipes; 1200 x 75 boxes.	Cell joins and lift holes	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1716	-29.579662	153.07787	Pipe culvert	1	450	Cell joins	No	Low	Susceptible to inundation.	No	Yes
1717	-29.586708	153.08916	Pipe culvert	1	600	Unknown	Unknown	Low	Inlet and outlet covered with vegetation.	No	Yes
1718	-29.571645	153.09171	Pipe culvert	1	450	Unknown	Unknown	Low	Inlet and outlet covered with vegetation.	No	Yes
1719	-29.590924	153.10071	Bridge	-	-	Fairy Martin nests; exposed roost features	No	Low	Good foraging habitat.	No	Yes
1720	-29.593064	153.10962	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	Highly susceptible to inundation	No	Yes
1721	-29.584732	153.12122	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1722	-29.573967	153.11879	Culvert (unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by	Unknown	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
			type)						floodgate; inlet access on private property.		
1723	-29.574805	153.11115	Pipe culvert	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: inlet and outlet access on private property.	Unknown	Yes
1724	-29.570107	153.11068	Bridge	-	-	Exposed roost features.	No	Low	Good foraging habitat.	No	Yes
1725	-29.566914	153.12985	Coldstream Bridge	-	-	Scuppers, stringer chambers; Fairy Martin nests	Yes - guano present.	High	Unable to be comprehensively inspected. Previously recorded supporting Large-footed Myotis colony (Alison Martin pers. comm.).	Yes (probable breeding colony)	Yes
1726	-29.563564	153.14667	Box culvert	1	2200	Exposed roost features on rough concrete	No	Low	-	No	Yes
1727	-29.558608	153.15001	Box culvert	1	1500 x 1100	Fairy Martin nests; exposed roost features	No	Low	-	No	Yes
1728	-29.509531	153.19059	Shark Creek Bridge	-	-	New Bridge: gaps between concrete planks (large breeding	Yes - >300 Large-footed Myotis (including young) recorded in	Known	-	Yes (breeding colony)	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
						group in a cavity 15 mm wide at the bottom; 30 mm wide at the top and about 300 mm deep; also a step/ lip at the base of the concrete blanks which is likely to be important for allowing the bats to enter the roost). Existing timber truss bridge: exposed roosting features.	new bridge. Large guano deposits and staining. Numbering >300 southern span; unknown middle span; 10 northern span.				
1729	-29.491756	153.19693	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Floodgate on outlet. Highly susceptible to inundation.	No	Yes
1730	-29.496653	153.19635	Pipe culvert	Unknown	Unknown	Unknown	Unknown	Low	Inundated	No	Yes
1731	-29.533098	153.18688	Pipe culvert		Unknown	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Half inundated. Highly susceptible to inundation.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1732	-29.541998	153.17175	Pipe culvert	4	Unknown	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Half inundated. Highly susceptible to inundation.	No	Yes
1733	-29.499398	153.08498	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1734	-29.514446	153.09543	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1735	-29.520354	153.09086	Pipe culvert	2	750	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1736	-29.528909	153.09298	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1737	-29.530856	153.09474	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1738	-29.530165	153.09013	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1739	-29.539196	153.09092	Bridge	-	-	Exposed roost features.	No	Low	Good foraging habitat.	No	Yes
1740	-29.542241	153.09043	Pipe culvert	1	1500	Cell joins; lift holes and exposed roost	No	Low	-	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1741	-29.560613	153.07395	Pipe culvert	2	600	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Mostly inundated. Highly susceptible to inundation.	No	Yes
1742	-29.540584	153.10019	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1743	-29.522152	153.10357	Pipe culvert	-	-	Unknown	Unknown	Low	Not inspected: outlet blocked by floodgate; inundated inlet.	No	Yes
1744	-29.512313	153.10277	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1745	-29.46899	153.086	Pipe culvert	4	1800	Cell joins and lift holes	Yes - 1 x Little Bentwing Bat in lift hole (northern cell); > 20 Large-footed Myotis including young in lift holes (4 in one group in northern cell; one dead juvenile in southern cell; 3 in lift hole in	Known	Open water for foraging at outlet.	Yes (breeding colony)	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
							2nd from north cell; two breeding groups in lift holes numbering 5 and 6; and one single male in 3rd cell from the north). Large guano accumulations.				
1746	-29.46778	153.08491	Pipe culvert	3	1500	Cell joins and lift holes	No	High	Open water for foraging at outlet. Habitat similar to 1745, however inlet and outlet covered with vegetation.	No	Yes
1747	-29.462722	153.07772	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	-	No	Yes
1748	-29.427254	153.08472	Broadwater Creek Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1749	-29.415424	153.08648	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1750	-29.462072	153.11955	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1751	-29.454297	153.13738	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1752	-29.476221	153.12682	Box culvert	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: partly inundated and deep channel.	Unknown	Yes
1754	-29.487818	153.13239	Pipe culvert	1	1800	Cell joins and lift holes	Yes - < 5 bats present. Species and breeding status unknown.	Unknown	Channel too deep at inlet and outlet for inspection.	Unknown	Yes
1755	-29.480892	153.13974	Box culvert	1	2000	Unknown	Unknown	Unknown	Floodgate on outlet; inlet channel too deep to access. Susceptible to flooding.	Unknown	Yes
1756	-29.460164	153.16844	Pipe culvert	1	1200	Cell joins and lift holes	Yes - 1 x Large-footed Myotis (probable male).	Low	Floodgate at outlet. Flooding may reduce suitability.	No	Yes
1757	-29.462476	153.16982	Pipe culvert	1	1200	Unknown	Unknown	Unknown	No inspected. Channel too deep to access. Susceptible to frequent inundation.	Unknown	Yes
1758	-29.465625	153.17252	Poverty Creek Bridge	-	-	Rough concrete and bird nests	Yes – about 5 x Large-footed Myotis roosting in Welcome Swallow nest. Large staining on rough roof; large guano	Low - moderate	-	Yes (status unknown but unlikely to comprise a breeding colony).	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/ evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
							accumulations.				
1759	-29.467177	153.19339	Pipe culvert	5	900	Unknown	Unknown	Low	Floodgate on outlet; inlet half inundated. No comprehensively inspected. Susceptible to flooding.	No	Yes
1760	-29.468693	153.18977	Pipe culvert	5	1200	Unknown	Unknown	Low	Half inundated. No comprehensively inspected. Susceptible to flooding.	No	Yes

Table C4 Summary of McFarlane Bridge survey results

Bridge span	Pre-exclusion (pre-nest box installation; during and outside breeding season)	Pre-exclusion (post nest box installation; during and outside breeding season)	During S10 exclusion (outside breeding season)	During S11 exclusion (outside breeding season)	Post exclusion (outside breeding season – 15/8/2013)	Post exclusion (during breeding season – 8/10/2013)	Phase 2 pre-exclusion (outside breeding season - 13/08/2015-30/09/2015)
S1	No	No	N/A	No	N/A	No	No
S2	No	No	N/A	No	N/A	No	No
S3	No	No	N/A	No	N/A	No	No
S4	No	No	N/A	No	N/A	No	No
S5	No	No	N/A	No	N/A	Yes – breeding colony of about 15 bats (including young).	No
S6	Yes – non-breeding, small numbers, temporary usage.	No	N/A	No	N/A	No	No
S7	Yes – non-breeding, small numbers, temporary usage.	No	N/A	No	N/A	No	No
S8	No	No	Yes – > 62 bats in bat boxes.	Yes – about 40 bats in decking and 74 bats in bat boxes.	Yes – about 25 bats in decking and 76 bats in bat boxes.	Yes – about 110 bats in bat boxes, including two breeding colonies.	Yes – about 53 in bat boxes only.
S9	No	Yes – about 30 in a bat box (temporary, breeding status unknown).	No	No	Yes – about 25 bats in bat boxes.	Yes – about 36 bats in bat boxes, including one breeding group.	Yes – about 50 in bat boxes only.

Bridge span	Pre-exclusion (pre-nest box installation; during and outside breeding season)	Pre-exclusion (post nest box installation; during and outside breeding season)	During S10 exclusion (outside breeding season)	During S11 exclusion (outside breeding season)	Post exclusion (outside breeding season – 15/8/2013)	Post exclusion (during breeding season – 8/10/2013)	Phase 2 pre-exclusion (outside breeding season - 13/08/2015-30/09/2015)
S10	Yes – large (>100 bats) permanent breeding colony in bridge decking.	Yes – large (>100 bats) permanent breeding colony in bridge decking.	No	Yes – about 60 bats in bridge decking and 60 bats in bat boxes.	Yes – >27 bats in bridge decking and about 55 bats in bat boxes.	Yes – about 145 bats; breeding colony in bridge decking (93) and bat boxes (52).	Yes – 37 in bat boxes only.
S11	Yes – large (>100 bats) permanent breeding colony in decking.	Yes – large (>100 bats) permanent breeding colony in decking.	Yes – large number of bats (>100) in decking.	No (excluding temporary breach of exclusion).	Yes – no bats in the decking; 8 bats in bat boxes.	Yes – about 24 bats in bat boxes, including one breeding colony.	Yes – 33 in bat boxes only.
S12	N/A	N/A	No	No	No	N/A	No
S13	No	No	N/A	Yes – individual	No	No	No
S14	No	No	N/A	No	No	No	N/A
S15	No	No	N/A	No	No	No	N/A
S16	No	No	N/A	No	N/A	No	N/A
S17	No	No	N/A	No	N/A	No	No

Note: N/A indicates locations that were not inspected

Appendix D

Threatened species/populations/ecological communities potential occurrence assessment

An evaluation of the likelihood and extent of impact to threatened flora, fauna, populations and ecological communities recorded within a 10 kilometre radius of the subject site from a search of the Office of Environment and Heritage (OEH) BioNet Wildlife Atlas (OEH 2015) and/ or identified from the *Director General's Requirements for a Species Impact Statement: Demolition of the Existing Sportsmans Bride, Lawrence, NSW* (ref DOC15/19486) is provided in Tables D.1 and D.2.

Status

National	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NSW	NSW *Threatened Species Conservation Act 1995.*
E:	Endangered.
CE:	Critically Endangered.
V:	Vulnerable.

Potential occurrence within the study area

Unlikely:	Species, population or ecological community is not likely to occur. Lack of previous recent (<25 years) records and suitable potential habitat limited or not available in the study area.
Likely:	Species, population or ecological community could occur and study area is likely to provide suitable habitat. Previous records in the locality and/ or suitable potential habitat in the study area.
Known:	Species, population or ecological community was recorded during the field investigations.

Potential impact

Unlikely:	The proposal would be unlikely to impact this species, population or ecological community or its habitats. No EP&A Act seven-part test or EPBC Act significance assessment is necessary.
Likely:	The proposal could impact this species, population or ecological community or its habitats. An EP&A Act seven-part test and/ or EPBC Act significance assessment is required.

Habitat requirements

Habitat requirements have been obtained from the Threatened Species Profiles on the NSW OEH website (www.threatenedspecies.environment.nsw.gov.au) and from the Species Profiles and Threats Database on the Australian Government Department of Environment website (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl).

Study area

The study area comprises the subject site being Sportsmans Creek Bridge and approaches, Sportsmans Park and Flo Clark Park plus a 100 metre buffer.

Table D1 Threatened fauna - potential occurrence assessment

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Amphibia							
Crinia tinnula	Wallum Froglet	V	-	Acid paperbark and sedge swamps known as 'wallum', this is a banksia-dominated lowland heath ecosystem characterised by acidic waterbodies.	No suitable habitat within the study area. No wallum present.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Litoria brevipalmata	Green-thighed Frog	V	-	Rainforest, moist to dry eucalypt forest and heath, typically where surface water gathers after rain. Larger temporary pools and flooded areas preferred for breeding.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Aves							
Anseranas semipalmata	Magpie Goose	V	-	Shallow wetlands (<1 metre deep), large swamps and dams with dense growth of rushes or sedges, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation. Nests are formed in trees over deep water.	No suitable habitat within the study area. Study area includes only narrow area of sedges/ rushes which may provide marginal foraging habitat. No suitable nesting trees present within the study area.	Likely. Nine OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
							by the proposal.
Botaurus poiciloptilus	Australasian Bittern	E	E	Permanent freshwater wetlands with tall dense vegetation, particularly bullrushes and spikerushes.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Burhinus grallarius	Bush Stone-curlew	E	-	Lightly timbered open forest and woodland, and partly cleared farmland with woodland remnants, preferring areas with dry leaf-litter, fallen timber and sparse ground cover.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Calidris ferruginea	Curlew Sandpiper	E	CE	It generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	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.	No suitable habitat within the study area.	Unlikely. Five OEH (2015) records within 10 km radius.	Unlikely
Chthonicola sagittata	Speckled Warbler	V	-	Eucalyptus dominated communities with sparse shrubs and grassy understorey.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Climacteris picumnus	Brown Treecreeper	V	-	Eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range, and less commonly on coastal plains and ranges.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Coracina lineata	Barred	V	-	Rainforest, eucalypt forests and woodlands,	No suitable habitat	Unlikely. Two	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
	Cuckoo-shrike			clearings in secondary growth, swamp woodlands and timber along watercourses.	within the study area.	OEH (2015) records within 10 km radius.	
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Dromaius novaehollandiae	Emu population in the NSW North Coast Bioregion and Port Stephens LGA	E Population	-	Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest.	Moderately suitable in open farmland however does not occur in the study area.	Unlikely. 115 OEH (2015) records within 10 km radius.	Unlikely
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. They build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation.	No suitable habitat within the study area. No suitable nesting trees present within the study area. Habitat associated with edges of Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Likely. 762 OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.
Glossopsitta pusilla	Little Lorikeet	V	V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in *Angophora*, *Melaleuca* and other tree species. Riparian habitats are	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10	Unlikely

Scientific name	Common name	Status TSC Act	Status EPBC Act	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
				particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked *Eucalypts*. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like *Allocasuarina.*		km radius.	
Grus rubicunda	Brolga	V	-	Shallow swamps, floodplains, grasslands and pastoral lands, usually in pairs or parties. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water.	No suitable habitat within the study area. Habitat associated with edges of Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Likely. Seventy-one OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.
Haematopus longirostris	Pied Oystercatcher	E	-	Open beaches, intertidal flats, sandbanks and occasionally rocky headlands.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential	Unlikely. Twenty-one OEH (2015) records within 10 km radius.	Unlikely

Scientific name	Common name	Status TSC Act	Status EPBC Act	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
					foraging habitat.		
Hieraaetus morphnoides	Little Eagle	V	-	Open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch.	Low suitability.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Irediparra gallinacean	Comb-crested Jacana	V	-	Among vegetation floating on slow-moving rivers and permanent lagoons, swamps, lakes and dams.	No suitable habitat within the study area.	Unlikely. Twelve OEH (2015) records within 10 km radius.	Unlikely
Ixobrychus flavicollis	Black Bittern	V	-	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Moderate, mainly in vegetated riparian area to the east.	Unlikely. No OEH (2015) record within 10 km radius.	Unlikely.
Limosa limosa	Black-tailed Godwit	V	-	Tidal mudflats, sand spits, swamps, shallow river-margins and reservoirs.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Lophoictinia isura	Square-tailed Kite	V	-	Dry woodland and open forest, particularly along major rivers and belts of trees in urban or semi-urban areas. Home range can extend over at least 100 km^2. Nest sites are generally located along or near watercourses, in a fork or on large horizontal limbs.	The study area may form a small portion of the large (100 km^2) hunting range. Provides only low quality foraging habitat. Study area lacks large trees to	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely.

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
					provide a suitable nest site.		
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage.	No suitable habitat within the study area. No associated species present.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Ninox strenua	Powerful Owl	V	-	Woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of eucalypt species.	No suitable habitat within the study area. Study area includes only a small area of managed parkland and lacks forested vegetation. No suitable nesting trees present.	Unlikely. Four OEH (2015) records within 10 km radius.	Unlikely
Pandion cristatus	Eastern	V	-	Forage for fish in fresh, brackish or saline	Foraging habitat	Likely. 137	Unlikely.

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
(formerly Pandion haliaetus)	Osprey			waters of rivers, lakes, estuaries with suitable nesting sites nearby.	available within the study area comprising Sportsmans Creek and the Clarence River. No suitable nest trees present within the study area. Several nest sites known within the locality.	OEH (2015) records within 10 km radius.	Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.
Podargus ocellatus	Marbled Frogmouth	V	-	Subtropical rainforest, particularly in deep, wet, sheltered gullies along creeklines and often containing stands of Bangalow Palms or ferns. In NSW, it is most often found in moist, lowland, mesophyll vine forest. Less often, they are found in the ecotone between rainforest and wet Eucalyptus forests, or occasionally in cool rainforest and higher elevation temperate rainforests. Rarely in wet eucalypt forest.	No suitable habitat within the study area.	Unlikely. No OEH (2015) record within 10 km radius.	Unlikely
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	No suitable habitat within the study area.	Unlikely. Thirty-one OEH (2015) records within 10 km radius.	Unlikely
Ptilinopus magnificus	Wompoo Fruit-dove	V	-	Rainforests, low-elevation moist eucalypt forest, and Brush Box forests. Most often seen in mature forests, but also found in remnant and regenerating rainforest.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Sternula albifrons	Little Tern	E	-	Almost exclusively coastal, preferring sheltered environments; however may	Foraging habitat present with	Unlikely, possible only as	Unlikely. Habitat

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
				occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	Sportsmans Creek and the Clarence River. Better quality habitat exists outside the study area in the lower reaches of the river and along the coast. No nesting habitat present.	rare forager within study area. One OEH (2015) record within 10 km radius.	values of the study area and local occurrence potential unlikely to be affected by the proposal.
Stictonetta naevosa	Freckled Duck	V	-	Permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. In drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Tyto longimembris	Eastern Grass Owl	V	-	Areas of tall grass, including tussocks in swampy areas, grassy plains, swampy heath, cane grass, sedges on flood plains.	Moderate in broad habitat terms, mainly as foraging habitat within the cane fields.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely.
Tyto novaehollandiae	Masked Owl	V	-	Dry eucalypt forest and woodlands. The Masked Owl is a forest owl but it often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	No suitable habitat within the study area. Study area includes a small area of managed parkland and lacks forested vegetation. No suitable nesting trees present.	Unlikely. Three OEH (2015) records within 10 km radius.	Unlikely
Mammalia							
Aepyprymnus	Rufous	V	-	Tall moist eucalypt forest to open woodland	No suitable habitat	Unlikely. One OEH (2015)	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
rufescens	Bettong			with tussock grass understorey.	within the study area.	record within a 10 km radius.	
Chalinolobus nigrogriseus	Hoary Wattled Bat	V	-	Dry open eucalypt forest dominated by spotted gum, boxes and ironbarks. Also healthy coastal forests where Red Bloodwood and Scribbly Gum are common. Naturally sparse understorey is favourable.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within a 10 km radius.	Unlikely
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Found mainly in areas with extensive cliffs (in crevices) and caves (near their entrances), old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies.	General area provides potential aerial foraging habitat.	Unlikely. Foraging individuals recorded in 2002 by D and D consultants. No OEH (2015) records within a 10 km radius.	Unlikely
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	Dry and moist eucalypt forests and rainforests, fallen hollow logs, large rocky outcrops.	No suitable habitat within the study area.	Unlikely. Six OEH (2015) records within a 10 km radius.	Unlikely
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Moist and dry eucalypt forest and rainforest, particularly at high elevations. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	No suitable habitat within the study area.	Unlikely. Three OEH (2015) records within a 10 km radius.	Unlikely
Miniopterus australis	Little Bentwing-bat	V	-	Moist eucalypt forest, rainforest and dense coastal scrub.	Sportsmans Creek Bridge provides suitable non-breeding roosting habitat. General area provides	Likely. Fifteen OEH (2015) records within a 10 km radius.	Unlikely. No impact to breeding habitat or

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
					potential aerial foraging habitat		foraging habitat values of the study area.
Miniopterus orinae oceanensis (previously *M. schreibersii)*	Eastern Bentwing-bat	V	-	Forest or woodland, roost in caves, old mines and stormwater channels.	Sportsmans Creek Bridge provides suitable non-breeding roosting habitat. General area provides potential aerial foraging habitat.	Unlikely. Foraging individuals recorded in 2002 by D and D consultants. No OEH (2015) records within a 10 km radius.	Unlikely
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts in tree hollows.	Sportsmans Creek Bridge provides potential opportunistic non-breeding roosting habitat. General area provides low quality potential aerial foraging habitat. No tree hollows present.	Unlikely. No OEH (2015) records within a 10 km radius.	Unlikely
Myotis macropus	Large-footed Myotis	V	-	Bodies of water, rainforest streams, large lakes, reservoirs in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Known breeding roosting habitat on existing Sportsmans Creek Bridge and foraging habitat along Sportsmans Creek/ Clarence River.	Known. Six OEH (2015) records within a 10 km radius.	Likely
Nyctophilus bifax	Eastern Long-eared	V	-	Lowland subtropical rainforest and wet and swamp eucalypt forest, extending to	No suitable habitat within the study area.	Unlikely. No OEH (2015)	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
	Bat			adjacent moist eucalypt forest.	Prefers more intact habitats.	records within a 10 km radius.	
Petaurus australis	Yellow-bellied Glider	V	-	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.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Petaurus norfolcensis	Squirrel Glider	V	-	Blackbutt, bloodwood and ironbark eucalypt forest with heath understorey in coastal areas, and box-ironbark woodlands and River Red Gum forest inland.	No suitable habitat within the study area.	Unlikely. Ten OEH (2015) records within a 10 km radius.	Unlikely
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	This tree dwelling-marsupial is found in dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. They prefer rough barked trees of 25 cm DBH or greater. They nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span.	No suitable habitat within the study area.	Unlikely. 31 OEH (2015) records within a 10 km radius.	Unlikely
Phascolarctos cinereus	Koala	V	-	Appropriate food trees in forests and woodlands, and treed urban areas.	Scattered food trees in locality. No suitable habitat within the study area.	Unlikely. 116 OEH (2015) records within a 10 km radius.	Unlikely
Planigale maculata	Common Planigale	V	-	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas with	No suitable habitat within the study area.	Unlikely. One OEH (2015)	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
				surface cover close to water. During the day they shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks.		record within a 10 km radius.	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	No known roosts within the study area. Suitable foraging habitat within the locality and provided by ornamental trees within the study area.	Likely. Sixteen OEH (2015) records within a 10 km radius.	Unlikely. No impact to breeding habitat or significant foraging habitat.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	Sportsmans Creek Bridge provides potential opportunistic non-breeding roosting habitat. General area provides low quality potential aerial foraging habitat. No tree hollows present.	Unlikely. Two OEH (2015) records within a 10 km radius.	Unlikely
Vespadelus troughtoni	Eastern Cave Bat	V	-	Cave roosting species found in dry open forest and woodland near cliffs and rocky overhangs. Has been recorded roosting in disused mine workings. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Reptilia							
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	This tree-dwelling snake shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. Inhabits dry eucalypt forests and woodlands,	No suitable habitat within the study area. Riparian area present however no	Unlikely. Two OEH (2015) records within a	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
				cypress woodland and occasionally in rainforest or moist eucalypt forest. In drier environments, it favours riparian areas.	tree hollows, no dry or moist eucalypt woodlands or rainforest present.	10 km radius.	
Hoplocephalus stephensii	Stephen's Banded Snake	V	-	Rainforest and eucalypt forests and rocky areas up to 950 m. This nocturnal partly tree-dwelling snake shelters between loose bark and tree trunks, amongst vines, or in hollow trunks, limbs, rock crevices or under slabs during the day.	No suitable habitat within the study area. No hollow trunks or rock crevices present.	Unlikely. No OEH (2015) records within a 10 km radius.	Unlikely

Table D2 Threatened flora – potential occurrence assessment

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Flora							
Angophora robur	Sandstone Rough-barked Apple	V	V	Dry open forest in sandy or skeletal soils on sandstone, or occasionally granite, with frequent outcrops of rock.	No suitable habitat occurring at the site. No rocky outcrops or suitable substrate. No dry open forest present.	Unlikely. 277 OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Cyperus aquatilis	Water Nutgrass	E	-	In NSW, known only from a few sites north from Grafton. Grows in ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Desmodium acanthocladum	Thorny Pea	V	V	Fringes of riverine subtropical and dry rainforest on basalt-derived soils at low elevations.	No suitable habitat within the study area. No riverine subtropical or dry rainforest present.	Unlikely. One OEH (2015) record with in a 10 km radius. Not recorded during surveys.	Unlikely
Eucalyptus glaucina	Slaty Red Gum	V	V	Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common and farther south, from Taree to Broke, west of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage.	No suitable habitat within the study area. No dry or moist eucalypt forest present.	Unlikely. Five OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Grevillea masonii	Mason's Grevillea	E	E	Road verges and pasture at low altitudes in gravelly loam soils.	No suitable habitat within the study area.	Unlikely. 155 OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Maundia triglochinoides	-	V	-	Swamps or shallow freshwater on clay.	No suitable habitat within the study area. Sportsmans Creek and Clarence River are brackish within the study area.	Unlikely. Fourteen OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Melaleuca irbyana	Weeping Paperbark	E	-	Open eucalypt forest in poorly drained, usually clay, soils.	No suitable habitat occurring within the study area.	Unlikely. Ninety-five OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Polygala linariifolia	Native Milkwort	E	-	Sandy soils in dry eucalypt forest or woodland with sparse understorey.	No suitable habitat occurring within the study area. No dry eucalypt forest or woodland present.	Unlikely. Two OEH (2015) records with in a 10 km radius. Not recorded on site during surveys.	Unlikely
Syzygium moorei	Durobby	V	V	Subtropical and riverine rainforest at low altitude.	No natural habitat occurring within the study area. Study area is outside species' natural distribution.	Known. One specimen planted in south-western corner of Flo Clark Park.	Unlikely
Ecological Communities							

Scientific name	Common name	Status TSC Act	Status EPBC Act	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes but may also occur in back barrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely
Lowland rainforest on floodplain of the NSW North Coast Bioregion.		E	-	Occurs on fertile soils in lowland river valleys. Occupies riverine corridors and alluvial flats with rich, moist silts often in subcatchments dominated by basic volcanic substrates.	No suitable habitat occurring within the study area.	Unlikely	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Subtropical coastal floodplain forest of the NSW North Coast Bioregion.		E	-	Occupies central or marginal parts of floodplains and sandy flats, including Pleistocene back-barrier flats; habitats where flooding is periodic and soils are rich in silt and sand, sometimes humic, and show little influence of saline ground water. Associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m, but may occur on localised river flats up to 250 m elevation. May form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely

Scientific name	Common name	Status	Status	Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Swamp Oak Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.	Suitable land formation present. A narrow band of low condition Swamp Oak forest is present along the riparian zone of the Clarence River/ Sportsmans Creek junction.	Known from south-eastern corner of Sportsmans Park at the junction of Sportsmans Creek and Clarence River.	Unlikely. No direct or significant indirect impacts on EEC likely.

Appendix E

Biodiversity assessment, Sportsmans Creek Bridge removal, Lawrence (GeoLINK 2016)

Biodiversity assessment

Sportsmans Creek Bridge removal, Lawrence

March 2016

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Contents

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Executive summary

This biodiversity assessment has been prepared by GeoLINK for NSW Roads and Maritime Services (Roads and Maritime) to accompany a Review of Environmental Factors (REF) prepared by Kellogg Brown and Root (KBR) for the proposed removal of Sportsmans Creek Bridge, located on the southern approach to the village of Lawrence within the Clarence Valley Council (CVC) Local Government Area (LGA) in the NSW Northern Rivers region.

This biodiversity assessment draws upon information previously prepared for construction of the new bridge over Sportsmans Creek upstream of the existing timber truss bridge including *Biodiversity Assessment: Sportsmans Creek New Bridge* prepared by GeoLINK in December 2014 (ref: 2228-1023) and *Microbat impact assessment: construction of a new Sportmans Creek Bridge and demolition of the existing Sportsmans Creek Bridge* prepared by GeoLINK in August 2014 (ref: 2311-1010).

The existing bridge is to be replaced under the Roads and Maritime Timber Truss Heritage Conservation Strategy (2012) which has been endorsed by the NSW Heritage Office. Replacement of this bridge relates to issues of poor sight distance, poor alignment and no pedestrian access. Additionally, the bridge presents significant transport limitations at the present and in the future due to its geometry and design limitations.

Preliminary investigations of the timber truss Sportsmans Creek Bridge identified a breeding population of the threatened Large-footed Myotis (*Myotis macropus*). A microbat impact assessment for the construction of a new Sportmans Creek Bridge and demolition of the existing Sportsmans Creek Bridge was therefore prepared by GeoLINK in August 2014 (ref: 2311-1010). The results of the microbat impact assessment are incorporated into this Biodiversity Assessment.

The purpose of this report is to describe ecological values of the site and assess the ecological constraints associated with the proposal. This was achieved by undertaking a comprehensive desktop review of background data including literature review, database searches and liaison with local ecologists. Additionally, flora and fauna habitat assessments were undertaken and targeted searches were conducted in areas of preferred habitat for threatened flora and fauna species and threatened ecological communities identified in desktop database searches as having potential to occur in the study area.

Vegetation types within the study area comprise managed parkland, riparian zones, sugar cane and cleared pasture land. Results of field assessments found that the study area represents a highly modified agricultural landscape, previously cleared of native vegetation. Pastoral grasses dominate and native vegetation is limited in extent degraded and generally exhibits low diversity with significant weed cover. Trees are few, generally isolated and mostly exotic.

One threatened flora species; Durobby (*Syzygium moorei*) is located in the south-western corner of Flo Clark Park. The tree has been planted and is of low conservation significance due to it occurring far outside its natural range. No other threatened flora species were recorded.

One vegetation community within the far eastern portion of Sportsmans Park on the edge of the Clarence River was considered to represent a low condition form of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC), listed under the *Threatened Species Conservation Act 1995* (TSC Act).

No threatened fauna species (apart from the already identified colony of Large-footed Myotis) were recorded in the study area during the field assessment. Based on a fauna habitat assessment of the study area it is considered unlikely that the study area represents a significant area of habitat for any of the threatened fauna species that have been recorded in the locality.

The microbat impact assessment (GeoLINK, 2014a) found that Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. This species is listed as vulnerable under the TSC Act. Large breeding colonies are uncommon in the lower Clarence and are not in close proximity to the Sportsmans Creek Bridge (>10 kilometres along waterways). Surveys of drainage structures in the locality found that potential unoccupied alternative breeding roost drainage structures within the locality are uncommon and likely to have a lower roost carrying capacity to occupied sites.

Sportsmans Creek Bridge also offers potential non-breeding roosting habitat for two other threatened species; the Little Bent-winged Bat (*Miniopterus australis*) and Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*).

Seven-part tests of significance in accordance with Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Large-footed Myotis, Little Bent-winged Bat and Eastern Bent-winged Bat and *Swamp Oak Floodplain Forest of New South Wales North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC) have been undertaken. These assessments concluded:

- **Large-footed Myotis**: The proposal involves removal of habitat occupied by a large breeding colony. Although it is highly likely that the local Large-footed Myotis population would relocate to the habitat to be provided on the new bridge, the precautionary approach outlined in OEH guidelines: *Threatened species assessment guidelines, The assessment of significance* (DECC, 2007) has been adopted and removal of the timber truss bridge has the potential to significantly affect the local Large-footed Myotis population. Therefore a Species Impact Statement (SIS) for the Large-footed Myotis is required.
- **Little and Eastern Bent-winged Bats**: A significant impact on these species is considered unlikely. No breeding habitat would be affected by the proposal and alternative potential roosting habitat in their non-breeding range in the lower Clarence is available to support the local potential occurrences of these species.
- **Swamp Oak Floodplain Forest EEC**: The proposal is not expected to result in a significant adverse impact on Swamp Oak floodplain forest EEC that would put the local viability of this community at risk.

No other threatened or migratory flora/fauna species listed under the TSC Act or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are considered likely to be significantly impacted by the proposal however it is recommended that a SIS be prepared for the local Large-footed Myotis population.

1 Introduction

1.1 Background

The NSW Roads and Maritime Services (Roads and Maritime) propose to remove the timber truss bridge over Sportsmans Creek, located on the southern approach to the village of Lawrence (refer to Illustration 1.1) within the Clarence Valley Council (CVC) Local Government Area (LGA). Lawrence is located 25 kilometres north of Grafton on Lawrence Road (MR152) which is managed and maintained by CVC.

Kellogg Brown and Root (KBR) have been engaged by Roads and Maritime to prepare a Review of Environmental Factors (REF) for removal of the timber truss bridge. The existing bridge is to be replaced under the Roads and Maritime Timber Truss Heritage Conservation Strategy (2012) which has been endorsed by the NSW Heritage Office. Replacement of this bridge relates to issues of poor sight distance, poor alignment and no pedestrian access. Additionally, the bridge presents significant transport limitations at the present and in the future due to its geometry and design.

The purpose of the biodiversity assessment is to:

- Describe ecological values of the site.
- Assess ecological constraints associated with the proposal.

For the purposes of this assessment:

- ***'the site'*** refers to the area which is subject to direct impacts inclusive of permanent and temporary work and includes the existing Sportsmans Creek Bridge and its approaches, Sportsmans Park and Flo Clark Park.
- ***'the study area'*** refers to the site plus a 100 metre buffer which includes areas that may be affected by the proposal, either directly or indirectly.
- ***'the locality'*** refers to the area within a 10 kilometre radius of the site.

Preliminary investigations of the timber truss Sportsmans Creek Bridge identified a breeding population of the threatened Large-footed Myotis (*Myotis macropus*). A microbat impact assessment for the construction of a new Sportmans Creek Bridge and removal of the existing Sportsmans Creek Bridge was therefore prepared by GeoLINK in August 2014 (ref: 2311-1010). The results of the microbat impact assessment are incorporated into this Biodiversity Assessment.

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: VJS Date: 7/12/2015
Source of base data: SIX Maps

0 2 km

North

GeoLINK environmental management and design

Biodiversity Assessment - Sportsmans Creek Bridge Removal, Lawrence
2465-1017

Site Locality

Illustration 1.1

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: VJS Date: 15/12/2015
Source of base data: SIX Maps

0 50

North

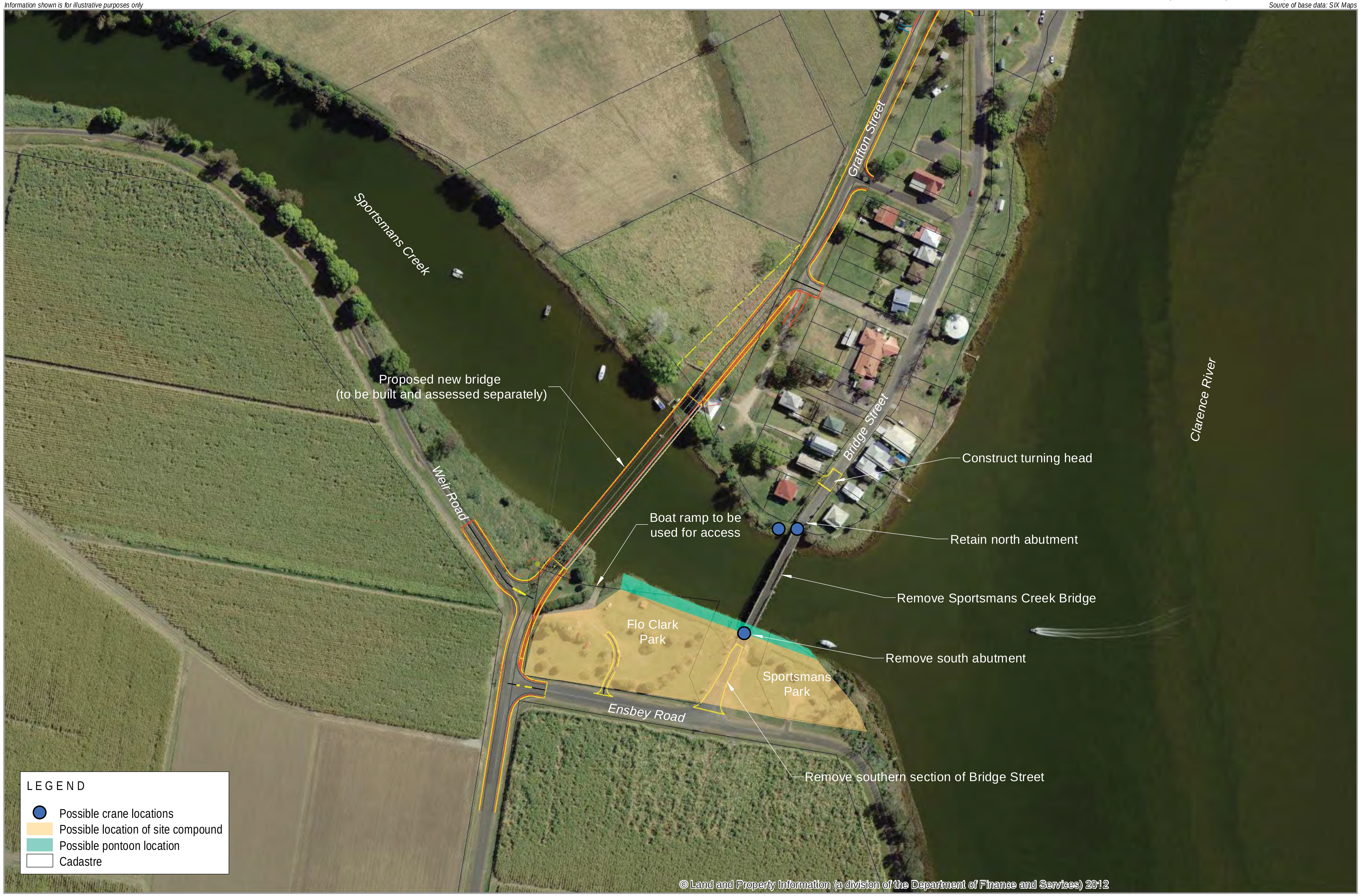
GeoLINK environmental management and design

Biodiversity Assessment - Sportsmans Creek Bridge Removal, Lawrence
2465-1018

Subject Site and Study Area

Illustration 1.2

Information shown is for illustrative purposes only



Species Impact Statement: Sportmans Creek Bridge Removal, Lawrence
2465-1019

The Proposal

Illustration 1.3

2 Methodology

2.1 Database searches

The following database searches were undertaken to identify potential biodiversity constraints associated with the site:

- A 10 kilometre radius search of the BioNet Atlas of NSW Wildlife (OEH) to identify threatened flora/fauna species and EECs known to occur within the search area on 19 August 2015.
- A 10 kilometre radius search of the EPBC Act Protected Matters Search Tool (PMST) for federally listed threatened flora/fauna species and ecological communities predicted to occur within the search area on 8 December 2015.
- Fisheries Records Viewer for threatened aquatic fauna occurring within the CVC LGA (NSW Department of Primary Industries [DPI]) on 8 December 2015.
- Searches of current noxious weed declarations for the Clarence Valley control area (NSW DPI) on 8 December 2015.

2.2 Literature review

A comprehensive literature review of information pertaining to the study area was undertaken. Key sources of information reviewed include:

- Critical Habitat Register (OEH).
- Threatened Species Profile Database (OEH).
- Directory of Important Wetlands in NSW (DIWA) Spatial Database.
- Key Fish Habitat mapping for Clarence Valley LGA (NSW DPI).
- Mapped bird routes of the Clarence Valley (Clarence Valley Birdos, 2006).
- Clarence Valley Estuary Management Plan (Umwelt, 2003).
- State Environmental Planning Policy (SEPP) 14 Coastal Wetland (Department of Planning and Environment).
- Terrestrial and Aquatic Flora and Fauna Assessment: Proposed Replacement of the Sportsmans Creek Bridge, Lawrence (D and D Consultants, 2002).
- Environmental Impact Statement for Demolition of Existing Bridge and Construction of New Bridge over Sportsmans Creek, Lawrence (Maclean Shire Council, 2002).
- Bat Survey and Impact Assessment: Sportsmans Creek Bridge, Lawrence NSW (Ecotone, 2007).
- Technical paper – A review of the Status of Breeding Osprey in 2006 (Ekert and Brady, 2007).
- Microbat Impact Assessment: Construction of a new Sportsmans Creek Bridge and Demolition of the existing Sportmans Creek Bridge (GeoLINK, 2014a).
- Biodiversity Assessment: Sportsmans Creek New Bridge (GeoLINK, 2014b).

2.3 Liaison

In order to collect anecdotal information on biodiversity associated with the study area the following individuals/agencies were contacted in 2014 during preparation of the biodiversity assessment (GeoLINK 2104a):

- Mr Martin Swain, CVC ecologist.
- Mr Greg Clancy, local ecologist and avifauna researcher.

Mr Swain was again contacted in August 2015 for the purposes of gathering any recent data.

2.4 Review of aerial photography

In addition to the above, aerial photographs of the study area were reviewed to identify vegetation extent, wetland areas and other ecological features of the site.

2.5 Flora assessment

A flora assessment of the study area was conducted on 8 July 2014 to enable vegetation to be described and to provide an indicative list of flora species occurring at the site. Considering the small size and modified state of the study area, the random meander method (DEC 2004) was chosen as an appropriate method to survey vegetation. The survey method included thorough and targeted searches in areas of preferred habitat for threatened flora species identified in desktop database searches as having potential to occur in the study area.

Plant species were identified and recorded in the field with the aid of identification keys as required. The structure of vegetation communities was also recorded. A total survey effort of three field hours was dedicated to the flora survey.

Vegetation types recorded were compared with EEC descriptions in final determinations of the NSW Scientific Committee under the NSW *Threatened Species Conservation Act 1995* (TSC Act), and Threatened Ecological Communities (TECs) listed by the Commonwealth Threatened Species Scientific Committee under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.6 Fauna assessment

2.6.1 Fauna habitat assessment

A fauna habitat assessment of the site was undertaken on 8 July 2014 in addition to previous survey work undertaken to identify threatened microbats on the existing Sportsmans Creek Bridge.

The fauna habitat assessment was based on a review of database records and fauna habitat features within the study area. This methodology was deemed adequate due to the disturbed nature of the site and minimal native vegetation occurring within the site.

Fauna habitat features were observed over the study area and the suitability for threatened species recorded in the locality. Seven field hours was dedicated to fauna habitat assessment.

Fauna habitat surveys targeted the following fauna habitat features and resources. Where they were encountered, a close examination was made in relation to threatened species and their habitat requirements:

- Vegetation structure.

- Dominant plant species and plant diversity.
- Levels of disturbance.
- Leaf litter.
- Fauna scats.
- Fauna tracks, diggings and burrows.
- Signs of fauna feeding.
- Tree scratch/claw marks.
- Tree hollows, stags and fallen logs.
- Vegetation connectivity.
- Rock outcrops and ledges.
- Availability of water.

2.6.2 Bird surveys

Bird surveys were undertaken during afternoon/dusk on 3 and 26 August 2015 (for two person hours each day). They involved recording all bird species observed, or heard calling within the study area.

2.6.3 Microbat surveys at Sportsmans Creek Bridge

Direct inspections of the bridge for roosting microbats were undertaken on 16 December 2013 and 3 February 2014. This involved torch and pole mounted camera inspection of the entire bridge for roosting microbats from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land. The two inspection periods were proposed to coincide with the two Large-footed Myotis breeding events in the north coast of NSW (October to mid-April inclusive). The following information was recorded:

- Potential microbat roosting features.
- Species present.
- Location and size of any microbat colonies.
- Description of occupied roost sites.
- Breeding status of microbats recorded.

2.6.4 Microbat surveys for other Large-footed Myotis breeding colonies

Surveys for other Large-footed Myotis breeding colonies within a 10 kilometre radius of Sportsmans Creek Bridge involved direct inspection (torch searches) of other accessible road drainage structures (bridges and culverts >500 millimetre diameter) on public land. The drainage structures were identified via GIS analysis (topographic maps and aerial photographs), targeting drainage structures adjacent to open water. The surveys were undertaken on 3 and 4 February 2014, with the following information recorded at each site:

- Potential microbat roosting features.
- Species present.
- Location and size of any microbat colonies.

- Description of occupied roost sites.
- Breeding status of microbats recorded.

While the Large-footed Myotis may also occupy tree hollows as breeding roost sites (Campbell, 2009), no hollow-bearing trees occur within the study area and are uncommon across the majority of the locality (particularly in proximity to waterways on the Clarence River floodplain). Such hollow-bearing trees were not surveyed because they are unlikely to support large populations (eg >30 bats).

2.7 Survey limitations

Considerable effort was made to sample vegetation and fauna habitat features within the study area, however not all flora and fauna that may occur on the site were able to be recorded. Seasonal surveys are required to detect species that are inconspicuous due to their rarity, elusive nature or sporadic use of the site. Such species may have gone undetected in the survey. It is, however, unlikely that species with high conservation significance have been overlooked due to the thorough and methodical nature of the assessment. Habitat evaluation and application of the precautionary principle has however been adopted to address survey limitations.

The main limitation of microbat surveys is associated with microbat species behaviour/ecology. Microbat roosts are important for providing shelter, protection from predators and an appropriate microclimate for energy conservation and reproduction. To satisfy different seasonal and lifecycle requirements and to respond to ecological interactions with other species (eg parasites), microbats often make use of multiple roosting sites, shifting between roosts regularly (Evans, 2009), though this varies per species and is dependent on lifecycle periods. To counter these limitations, this assessment has used both desktop assessment and two seasonal surveys of Sportsmans Creek Bridge to maximise the validity of that information gathered for which the impact assessment is based.

3 Results

3.1 Flora

3.1.1 Database results

The OEH BioNet Atlas of NSW Wildlife and PMST identified records of 18 threatened flora species listed under the TSC Act and/ or EPBC Act previously recorded or having habitat within the search area (10 kilometre radius around the site). An assessment of the likely occurrence of these species within the study area is provided in Appendix A.

3.1.2 Vegetation communities

Vegetation within the study area comprises managed parkland, riparian zones (cleared and Swamp Oak forest), sugar cane and cleared pasture land as described below (refer to Illustration 3.1). Flora species within the study area are listed in Appendix B.

3.1.2.1 Parkland

Vegetation associated with the southern bank of Sportsmans Creek has been cleared in the past and is now Flo Clark Park (to the west of the timber truss bridge) and Sportsmans Park (to the east of the timber truss bridge). Cultivated native trees have been planted to landscape these areas including Bottlebrush (*Callistemon* sp.), Cadagi (*Corymbia torreliana*), Jacaranda (*Jacaranda mimosifolia*), African Tulip Tree (*Spathodea companulata*) and Water Gum (*Tristaniopsis laurina*) (refer to Plate 3.1 and Plate 3.2). This vegetation is highly modified/disturbed and is considered to be of low conservation value.

Plate 3.1 View north-east towards Sportsmans Creek Bridge showing isolated trees within Flo Clark Park

Plate 3.2 View south over Sportsmans Park

3.1.2.2 Riparian zones - cleared

Riparian zones associated with the southern and northern banks of Sportsmans Creek have been cleared and are largely free of native vegetation. Vegetation within these areas is dominated by exotic grasses and weeds, including Para Grass (*Urochloa mutica*) and Coastal Morning Glory (*Ipomoea cairica*) (refer to Plate 3.3). The southern bank of Sportsmans Creek which adjoins the northern edge of the parkland comprises about a 10 metre wide area of Common Reed (*Phragmites australis*) and exotic Para Grass (refer to Plate 3.4). One immature Forest Red Gum (*Eucalyptus tereticornis*) occurs on the southern bank of Sportsmans Creek and is heavily smothered by Coastal Morning Glory (*Ipomoea cairica*).

Aquatic vegetation associated with the site was not identified at the time of survey. Mapped areas of seagrass and saltmarsh were identified within the Clarence River to the east of the site, from a literature review of information pertaining to the site (refer to Illustration 3.1). No saltmarsh or seagrass beds were identified within the site during the field surveys.

Plate 3.3 View east showing un-mown riparian vegetation

Plate 3.4 Exotic Para Grass (*Urochloa mutica*) on the steep southern bank

3.1.2.3 Riparian zone - Swamp Oak forest

Swamp Oak forest within the far eastern portion of Sportsmans Park on the edge of the Clarence River is highly degraded (refer to Illustration 3.1). It has an open canopy with vine weeds smothering mature Swamp Oak (*Casuarina glauca*) and evidence of previous heavy pruning.

3.1.2.4 Cleared pasture land

On the northern side of Sportsmans Creek, cleared pasture land occurs on the western side of Grafton Street. It comprises a range of grass species dominated by Kikuyu (*Pennisetum clandestinum*), Common Couch (*Cynodon dactylon*) and *Paspalum* spp.

3.1.2.5 Sugar cane

Managed land in the form of cultivated sugar cane dominates the land south of Ensby Road and Weir Road.

3.1.3 Noxious weeds

Two listed 'Noxious weeds' declared for the Clarence Valley control area were detected within the riparian zone during the survey (refer to Table 3.1). Lantana (*Lantana camara*) is also listed as a Weed of National Significance (WoNS). The invasion, establishment and spread of Lantana is listed as a Key Threatening Process (KTP) under the TSC Act.

Table 3.1 Listed noxious weeds identified within the site

Scientific name	Common name	Listing	Extent/location
Cinnamomum Camphora	Camphor Laurel	N4	A number of Camphor Laurels were recorded on the site in the riparian zone.
Lantana camara	Lantana	N4, WoNS	A small number of occurrences occur in the riparian zone.

Noxious weeds declared under the *Noxious Weeds Act,* are required by law to be controlled by all landholders within a given control area. The control requirements for N4 noxious are that '*the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority'.*

3.1.4 Threatened flora

One threatened flora species; Durobby (*Syzygium moorei*) is located in the south-western corner of Flo Clark Park (refer to Illustration 3.1). The tree has been planted and is of low conservation significance due to it occurring far outside its natural range. No other threatened flora species were recorded. The threatened flora potential occurrence assessment of locally recorded/potentially occurring species identified in the database searches (refer to Appendix A), found that based on their habitat requirements and the modified nature of the site, no threatened flora species are likely to occur at the site.

3.1.5 Endangered ecological communities

One vegetation community covering 0.09 hectares within the far eastern portion of Sportsmans Park on the edge of the Clarence River was considered to represent a low condition form of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* Endangered Ecological Community (EEC) listed under the TSC Act (refer to Illustration 3.1). No other TSC Act or EPBC Act listed EECs occur within the study area.

Information shown is for illustrative purposes only

Drawn by: GJM Checked by: DSA Reviewed by: VJS Date: 8/12/2015
Source of base data: SIX Maps

North

0 50

GeoLINK environmental management and design

Biodiversity Assessment - Sportsmans Creek Bridge Removal, Lawrence
2465-1020

Ecological Features

Illustration 3.1

3.2 Microbats

3.2.1 Potential microbat roosting habitat

Potential microbat roosting habitat occurs throughout Sportsmans Creek Bridge (refer to Plate 3.5) and includes:

- Split (two piece) stringers (refer to Plate 3.6). These features are common across the bridge.
- Decking gaps (ie below longitudinal decking, between transverse decking and most above or directly adjacent to the middle three stringers) (refer to Plate 3.7). These features are common across the bridge.
- Rotted timber features (primarily girder) (refer to Plate 3.8). Uncommon feature and generally in exposed locations or not well formed.

Bird nests (Welcome Swallow *Hirundo neoxena* and Fairy Martin *H. ariel*) and mud dauber wasp nest would also be expected to occur at least periodically and provide mostly non-breeding roosting opportunities.

No hollow-bearing trees, caves or mines occur within the study area. While local buildings may provide roosting opportunities for some microbat species, inspection of the dwelling proposed for removal as part of the new bridge construction failed to record any microbats. The potential for the dwelling affected by the proposal to provide significant threatened microbat roosting habitat is low

Plate 3.5 View north showing underside of Sportsmans Creek Bridge

Plate 3.6 Two piece (split) stringer

Plate 3.7 Large-footed Myotis in bridge decking

Plate 3.8 Cavity at the end of a rotted girder

3.2.2 Potential microbat foraging habitat

The study area comprises a mostly cleared floodplain landscape. It offers potential aerial foraging habitat for microbat species capable of foraging in modified or non-forested coastal landscapes. Aquatic foraging habitat for the Large-footed Myotis is present locally, including Sportsmans Creek and the Clarence River. Aerial and aquatic microbat foraging habitat of similar value occurs throughout the locality.

3.2.3 Microbats at Sportsmans Creek Bridge

About 300 Large-footed Myotis (adults and juveniles) were recorded roosting at Sportsmans Creek Bridge during both the December 2013 and February 2014 surveys (numbering 308 and 301 respectively). No other microbat species were recorded. Twenty-one roost sites within the bridge were recorded (19 in December 2013 and nine in February 2014); all located above the water in spans 2 and 3. Occupied roosting habitat features included:

- Split (two piece) stringers: Six in total.
- Decking gaps: Twenty in total.

Occupied cavities ranged between 11 and 108 millimetres wide, with an average of about 39 millimetres. Other sections of the bridge supported similar structures, providing potential bat roosting habitat however were not occupied at the time of the survey. This included some areas showing signs of previous usage (stained/'polished' timber).

The Large-footed Myotis population comprised adults and young indicating a breeding population. Population fluctuations would be expected throughout the year with a peak in late February/March following the completion of the second seasonal birthing period (the number of new born bats during the second survey were low suggesting the second seasonal birthing period was not complete).

3.2.4 Surveys for other Large-footed Myotis breeding colonies

The results of the surveys for other Large-footed Myotis breeding colonies within a 10 kilometre radius of the site are provided in Appendix C. Site visits were undertaken at 66 drainage structures (five bridges and 61 culverts), of which 55 were able to be inspected for microbats. The remaining 11 drainage structures (all culverts) were unable to be inspected due to access constraints (eg inlet on private property; outlets with floodgates, etc). Most of these however were located in floodplain environments and susceptible to complete inundation, reducing their potential to support Large-footed Myotis breeding colonies.

Microbats or evidence of microbat occurrence was recorded in ten drainage structures (three bridges and seven culverts). Three microbat species were recorded:

- Large-footed Myotis: Recorded at three drainage structures, with one non-breeding colony (Poverty Creek Bridge) and two breeding colonies recorded (pipe culvert – Pringles Way and Shark Creek Bridge – Pacific Highway). Evidence of microbat activity was also recorded at Coldstream Bridge (Pacific Highway) which is reported to also support a Large-footed Myotis colony).
- Chocolate Wattled Bat (*Chalinolbus gouldii*): Two non-breeding colonies were recorded at two culverts, numbering three and nine bats.
- Little Bent-winged Bat: An individual was recorded at one drainage structure (pipe culvert).

Five microbats (likely to comprise a non-breeding colony) were also recorded at another pipe culvert, though were unable to be identified due to the depth of water in the channel inhibiting access. Small guano accumulations were present at another two culverts evidencing usage by a small number of microbats or irregular usage.

Most of the inspected drainage structures support potential microbat roost features (eg rough concrete, culvert cell joins and lift holes), however offered low suitability as important roost features for threatened microbats due to their high flood susceptibility and presence of only exposed roost opportunities etc.

3.2.5 Other local Large-footed Myotis breeding colonies

Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. Large breeding colonies are uncommon in the lower Clarence and are not in close proximity to the Sportsmans Creek Bridge (>10 kilometres along waterways which is how Large-footed Myotis would be expected to disperse).

In addition to Sportsmans Creek Bridge, three other Large-footed Myotis breeding colonies were recorded or are known to occur within a 10 kilometre radius of Sportsmans Creek Bridge (refer to Table 3.2). Only three of the other drainage structures inspected (all culverts) were considered to provide potentially suitable Large-footed Myotis breeding habitat (refer to Appendix C), though were not occupied by this species during the survey and offer potential habitat only for small colonies (<30 bats). Three other known Large-footed Myotis breeding colonies in the lower Clarence River area are listed in Table 3.3.

Table 3.2 Known Large-footed Myotis populations within 10 kilometres of Sportsmans Creek Bridge

Structure Name	Structure Type	Population Size	Direct Distance (km)	Along Waterways (km)
Coldstream Bridge (Pacific Highway)	Concrete bridge	Unknown	7.4	13.8
Shark Creek Bridge (Pacific Highway)	Concrete plank bridge	300	8.8	16.8
Pipe culvert – Pringles Way (4 x 1,800 mm diameter pipes	Reinforced concrete pipe culvert	>20	4.1	6.1

Table 3.3 Other Large Myotis populations in the Lower Clarence > 10 kilometres from Sportsmans Creek Bridge

Structure Name	Structure Type	Population Size	Direct Distance (km)	Along Waterways (km)	Details
McFarlane Bridge (Lawrence Road)	Timber Bridge	Varies between 200 and >600 (numbers recorded during monitoring between 2011 and 2014)	10.3	11.4	McFarlane Bridge Large-footed Myotis population was known to fluctuate between >100 (most likely around 200) and peaking at well over 500 individuals (recorded on 26 March 2013). At the time of the population peak, the configuration of bats comprised 17 groups within span 10 and span 11, and about 30 bats

Structure Name	Structure Type	Population Size	Direct Distance (km)	Along Waterways (km)	Details
					within a bat box in span 9. The population fluctuations are likely to correspond with the inclusion of young in the population estimates during the breeding season, with large numbers of young dispersing at the end of the breeding season, resulting in overall lower bat numbers. Monitoring in September 2015 recorded about 180 Large-footed Myotis.
Mororo Bridge (Pacific Highway)	Concrete bridge	About 30 in 2013/14 breeding season	21.1	>23	Four bat boxes were installed under the south bound Mororo Bridge prior to bridge work on the neighbouring steel girder north bound Mororo Bridge, which had a history of usage by Large-footed Myotis. Surveys completed in November 2014 estimated 153 individuals including newborns inside the bat boxes. An estimation of 255 individuals was also recorded during the February 2015 surveys at the same location.
Oyster Creek Channel (Yamba Road)	Unknown	Unknown	22.2	>33	Four Large-footed Myotis were 'observed' in April 2003, and this site has been confirmed by Mr Paul Burcher (pers. comm. to A.Lloyd) as a Large-footed Myotis roost site.

A review of *Myotis macropus* records from the OEH Wildlife Atlas shows that six records of this species have been lodged within 10 kilometres of Sportsmans Creek Bridge. These records are roughly located within Woodford Island Nature Reserve, Gurranang State Conservation Area, Patemans Road and the subject site.

Large-footed Myotis was also detected at Harwood Bridge 16 kilometres north-east of Sportsmans Creek Bridge, via ultrasonic call detection in 2007 and an 'observed' record also exists from 2002, however Harwood Bridge is predominantly of steel construction and unlikely to be able to support roosting microbats of any species.

It should be noted that additional Large-footed Myotis colonies have been observed by the authors however OEH's Wildlife Atlas does not yet reflect these records. For example, four clusters of Large-footed Myotis have been recorded within a concrete plank bridge over Serpentine Creek, 17 kilometres north-east of Sportsmans Creek Bridge between November 2013 and February 2014. Surveys in February 2015 recorded ten Large-footed Myotis roosting in four different clusters in the gaps between the concrete planking.

There are no known cave or other subterranean (eg disused mines or tunnel) roosting opportunities within the locality for the Large-footed Myotis and the other threatened microbat species. Hollow-bearing trees are uncommon as the local landscape is largely cleared. While Large-footed Myotis hollow-bearing tree breeding roosts may occur within the locality, they are unlikely to support large populations (eg >30 bats).

3.2.6 Microbat summary

Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. This species is listed as vulnerable under the TSC Act. Large breeding colonies are uncommon in the lower Clarence and are not in close proximity to Sportsmans Creek Bridge (>10 kilometres along waterways). Surveys of drainage structures in the locality found that potential unoccupied alternative breeding roost drainage structures within the locality are uncommon and likely to have a lower roost carrying capacity to occupied sites. Sportmans Creek Bridge is one of only three large (>100) breeding colonies known within 10.3 kilometres of the site (the other two being McFarlane Bridge and Shark Creek).

Sportsmans Creek Bridge also offers potential non-breeding roosting habitat for two other threatened species; the Little Bent-winged Bat and Eastern Bent-winged Bat.

3.3 Fauna (excluding microbats)

3.3.1 Database results

The OEH BioNet Atlas of NSW Wildlife and PMST identified records of 64 threatened fauna species listed under the TSC Act and/or EPBC Act previously recorded or having habitat within the search area (10 kilometre radius around the site). An assessment of the likely occurrence of these species within the study area is provided in Appendix B.

The potential occurrence and likely impact of each of the species previously recorded or having habitat within the search area (10 kilometre radius around the site) has taken into account a review of previous records in the study area and locality, surveys undertaken for this report and surveys undertaken for the microbat impact assessment (GeoLINK 2014a). It is acknowledged that some threatened species are likely to utilise the study area on occasion as part of a broader foraging area occurring in the locality however the assessment has determined that Large-footed Myotis is the only threatened species likely to be impacted by the proposal.

3.3.2 Fauna habitat assessment

Observations within the study area of fauna habitat features and resources are noted as follows, particularly in relation to the habitat requirements of threatened species recorded in the locality.

- Low species diversity of mostly managed parkland dominates the site.
- The southern bank of Sportsmans Creek which adjoins the northern edge of the parklands comprises about a 10 metre wide area of Common Reed (*Phragmites australis*) and exotic Para Grass (*Urochloa mutica*). This area provides shelter for common small mammals and terrestrial birds, and water birds.
- Few trees are present to provide perching and roosting opportunities for birds. Most trees in the study area are exotic species occurring as isolated trees.
- Fruit from Camphor Laurel (*Cinnamomum camphora*) may support native birds such as fruit pigeons. No threatened bird species recorded in the locality are likely to rely on the fruit of this species.

- No tree stags or fallen logs were observed.
- Due to a lack of over-storey vegetation, leaf litter is generally sparse offering very little habitat for leaf litter dependant frogs and ground dwelling birds.
- No fauna scats were detected.
- No fauna tracks, diggings or burrows were detected.
- There were no obvious signs of fauna feeding.
- No scratch or claw marks were observed on smooth-barked trees.
- No significant surface rock, rock outcrops or ledges were observed to offer habitat for reptiles and ground-dwelling mammals. A small built rock wall on the southern side of the residential house block may support common skink species.
- Sportsmans Creek provides watering opportunities and aquatic habitat for a range of fauna. The creek and riparian area represents the zone with the greatest fauna habitat and habitat diversity.
- Large-footed Myotis was the only threatened fauna species recorded in the study area during field surveys. Based on a fauna habitat assessment of the study area it is considered unlikely that the study area represents a significant area of habitat for any of the threatened fauna species that have been recorded in the locality.

3.3.3 Threatened fauna (excluding microbats)

Apart from the Large-footed Myotis previously recorded on the existing timber truss bridge, no threatened fauna species were recorded in the study area during the fauna habitat assessments and bird survey. Based on a fauna habitat assessment of the study area it is considered unlikely that the study area represents a significant area of habitat for any of the subject threatened fauna species (refer to Appendix A).

A number of wetland bird species records occur around Sportsmans Creek on the Clarence River floodplain including the threatened Black-necked Stork (*Ephippiorhynchus asiaticus*) and Brolga (*Grus rubicunda*). Neither species were observed during field assessments, however both species have potential to utilise the ephemeral wetlands to the north-west of Sportsmans Creek Bridge for foraging. These ephemeral wetlands are outside the study area for this proposal. Mr Greg Clancy notes that nesting areas for both of these species are likely to be associated with Everlasting Swamps (refer to Illustration 1.1).

The timber truss bridge represents potential non-breeding roosting habitat for the Eastern Osprey (*Pandion cristatus*) which has been recorded nesting on a number of timber truss bridges on the north coast of NSW. There are no known records of Eastern Osprey utilising the Sportsmans Creek Bridge as a nesting site. The bridge offers low suitability as nesting habitat for the Eastern Osprey due to the low truss height. An Eastern Osprey nest is located adjacent to the Lawrence Road several kilometres to the south of the site (G. Clancy, pers. comm 2013).

3.3.4 Bird survey results

A list of birds observed during afternoon/dusk surveys are provided within Appendix D. No threatened avifauna species were recorded or are considered likely to be significantly affected by the proposal (refer to Appendix D).

3.3.5 Wildlife corridors and key habitats

A review of OEH wildlife corridor and key habitat mapping indicated no mapped wildlife corridors or areas of nominated key habitats are associated with the study area. Field assessment of fauna habitat features supported these findings. Vegetation was found to be fragmented and lacking connectivity, apart from pasture grasses and the dense mat of understorey, weed-dominated vegetation adjacent to both sides of Sportsmans Creek.

Sportsmans Creek would however act as a local corridor for bird species moving between habitats associated with the upstream reaches of Sportsmans Creek and the Everlasting Swamps and habitats associated with the lower Clarence River.

Lawrence and environs is described by Clarence Valley Birdos (2006) as being one of the Bird Routes of the Clarence Valley. The following species are listed as being potential occurrences in this area:

- Pied Oystercatcher (*Haematopus longirostris*).
- Brolga.
- Egrets.
- Waterbirds.
- Raptors.

3.3.6 Critical habitat

No areas of critical habitat occur within the study area.

3.3.7 Fisheries

A search of the NSW DPI (Fisheries) Records Viewer for threatened aquatic fauna did not find any records of threatened aquatic fauna within the locality. The local section of Sportsmans Creek does not provide potential habitat for any FM Act listed threatened species.

Sportsmans Creek forms part of an area of mapped Key Fish habitat within the CVC LGA. It is likely to provide habitat for a number of fish species, including the Australian Bass (*Macquaria novemaculeata*) which would likely spawn within this estuary. The creek is a known breeding ground for crustaceans which were observed during the fauna habitat assessment.

3.4 Wetlands

3.4.1 Directory of important wetlands in NSW (DIWA) spatial database

Four nationally important wetlands listed in the NSW DIWA Spatial Database were identified in the EPBC Act PMST as occurring within a 10 kilometre radius of the site. These are:

- Clarence River Estuary.
- Everlasting Swamp.
- The Broadwater.
- Upper Coldstream.

Two of these wetlands occur in proximity to the study area namely, Everlasting Swamp which occurs about 500 metres west of the study area and the Clarence River Estuary which occurs within the Clarence River immediately east of the existing Sportsmans Creek Bridge.

3.4.2 SEPP 14 Coastal Wetlands

No SEPP 14 Coastal Wetlands occur within the study area. The nearest SEPP 14 Coastal Wetlands are:

- 231 located about 1.0 kilometre south-west.
- 231b located about 1.1 kilometres north-east.

4 Potential biodiversity impacts

4.1 Potential biodiversity impacts (excluding Large-footed Myotis)

The study area comprises managed parkland, predominantly cleared of native vegetation. Remnant vegetation along the Clarence River and Sportsmans Creek is highly degraded and generally exhibits low diversity with significant weed cover. Terrestrial fauna habitat values are generally low due to the modified nature of the site however Sportsmans Creek provides suitable habitat for a range of aquatic fauna. The potential biodiversity impacts are therefore expected to be minimal.

Key anticipated biodiversity impacts are as follows:

- Disturbance to/removal of planted parkland vegetation within Flo Clark Park and Sportsmans Park as required, retaining riparian vegetation on the banks of Sportsmans Creek.
- Disturbance to/removal of riparian vegetation on the southern bank of Sportsmans Creek to establish a 5 metre long pontoon to provide waterway access for barge transport to the bridge.

Potential indirect impacts to local habitats such as water quality impacts would be managed through implementation of the safeguards covered in the corresponding Review of Environmental Factors.

4.2 Potential impacts to Large-footed Myotis

Potential impacts of the proposal on Large-footed Myotis are listed in Table 4.1. They are divided into ‘direct impacts’ (those that directly affect habitat and individuals) and ‘indirect impacts’ (occur when project-related activities affect habitat and individuals in a manner other than direct loss). Key potential impacts include habitat removal and disruption to the breeding cycles which are likely to have a significant impact on the subject Large-footed Myotis population and potential mortality/ injury during bridge removal.

Table 4.1 Potential impacts of the proposal on Large-footed Myotis

Potential impact (risk)	Impacts	Safeguards and management measures
Direct impacts		
Habitat removal (definite): The proposal would result in the removal of the existing timber truss Sportsmans Creek Bridge and replacement with a new concrete bridge about 100 m upstream. The removal is proposed to start at least three months after completion of the new bridge.	Significant – the proposal would remove habitat occupied by a large Large-footed Myotis breeding colony. The colony's response is unknown but may include adoption of alternative roosting habitat within the locality, either as a single unit or fragmented into smaller groups. Alternative roosting habitat locally is mainly provided by culverts, most of which are susceptible to flooding which poses a risk to the future breeding success of the population. The colony or part of the colony may also disperse and join part of other colonies in the broader region (eg McFarlane Bridge). The species ability to do this is however unknown.	• Build compensatory breeding roosting habitat on the new bridge based on known Large-footed Myotis breeding habitat structures in the region. Three different types of compensatory breeding roosting habitat would be provided on the new bridge: – Microbat habitat 1: Walkway Super-T join void. – Microbat habitat 2: Walkway void. – Microbat habitat 3: Pre-cast parapet. • One opportunistic alternative microbat roosting habitat feature would be provided on the new bridge: – Microbat habitat 4: Super-T girder joins. • Staged microbat exclusion from the timber truss bridge would be carried out following building of the new bridge and prior to removal of the timber truss bridge. This will ensure that no microbats are able to gain access to the underside of the timber truss bridge. The aim is to have the existing timber truss bridge completely free of roosting microbats prior to bridge removal. • Monitoring as per Table 5.1.
Disruption to breeding (mating or birthing) cycle (high): The proposal poses a high risk of disruption to the breeding cycle of Large-footed Myotis through removal of the location within which this currently occurs being Sportsmans Creek Bridge.	Potentially significant – the timber truss Sportsmans Creek Bridge supports a large breeding colony of Large-footed Myotis. Depending on the response to habitat removal and construction of the new roosting habitat, breeding may not occur within the local area. Loss of a local breeding site for a viable local population is therefore a potentially significant impact.	• Provide compensatory breeding roosting habitat on the new bridge. • Bridge removal is proposed to commence at least three months following completion of the new bridge to allow microbats to become accustomed to new available habitat. • Carry out staged exclusion of microbats from the timber truss bridge prior to bridge removal and outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. • May to September is the optimal time to exclude microbats to

Potential impact (risk)	Impacts	Safeguards and management measures
		avoid impacts on the Myotis breeding population. • Monitoring as per Table 5.1. • Carry out staged exclusion of microbats from the timber truss bridge prior to bridge removal and outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. • May to September is the optimal time to exclude microbats to avoid impacts on the Myotis breeding population. • Monitoring as per Table 5.1.
Mortality or injury during bridge removal (high): The proposal poses a high risk of mortality and injury to microbats roosting at the bridge during removal. There is a particular risk to juvenile microbats if the removal or exclusion work were scheduled during the Large-footed Myotis breeding period or when juveniles are flightless and dependent.	Potentially significant – Sportsmans Creek Bridge supports a large breeding colony of Large-footed Myotis.	• Provide compensatory breeding roosting habitat on the new bridge. • Carry out staged exclusion of microbats from the timber truss bridge prior to bridge removal and outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. • May to September is the optimal time to exclude microbats to avoid impacts on the Myotis breeding population. • Exclusion installation programming would allow for flexibility to avoid torpor periods (during significant cold and/ or wet weather). • Where > 20 microbats are present at the time of exclusion installation, install exclusion at nights after fly-out. • Check exclusion devices to avoid microbat entrapment or breaches. • Ecologist to be present during exclusion installation to ensure the welfare of animals is maintained; and available for call-outs during bridge removal.

Potential impact (risk)	Impacts	Safeguards and management measures
Fly-way impacts (unlikely): The new bridge would be of a similar height above the water as the existing bridge, with similar distances between piers for the main structure. No fly-way impacts are considered likely.	Unlikely	N/A
Indirect impacts		
Foraging habitat degradation (low): No forest/woodland habitats would be affected. During removal of the bridge, there is a risk of water quality impacts which could reduce the foraging habitat values of local waterways including Sportsmans Creek for the Large-footed Myotis (eg from chemical spills, erosion and turbidity impacts, etc). After the removal of the bridge, it is unlikely that the flow of Sportsmans Creek would be modified such that foraging habitat values of Sportsmans Creek would be significantly impacted.	Low	• Removal of the bridge would be carried out in accordance with Roads and Maritime QA *Specification G36 Environmental Protection* and *Specification G38 Soil and Water Management* ensuring the risk and the magnitude of potential indirect impacts that may affect the foraging carrying capacity of the study area is low.

Potential impact (risk)	Impacts	Safeguards and management measures
Reduction in habitat connectivity: Removal of Sportsmans Creek Bridge may result in a break to the linkage of the network of roost sites.	Low – No direct habitat fragmentation/impacts to corridors would occur as a result of the proposal and barriers to fly-ways for microbats moving along Sportsmans Creek are unlikely to be created. Medium – Removal of Sportsmans Creek Bridge however would remove a roosting site within the lower Clarence located in nightly movement distance of other local roost. The relationship between roost sites in the locality is unknown particularly in relation to facilitating broad range dispersal.	• Provide compensatory breeding roosting habitat on the new bridge. • Monitoring as per Table 5.1.

4.3 Statutory assessments

Seven-part tests of significance prepared in accordance with Section 5A of the EP&A Act for the Large-footed Myotis, Little Bent-winged Bat and Eastern Bent-winged Bat have been undertaken (refer to Appendix E). These assessments concluded:

- **Large-footed Myotis**: The proposal involves removal of habitat occupied by a large breeding colony. Although it is highly likely that the local Large-footed Myotis population would relocate to the habitat to be provided on the new bridge, the precautionary approach outlined in OEH guidelines: *Threatened species assessment guidelines, The assessment of significance* (DECC, 2007) has been adopted and removal of the timber truss bridge has the potential to significantly affect the local Large-footed Myotis population. Therefore a Species Impact Statement (SIS) for the Large-footed Myotis is required.
- **Little and Eastern Bent-winged Bats**: A significant impact on these species is unlikely. No breeding habitat would be affected by the proposal and alternative potential roosting habitat in their non-breeding range in the lower Clarence is available to support the local potential occurrences of these species.

As mentioned previously, one Durobby (*Syzygium moorei*) is located in the south-western corner of (listed as Vulnerable under the TSC Act and EPBC Act). This tree has been planted and is of low conservation significance due to it occurring far outside its natural range. Therefore a seven-part test of significance in accordance with Section 5A of the EP&A Act has not been completed for this species.

One vegetation community, within the far eastern portion of Sportsmans Park on the edge of the Clarence River was considered to represent a highly degraded/disturbed low condition form of *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* EEC. A seven-part test of significance prepared in accordance with Section 5A of the EP&A Act concluded that the proposed removal of the existing timber truss Sportsmans Creek Bridge is unlikely to significantly impact upon this community.

5 Biodiversity management

5.1 General biodiversity safeguards

- Tree protection zones would be implemented around trees to be retained in proximity to the proposed work in accordance with the *Australian Standard 4970-2009 Protection of trees on development sites* to prevent machinery impacts to trees.
- Weed and pathogen hygiene protocols would be implemented in accordance with the *Guide 6 (Weed Management)* and *Guide 7 (Pathogen)* of the Roads and Maritime Biodiversity Guidelines 2011 to avoid introduction and spread of weeds and pathogens to and from the site.
- If unexpected threatened fauna or flora species are discovered, work would cease immediately and the *Roads and Maritime Unexpected Threatened Species Find Procedure in the Roads and Maritime Biodiversity Guidelines 2011 – Guide 1 (Pre-clearing process)* would be followed.
- Should injured fauna be found on the site, local wildlife care groups and/ or local veterinarians would be contacted immediately and arrangements made for the immediate welfare of the animal. The phone number of the local WIRES group (ph: 1800 094 737) or Northern Rivers Wildlife Carers (ph: 6643 4055) would be known to the project foremen.
- Environmental safeguards would be communicated to all construction personnel as part of an Environmental Site Induction, and repeated where appropriate at Toolbox Sessions prior to commencement of relevant work components.

5.2 Large-footed Myotis specific safeguards

Proposed microbat safeguards are provided in Table 5.1. Key components of impact amelioration for the local Large-footed Myotis population include:

- Provision of compensatory microbat roosting habitat on the new concrete Super-T bridge prior to removal of the existing bridge.
- Staged microbat exclusion outside the Large-footed Myotis breeding season from the existing Sportsmans Creek Bridge prior to removal.

The proposed exclusion methods have been effective on other similar bridge and culvert work projects involving breeding Large-footed Myotis colonies (Ecotone 2001; Hoye and Hoye 1999; Marshall 2011; GeoLINK 2014c, 2014d, 2014e). Monitoring pre, during and post exclusion is also proposed to ensure any issues can be identified and addressed at the earliest possibility.

Table 5.1 Microbat safeguards

Management measures	Details	Timing	Performance indicators	Responsibility
Monitor Large-footed Myotis numbers	Direct inspection of the entire existing timber truss bridge using torch and pole mounted camera from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land; documenting: • Species present. • Locations of roosting microbats. • Total number of individuals and groups per occupied roost site. • Locations of roosting microbats. • Description of occupied roost sites. • Breeding status of the colony, including approximate adult to juvenile ratios. Monitoring during this period would extend to the new bridge, if constructed, using the same methodology. Where alternative monitoring methodologies are proposed, the feasibility and practicality of them would be assessed and approved by Roads and Maritime Services in consultation with OEH.	Quarterly throughout the year pre-exclusion. Key seasonal times (winter, spring, summer/autumn) prior to exclusion. For one monitoring event per season.	Accurately record numbers within timber truss Sportsmans Creek Bridge.	Ecologist

Management measures	Details	Timing	Performance indicators	Responsibility
Provision of compensatory habitat	Compensatory breeding roosting habitat for the Large-footed Myotis would be incorporated into the new concrete bridge and available for microbat usage prior to the commencement of exclusion and removal of the existing timber truss bridge. Compensatory roosting habitat is discussed further in the *Species Impact Statement: Sportsmans Creek Bridge removal, Lawrence* (GeoLINK 2016).	During construction of the new bridge. At least three months prior to removal of existing timber truss bridge.	The new bridge is occupied as breeding roosting habitat by a significant proportion of the subject Large-footed Myotis colony upon completion of exclusion from the existing timber truss bridge. A significant proportion is regarded as 65% of the Large-footed Myotis numbers present from the baseline data recorded throughout the year pre-exclusion.	Roads and Maritime construction team are responsible for provision of compensatory habitat. Ecologist is responsible for determining the significant proportion of Large-footed Myotis.
Site induction	All construction personnel involved with bridge exclusion and removal would be trained regarding their responsibilities, signs of and how to search for microbats, what to do if microbats are encountered and personal safety practices.	Prior to existing timber truss bridge removal.	All relevant construction personnel receive, understand, signoff and adhere to the requirements of the Microbat Management Plan (MMP).	Construction manager
Staged microbat exclusion	Staged microbat exclusion from the timber truss bridge would be undertaken following construction of the new bridge to ensure that no microbats are able to gain access to the underside of the timber truss bridge. The aim is to have the timber truss bridge completely free of roosting microbats prior to bridge removal. An ecologist would be engaged to help manage and provide advice throughout the exclusion and bridge removal process. If microbats are present within the timber truss bridge, staged exclusion of the whole bridge is required. Details of staged	• Following completion of the new bridge. • Between the months of May and September. • Prior to removal of the existing timber truss bridge.	• Microbats completely excluded from the existing timber truss bridge prior to removal. • Exclusion carried out outside the Large-footed Myotis breeding season which is October to mid-April inclusive. Exclusion may therefore **occur only from May to September (inclusive).** • No or very low	Roads and Maritime, contractors and ecologist

Management measures	Details	Timing	Performance indicators	Responsibility
	microbat exclusion methodology and timing are provided within **Section 2** of *Microbat Management Plan - Sportsmans Creek Bridge removal, Lawrence* (ref: 2465-1027), GeoLINK (2016).	• A minimum of one month after installation of ten bat boxes with four chambers each below the existing timber truss bridge.	morality/injury occurs as a result of exclusion. • The new bridge is occupied as breeding roosting habitat by a significant proportion of the subject Large-footed Myotis colony upon completion of exclusion from the existing timber truss bridge. Note: Sportsmans Creek Bridge population is considered a single population (the local population) being the subject Large-footed Myotis colony.	
Exclusion monitoring	Post exclusion installation and prior to commencement bridge removal, exclusion monitoring and inspection would be undertaken following any weather events that may compromise the exclusion (such as significant rain or strong winds). Any damage to the exclusion would be rectified, following ecologist inspection for microbats and input where needed.	As required post exclusion installation and prior to commencement bridge removal.	Bridge and exclusion monitored and maintained as required following significant weather events.	Roads and Maritime and ecologist where required.
Daily inspections during existing timber truss bridge removal	Work areas would be inspected daily during existing timber truss bridge removal, including: • Morning inspections to ensure exclusion is intact and no potential microbat breaches have occurred. An	Daily during existing timber truss bridge removal.	• Exclusion inspected and remains intact. • Ecologist inspects bridge if potential exclusion breaches have occurred and provide appropriate	Roads and Maritime, contractors and ecologist

Management measures	Details	Timing	Performance indicators	Responsibility
	ecologist would carry out inspections if potential exclusion breaches have occurred. • Afternoon inspections carried out to ensure the exclusion is functional at the end of each day to prevent microbats accessing the bridge at night.		management advice/actions if microbats are present.	
Vet/ WIRES contact details	Injured fauna would be taken to WIRES. The contact details of WIRES (Clarence Valley – 02 6643 4055) would be known to the microbat exclusion and bridge removal work supervisor, and the ecologist.	Throughout exclusion and bridge removal work.	• Contact details of WIRES known to microbat exclusion and bridge removal work supervisor, and the ecologist. • Injured microbats are promptly cared for.	Contact details of WIRES known to bat exclusion and bridge removal work supervisor, and the ecologist.
Monitor Large-footed Myotis numbers	Direct inspection of the new bridge (targeting compensatory roosting habitat). Methodology as for Pre-exclusion Monitoring.	Year 1 post exclusion: Key seasonal times (winter, spring, summer/autumn) for 12 months post exclusion. Year 2 and 3 post exclusion: One event during the breeding season (summer/ autumn).	• Accurately record numbers within the new Sportsmans Creek Bridge. • Determine need for contingency triggers and measures (refer to Table 4.1 of *Microbat Management Plan - Sportsmans Creek Bridge removal, Lawrence* (ref: 2465-1027), GeoLINK (2016).	Ecologist

6 Conclusion

Sportsmans Creek Bridge supports a large and important Large-footed Myotis breeding colony. This species is listed as vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act). Large breeding colonies are uncommon in the lower Clarence and are not in close proximity to the Sportsmans Creek Bridge (>10 kilometres along waterways). Surveys of drainage structures in the locality found that potential unoccupied alternative breeding roost drainage structures are uncommon and likely to have a lower roost carrying capacity to occupied sites. The proposal involves removal of the timber truss Sportsmans Creek Bridge. The seven-part test of significance prepared in accordance with Section 5A of the EP&A Act for the Large-footed Myotis concluded that although it is highly likely that the local Large-footed Myotis population would relocate to the habitat to be provided on the new bridge, the precautionary approach outlined in OEH guidelines: *Threatened species assessment guidelines, The assessment of significance* (DECC, 2007) has been adopted and removal of the timber truss bridge has the potential to significantly affect the local Large-footed Myotis population. Therefore a SIS for the Large-footed Myotis is required. Roads and Maritime received Director General's Requirements for the proposal on 26 February 2015. The biodiversity assessment has been undertaken in accordance with these.

No other EECs, threatened flora or fauna species listed under the TSC Act or EPBC Act are considered likely to be significantly impacted by the proposal.

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Revision log

UPR	Description	Date Issued	Issued By
2465-1016	Version 1	17/12/2015	Veronica Silver
2465-1028	Version 2	03/03/2016	Veronica Silver
2465-1034	Version 3	21/03/2016	Veronica Silver

Appendix A

Threatened species potential occurrence assessment

Table A1 Threatened fauna - potential occurrence assessment

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Amphibia							
Crinia tinnula	Wallum Froglet	V	-	Acid paperbark and sedge swamps known as 'wallum', this is a banksia-dominated lowland heath ecosystem characterised by acidic waterbodies.	No suitable habitat within the study area. No wallum present.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Litoria brevipalmata	Green-thighed Frog	V	-	Rainforest, moist to dry eucalypt forest and heath, typically where surface water gathers after rain. Larger temporary pools and flooded areas preferred for breeding.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Mixophyes balbus	Stuttering Frog	V	V	Cool rainforest, moist eucalypt forest and occasionally along creeks in dry eucalypt forest.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Mixophyes iteratus	Giant Barred Frog	E	E	Deep, damp leaf litter in rainforests, moist eucalypt forest and near dry eucalypt forest.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Aves							
Anseranas semipalmata	Magpie Goose	V	-	Shallow wetlands (<1 m deep), large swamps and dams with dense growth of rushes or sedges, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation. Nests are formed in trees over deep water.	No suitable habitat within the study area. Study area includes only narrow area of sedges/ rushes which may provide marginal foraging habitat. No suitable nesting trees	Likely. Nine OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
					present within the study area.		
Anthochaera phrygia (formerly *Xanthomyza phrygia)*	Regent Honeyeater	CE	CE	Dry open forest and woodland with an abundance of nectar-producing eucalypts, particularly box-ironbark woodland, swamp mahogany forests, and riverine sheoak woodlands.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Botaurus poiciloptilus	Australasian Bittern	E	E	Permanent freshwater wetlands with tall dense vegetation, particularly bullrushes and spikerushes.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Burhinus grallarius	Bush Stone-curlew	E	-	Lightly timbered open forest and woodland, and partly cleared farmland with woodland remnants, preferring areas with dry leaf-litter, fallen timber and sparse ground cover.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Calidris ferruginea	Curlew Sandpiper	E	CE	It generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	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.	No suitable habitat within the study area.	Unlikely. Five OEH (2015) records within 10 km radius.	Unlikely
Chthonicola sagittata	Speckled Warbler	V	-	Eucalyptus dominated communities with sparse shrubs and grassy understorey.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Climacteris picumnus	Brown Treecreeper	V	-	Eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range, and less commonly on coastal plains and ranges.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Coracina lineata	Barred Cuckoo-shrike	V	-	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Daphoenositta chrysoptera	Varied Sittella	V	-	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Dasyornis brachypterus	Eastern Bristlebird	E	E	High elevation open forest, woodland with dense tussock or sedge understorey adjacent to rainforest or wet eucalypt forest.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Dromaius novaehollandiae	Emu population in the NSW North Coast Bioregion and Port Stephens LGA	E Population	-	Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest.	Moderately suitable in open farmland however does not occur in the study area.	Unlikely. 115 OEH (2015) records within 10 km radius.	Unlikely
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. They build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation.	No suitable habitat within the study area. No suitable nesting trees present within the study area. Habitat associated with edges of Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Likely. 762 OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.
Erythrotriorchis radiatus	Red Goshawk	CE	V	Along or near watercourses, swamp forest and woodlands on the coastal plain.	Possible in broad habitat terms but species is a rare vagrant to north-east NSW.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Glossopsitta pusilla	Little Lorikeet	V	V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in *Angophora*, *Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, eg paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked *Eucalypts*. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like *Allocasuarina*.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Grus rubicunda	Brolga	V	-	Shallow swamps, floodplains, grasslands and pastoral lands, usually in pairs or parties. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water.	No suitable habitat within the study area. Habitat associated with edges of Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Likely. Seventy-one OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.
Haematopus longirostris	Pied Oystercatcher	E	-	Open beaches, intertidal flats, sandbanks and occasionally rocky headlands.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Unlikely. Twenty-one OEH (2015) records within 10 km radius.	Unlikely
Hieraaetus morphnoides	Little Eagle	V	-	Open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch.	Low suitability.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Irediparra gallinacean	Comb-crested Jacana	V	-	Among vegetation floating on slow-moving rivers and permanent lagoons, swamps, lakes and dams.	No suitable habitat within the study area.	Unlikely. Twelve OEH (2015) records within 10 km radius.	Unlikely
Ixobrychus flavicollis	Black Bittern	V	-	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Moderate, mainly in vegetated riparian area to the east.	Unlikely. No OEH (2015) record within 10 km radius.	Unlikely.
Lathamus discolor	Swift Parrot	E	E	Forests, woodlands, plantations, and banksias.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Limosa limosa	Black-tailed Godwit	V	-	Tidal mudflats, sand spits, swamps, shallow river-margins and reservoirs.	Habitat associated with Sportsmans Creek and the Clarence River provide only marginal potential foraging habitat.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Lophoictinia isura	Square-tailed Kite	V	-	Dry woodland and open forest, particularly along major rivers and belts of trees in urban or semi-urban areas. Home range can extend over at least 100 km^2. Nest sites are generally located along or near watercourses, in a fork or on large horizontal limbs.	The study area may form a small portion of the large (100 km^2) hunting range. Provides only low quality foraging habitat. Study area lacks large trees to provide a suitable nest site.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage.	No suitable habitat within the study area. No associated species present.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Ninox strenua	Powerful Owl	V	-	Woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of eucalypt species.	No suitable habitat within the study area. Study area includes only a small area of managed parkland and lacks forested vegetation. No suitable nesting trees present.	Unlikely. Four OEH (2015) records within 10 km radius.	Unlikely
Pandion cristatus (formerly Pandion haliaetus)	Eastern Osprey	V	-	Forage for fish in fresh, brackish or saline waters of rivers, lakes, estuaries with suitable nesting sites nearby.	Foraging habitat available within the study area comprising Sportsmans Creek and the Clarence River. No suitable nest trees present within the study area. Several nest sites known within the locality.	Likely. 137 OEH (2015) records within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Podargus ocellatus	Marbled Frogmouth	V	-	Subtropical rainforest, particularly in deep, wet, sheltered gullies along creeklines and often containing stands of Bangalow Palms or ferns. In NSW, it is most often found in moist, lowland, mesophyll vine forest. Less often, they are found in the ecotone between rainforest and wet Eucalyptus forests, or occasionally in cool rainforest and higher elevation temperate rainforests. Rarely in wet eucalypt forest.	No suitable habitat within the study area.	Unlikely. No OEH (2015) record within 10 km radius.	Unlikely
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.	No suitable habitat within the study area.	Unlikely. Thirty-one OEH (2015) records within 10 km radius.	Unlikely
Ptilinopus magnificus	Wompoo Fruit-dove	V	-	Rainforests, low-elevation moist eucalypt forest, and Brush Box forests. Most often seen in mature forests, but also found in remnant and regenerating rainforest.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within 10 km radius.	Unlikely
Rostratula benghalensis australis	Australian Painted Snipe	E	V	Well-vegetated shallows and margins of wetlands, dams, sewage ponds, wet pastures, marshy areas, irrigation systems, lignum, tea-tree scrub, and open timber.		Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Sternula albifrons	Little Tern	E	-	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	Foraging habitat present with Sportsmans Creek and the Clarence River. Better quality habitat exists outside the study area in the lower reaches of the river and along the coast. No nesting habitat present.	Unlikely, possible only as rare forager within study area. One OEH (2015) record within 10 km radius.	Unlikely. Habitat values of the study area and local occurrence potential unlikely to be affected by the proposal.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Stictonetta naevosa	Freckled Duck	V	-	Permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. In drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Turnix melanogaster	Black-breasted Button-quail	E	V	Drier rainforests and viney scrubs, often in association with Hoop Pine and a deep moist leaf litter layer. During drought it may move to adjacent wetter rainforests.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Tyto longimembris	Eastern Grass Owl	V	-	Areas of tall grass, including tussocks in swampy areas, grassy plains, swampy heath, cane grass, sedges on flood plains.	Moderate in broad habitat terms, mainly as foraging habitat within the cane fields.	Unlikely. One OEH (2015) record within 10 km radius.	Unlikely
Tyto novaehollandiae	Masked Owl	V	-	Dry eucalypt forest and woodlands. The Masked Owl is a forest owl but it often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	No suitable habitat within the study area. Study area includes a small area of managed parkland and lacks forested vegetation. No suitable nesting trees present.	Unlikely. Three OEH (2015) records within 10 km radius.	Unlikely
Mammalia							
Aepyprymnus rufescens	Rufous Bettong	V	-	Tall moist eucalypt forest to open woodland with tussock grass understorey.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Chalinolobus nigrogriseus	Hoary Wattled Bat	V	-	Dry open eucalypt forest dominated by spotted gum, boxes and ironbarks. Also healthy coastal forests where Red Bloodwood and Scribbly Gum are common. Naturally sparse understorey is favourable.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within a 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Found mainly in areas with extensive cliffs (in crevices) and caves (near their entrances), old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Found in well-timbered areas containing gullies.	General area provides potential aerial foraging habitat.	Unlikely. Foraging individuals recorded in 2002 by D and D consultants. No OEH (2015) records within a 10 km radius.	Unlikely
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	Dry and moist eucalypt forests and rainforests, fallen hollow logs, large rocky outcrops.	No suitable habitat within the study area.	Unlikely. Six OEH (2015) records within a 10 km radius.	Unlikely
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Moist and dry eucalypt forest and rainforest, particularly at high elevations. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	No suitable habitat within the study area.	Unlikely. Three OEH (2015) records within a 10 km radius.	Unlikely
Miniopterus australis	Little Bent-winged Bat	V	-	Moist eucalypt forest, rainforest and dense coastal scrub.	Sportsmans Creek Bridge provides suitable non-breeding roosting habitat. General area provides potential aerial foraging habitat	Likely. Fifteen OEH (2015) records within a 10 km radius.	Unlikely – demonstrated in seven-part test of significance. No impact to breeding habitat or foraging habitat values of the study area.
Miniopterus orianae oceanensis (previously *M. schreibersii)*	Eastern Bent-winged Bat	V	-	Forest or woodland, roost in caves, old mines and stormwater channels.	Sportsmans Creek Bridge provides suitable non-breeding roosting habitat. General area provides potential aerial foraging habitat.	Unlikely. Foraging individuals recorded in 2002 by D and D consultants. No OEH (2015) records within a 10 km radius.	Unlikely - demonstrated in seven-part test of significance. No impact to breeding habitat or foraging habitat values of the study area.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts in tree hollows.	Sportsmans Creek Bridge provides potential opportunistic non-breeding roosting habitat. General area provides low quality potential aerial foraging habitat. No tree hollows present.	Unlikely. No OEH (2015) records within a 10 km radius.	Unlikely
Myotis macropus	**Large-footed Myotis**	V	-	Bodies of water, rainforest streams, large lakes, reservoirs in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	Known breeding roosting habitat on existing Sportsmans Creek Bridge and foraging habitat along Sportsmans Creek/ Clarence River.	**Known.** Six OEH (2015) records within a 10 km radius.	**Likely**
Nyctophilus bifax	Eastern Long-eared Bat	V	-	Lowland subtropical rainforest and wet and swamp eucalypt forest, extending to adjacent moist eucalypt forest.	No suitable habitat within the study area. Prefers more intact habitats.	Unlikely. No OEH (2015) records within a 10 km radius.	Unlikely
Petaurus australis	Yellow-bellied Glider	V	-	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.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Petaurus norfolcensis	Squirrel Glider	V	-	Blackbutt, bloodwood and ironbark eucalypt forest with heath understorey in coastal areas, and box-ironbark woodlands and River Red Gum forest inland.	No suitable habitat within the study area.	Unlikely. Ten OEH (2015) records within a 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	This tree dwelling-marsupial is found in dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. They prefer rough barked trees of 25 cm DBH or greater. They nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span.	No suitable habitat within the study area.	Unlikely. 31 OEH (2015) records within a 10 km radius.	Unlikely
Phascolarctos cinereus	Koala	V	-	Appropriate food trees in forests and woodlands, and treed urban areas.	Scattered food trees in locality. No suitable habitat within the study area.	Unlikely. 116 OEH (2015) records within a 10 km radius.	Unlikely
Planigale maculata	Common Planigale	V	-	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas with surface cover close to water. During the day they shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Cool temperate rainforest, moist and dry forests, and wet heathland, inhabiting dense layers of grass, ferns, vines and shrubs.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Pseudomys novaehollandiae	New Holland Mouse	-	V	Occurs in open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	No known roosts within the study area. Suitable foraging habitat within the locality and provided by ornamental trees within the study area.	Likely. Sixteen OEH (2015) records within a 10 km radius.	Unlikely. No impact to breeding habitat or significant foraging habitat.

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	Sportsmans Creek Bridge provides potential opportunistic non-breeding roosting habitat. General area provides low quality potential aerial foraging habitat. No tree hollows present.	Unlikely. Two OEH (2015) records within a 10 km radius.	Unlikely
Vespadelus troughtoni	Eastern Cave Bat	V	-	Cave roosting species found in dry open forest and woodland near cliffs and rocky overhangs. Has been recorded roosting in disused mine workings. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius.	Unlikely
Xeromys myoides	False Water-rat	-	V	Primarily inhabits mangrove forests but has been recorded in a variety of well-watered habitats including, freshwater lagoons, sedged lakes close to foredunes, and swamps.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely
Reptilia							
Hoplocephalus bitorquatus	Pale-headed Snake	V	-	This tree-dwelling snake shelters during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. Inhabits dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. In drier environments, it favours riparian areas.	No suitable habitat within the study area. Riparian area present however no tree hollows, no dry or moist eucalypt woodlands or rainforest present.	Unlikely. Two OEH (2015) records within a 10 km radius.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Hoplocephalus stephensii	Stephen's Banded Snake	V	-	Rainforest and eucalypt forests and rocky areas up to 950 m. This nocturnal partly tree-dwelling snake shelters between loose bark and tree trunks, amongst vines, or in hollow trunks, limbs, rock crevices or under slabs during the day.	No suitable habitat within the study area. No hollow trunks or rock crevices present.	Unlikely. No OEH (2015) records within a 10 km radius.	Unlikely
Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	V	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	No suitable habitat within the study area. No rainforest or moist eucalypt forest present.	Unlikely. No OEH (2015) records within 10 km radius.	Unlikely

Table A2 Threatened flora – potential occurrence assessment

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Flora							
Angophora robur	Sandstone Rough-barked Apple	V	V	Dry open forest in sandy or skeletal soils on sandstone, or occasionally granite, with frequent outcrops of rock.	No suitable habitat occurring at the site. No rocky outcrops or suitable substrate. No dry open forest present.	Unlikely. 277 OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Allocasuarina defungens	Dwarf Heath Casuarina	E	E	Tall heath on sand, also on clay and sandstone.	No suitable habitat within the study area. No tall heath or suitable substrate.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Arthraxon hispidus	Hairy Joint Grass	V	V	Moist shady places in or on the edges of rainforest and wet eucalypt forest, often near creeks or swamps.	No suitable habitat within the study area. Parkland is predominantly managed lawn.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Cryptocarya foetida	Stinking Cryptocarya	V	V	Littoral rainforest in sandy soils, mature trees known on basalt soils.	No suitable habitat within the study area. No littoral rainforest.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Does not have well defined habitat and is known from a range of communities, including swamp-heath and woodland.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Cyperus aquatilis	Water Nutgrass	E	-	In NSW, known only from a few sites north from Grafton. Grows in ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	No suitable habitat within the study area.	Unlikely. One OEH (2015) record within a 10 km radius. Not recorded on site during surveys.	Unlikely
Desmodium acanthocladum	Thorny Pea	V	V	Fringes of riverine subtropical and dry rainforest on basalt-derived soils at low elevations.	No suitable habitat within the study area. No riverine subtropical or dry rainforest present.	Unlikely. One OEH (2015) record within a 10 km radius. Not recorded during surveys.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Eucalyptus glaucina	Slaty Red Gum	V	V	Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common and farther south, from Taree to Broke, west of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	No suitable habitat within the study area.	Unlikely. Two OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Eucalyptus tetrapleura	Square-fruited Ironbark	V	V	Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage.	No suitable habitat within the study area. No dry or moist eucalypt forest present.	Unlikely. Five OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Grevillea masonii	Mason's Grevillea	E	E	Road verges and pasture at low altitudes in gravelly loam soils.	No suitable habitat within the study area.	Unlikely. 155 OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Marsdenia longiloba	Clear Milkvine	E	V	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops.	No suitable habitat within the study area. No rainforest or eucalypt forest present.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Maundia triglochinoides	-	V	-	Swamps or shallow freshwater on clay.	No suitable habitat within the study area. Sportsmans Creek and Clarence River are brackish within the study area.	Unlikely. Fourteen OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Melaleuca irbyana	Weeping Paperbark	E	-	Open eucalypt forest in poorly drained, usually clay, soils.	No suitable habitat within the study area.	Unlikely. Ninety-five OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Melichrus hirsutus	Hairy Melichrus	E	E	Low-altitude eucalypt forest with shrubby understorey on sandy infertile soil with rocky outcrops.	No suitable habitat within the study area.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Phaius australis	Southern Swamp Orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest mostly in coastal areas.	No suitable habitat within the study area. No rainforest, eucalypt or paperbark forest present.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Polygala linariifolia	Native Milkwort	E	-	Sandy soils in dry eucalypt forest or woodland with sparse understorey.	No suitable habitat occurring within the study area. No dry eucalypt forest or woodland present.	Unlikely. Two OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Syzygium moorei	Durobby	V	V	Subtropical and riverine rainforest at low altitude.	No natural habitat occurring within the study area. Study area is outside species' natural distribution.	**Known**. One specimen planted in south-western corner of Flo Clark Park.	Unlikely
Thesium australe	Austral Toadflax	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	No suitable habitat occurring within the study area. Kangaroo Grass not present.	Unlikely. No OEH (2015) records within a 10 km radius. Not recorded on site during surveys.	Unlikely
Ecological Communities							
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes but may also occur in back barrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Lowland rainforest on floodplain of the NSW North Coast Bioregion.		E	-	Occurs on fertile soils in lowland river valleys. Occupies riverine corridors and alluvial flats with rich, moist silts often in subcatchments dominated by basic volcanic substrates.	No suitable habitat occurring within the study area.	Unlikely	Unlikely
Subtropical coastal floodplain forest of the NSW North Coast Bioregion.		E	-	Occupies central or marginal parts of floodplains and sandy flats, including Pleistocene back-barrier flats; habitats where flooding is periodic and soils are rich in silt and sand, sometimes humic, and show little influence of saline ground water. Associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m, but may occur on localised river flats up to 250 m elevation. May form mosaics with other floodplain forest communities and treeless wetlands, and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 m (though sometimes up to 50 m) elevation. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	Suitable land formation present, however subject ecological community not present.	Unlikely	Unlikely

Scientific name	Common name	Status		Habitat requirement	Suitability of habitat within the study area	Potential occurrence within the study area	Potential impact
		TSC Act	EPBC Act				
Swamp Oak Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.		E	-	Associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains. Generally occurs below 20 m (rarely above 10 m) elevation. The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.	Suitable land formation present. A narrow band of low condition Swamp Oak forest is present along the riparian zone of the Clarence River/ Sportsmans Creek junction.	Known from south-eastern corner of Sportsmans Park at the junction of Sportsmans Creek and Clarence River.	Unlikely. No direct or significant indirect impacts on EEC likely.

Appendix B

Flora species recorded in the study area

Table B1 Flora recorded during random meander within the study area on 8 July 2014 and 3 August 2015

Family	Species	Common name
Trees, palms and shrubs		
Bignoniaceae	*Jacaranda mimosaefolia**	Jacaranda
	*Spathodea companulata**	African Tulip Tree
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Fabaceae (Faboideae)	*Erythrina crista-galli**	Cockspur Coral Tree
Fabaceae (Mimosoideae)	*Acacia disparrima* var. *disparimma*	Brush Ironbark Wattle
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Meliaceae	*Melia azedarach*	White Cedar
Moraceae	*Ficus macrophylla*	Moreton Bay Fig
Myrsinaceae	*Aegicerus corniculatum*	River Mangrove
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
	*Corymbia torelliana**	Cadagi
	Callistemon sp.*	Bottlebrush
	Syzygium moorei	Durobby
	Tristaniopsis laurina	Water Gum
Pinaceae	*Pinus* sp.*	A pine
Proteaceae	*Grevillea robusta*	Silky Oak
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush
Verbenaceae	*Lantana camara**	Lantana
Grasses, herbs and forbs		
Amaranthaceae	*Alternanthera* sp.*	A joyweed
Apiaceae	*Centella asiatica*	Pennywort
Asteraceae	*Ageratina adenophora**	Crofton Weed
	*Ageratum houstonianum**	Blue Billygoat Weed
	*Bidens pilosa**	Cobbler's Peg
	*Cirsium vulgare**	Spear Thistle
	*Conyza bonariensis**	Flaxleaf Fleabane
	*Gamochaeta americana**	Cudweed
	*Hypochaeris radicata**	Flatweed
	*Senecio madagascariensis**	Fireweed
Brassicaceae	*Rorippa palustris**	Yellow Cress
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Convolvulaceae	*Dichondra repens*	Kidney weed
Cyperaceae	*Cyperus odoratus*	Fragrant Flatsedge
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant
Fabaceae (Faboideae)	*Desmodium* sp.	Fabaceae (Faboideae)
	*Trifolium repens**	White Clover

Family	Species	Common name
Juncaginaceae	*Juncus* sp.	A rush
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Poaceae	*Chloris gayana**	Rhodes Grass
	Cynodon dactylon	Common Couch
	Eragrostis leptostachya	Paddock Lovegrass
	*Paspalum conjugatum**	Sour Grass
	*Paspalum vaginatum**	Salt-water Couch
	*Paspalum wettsteinii**	Broad-leaved Paspalum
	*Pennisetum clandestinum**	Kikuyu Grass
	Phragmites australis	Common Reed
	Saccharum spp.*	Sugarcane
	*Setaria sphacelata**	Setaria
	*Urochloa mutica**	Para Grass
Polygonaceae	*Rumex crispus**	Curled Dock
Verbenaceae	*Verbena bonariensis**	Purpletop
Vines		
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Basellelaceae	*Anredera cordifolia**	Madiera Vine
Convolvulaceae	*Ipomoea cairica**	Coastal Morning Glory
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn
Passifloraceae	*Passiflora subpeltata**	White Passionfruit
Sapindaceae	*Cardiospermum halicacabum**	Balloon Vine
Mistletoe		
Loranthaceae	*Amylotheca dictyophleba*	Brush Mistletoe

* indicates a non-indigenous species

Appendix C

Large-footed Myotis survey results

Table C1 Sportsmans Creek Bridge field survey results – 16/12/2013

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comments
C1	1	7	Large-footed Myotis	Adults (no obvious juveniles)	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	-	47	-
C2	1	18	Large-footed Myotis	Adults (no obvious juveniles)	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Near stringer 69	27-30	-
C3	1	3	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 88	36	-
C4	1	20	Large-footed Myotis	Adults and juveniles	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 88	32	Signs of heavy wear on timber at access on stringer below.
C5	2	23	Large-footed Myotis	Adults (no obvious juveniles)	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 26 mm; decking 32 mm	-
C6	1	9	Large-footed Myotis	Adults and juveniles	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 89	35	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comments
C7	3	100	Large-footed Myotis	Adults and juveniles	2	Split (two-piece) stringer and two bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 34 mm; both decking gaps = 55 mm	Signs of heavy wear on timber. Also large guano deposits on top of stringer.
C8	1	2	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Above Stringer 180 near pier 2	37 mm	-
C9	2	10 in total (1 in stringer; 9 in decking)	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 259 near pier 3	Stringer = 22 mm; decking gap = 80 mm	-
C10	3	29 in total (number 10, 13 and 6)	Large-footed Myotis	Adults and juveniles in middle gap/ group with 13 bats	3	Bridge decking - three gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 256	Group of 10 bats = 45 mm; group of 13 bats = 35 mm; group of 6 bats 35 mm	-
C11	1	1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 288	30 mm	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comments
C12	3	4 in total (numbering 3 the 1)	Large-footed Myotis	Adults (no obvious juveniles) - probably a male group	3	Split (two-piece) stringer with two groups.	Stringer 2XX, south of girder 45.	Stringer = 20 to 35 mm	-
C13	1	13	Large-footed Myotis	Adults (no obvious juveniles)	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Girder 42 (no adjacent stringer number).	35 mm	-
C14	1	1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	3	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 191	37 mm	-
C15	3	46 in total (numbering 23, 17 and 6)	Large-footed Myotis	Adults and juveniles in group of 23 and 17	3	Bridge decking - three gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 292	Group of 23 bats = 70 mm; group of 17 bats = 43 mm; group of 6 bats 36 mm.	-
C16	2	11 in total (numbering 6 and 5)	Large-footed Myotis	Adults (no obvious juveniles)	3	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 193	Both 40 mm	-
C17	1	2	Large-footed Myotis	Adults (no obvious juveniles) - probably males	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 181	34 mm	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber number	Gap size (mm)	Other comments
C18	2	7 and 1	Large-footed Myotis	Adults (no obvious juveniles) - single bat probably a male	2	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 88	Group of 7 bats = 34 mm; one bat = 41 mm	-
C19	2	15 in stringer; 3 in decking	Large-footed Myotis	Adults and juveniles; separate group of three probably a group of males	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 71	Stringer = 11 to 24 mm; decking = 30 mm	-

Table C2 Sportsmans Creek Bridge field survey results – 03/02/2014

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comments
C1	Not Occupied	-	-	-	2	-	-	-	-	-
C2	Not Occupied	-	-	-	2	-	-	-	-	-
C3	Not Occupied	-	-	-	2	-	-	-	-	-
C4	Not Occupied	-	-	-	2	-	-	-	-	-
C5	5	57 in total (12 in decking [2,6, 4]; 45 in Stringer)	Large-footed Myotis	Mainly adults size bat; Two obvious juveniles about one week old	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 15 to 25 mm; Decking 34 to 40 mm	Temp: 27.2°c; Humidity: 61% Same as ambient conditions below bridge.	Signs of heavy wearing on stringer and decking.
C6	2	11 (10 and 1)	Large-footed Myotis	Adult sized bats only	2	Bridge decking - between two transverse decking plank, below longitudinal decking and above a stringer.	Stringer 89	33 to 42 mm	Temp: 27.2°c; Humidity: 60.2% Same as ambient conditions below bridge.	-
C7	3	About 100 in total (25 in decking [10,15]; 95 in stringer)	Large-footed Myotis	Adults and juveniles	2	Split (two-piece) stringer and two bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Stringer 90	Stringer = 21 to 36 mm; decking gaps = 42 and 55 mm	Temp: 25.8°c; Humidity: 61.0% Same as ambient conditions below bridge.	-
C8	Not Occupied	-	-	-	2	-	-	-	-	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comments
C9	Not Occupied	-	-	-	3	-	-	-	-	-
C10	Not Occupied	-	-	-	3	-	-	-	-	-
C11	Not Occupied	-	-	-	3	-	-	-	-	-
C12	2	30 in total (numbering 5 and 25)	Large-footed Myotis	Adults (no obvious juveniles)	3	Split (two-piece) stringer with two groups.	Stringer 2XX, south of girder 45	30-32 mm	Temp: 26.4°c; Humidity: 61.8% Same as ambient conditions below bridge.	-
C13	3	48 in total (14 in decking [2, 12]; 34 in Stringer)	Large-footed Myotis	Adults (no obvious juveniles)	3	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer).	Girder 42 (no adjacent stringer number)	Stringer = 25 to 33 mm; decking gaps = 108 and 23 mm	Temp: 25.6°c; Humidity: 60.3% Same as ambient conditions below bridge.	-
C14	Not Occupied	-	-	-	3	-	-	-	-	-
C15	2	20 in total (numbering 15 and 5)	Large-footed Myotis	Adults and juveniles	3	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above a stringer.	Stringer 292	43 and 65 mm	Temp: 24.8°c; Humidity: 60.4% Same as ambient conditions below bridge.	-
C16	Not Occupied	-	-	-	3	-	-	-	-	-

Roost no.	No. of bat clusters	Approx. no. of bats	Species	Status	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Climatic conditions	Other comments
C17	Not Occupied	-	-	-	2	-	-	-	-	-
C18	2	17 in total (numbering 15 and 2)	Large-footed Myotis	Adult sized bats only	2	Bridge decking - two gaps occupied, each between two transverse decking planks, below longitudinal decking and above or near a stringer.	Stringer 88	32 and 25 mm	Temp: 27.0°c; Humidity: 63.4% Same as ambient conditions below bridge.	-
C19	2	About 130 in total (90 in stringer; 40 in decking)	Large-footed Myotis	Adult sized bats only	2	Split (two-piece) stringer and bridge decking (between two transverse decking plank, below longitudinal decking and above a stringer). Part of the group in the decking was not above the stringer, midway between the edge and first stringer.	Stringer 71	Stringer = 15 to 25 mm; decking 30 to 62 mm	Temp: 26.0°c; Humidity: 62.0% Same as ambient conditions below bridge.	-
C20	1	4	Large-footed Myotis	Adult sized bats only	2	Bridge decking - between two transverse decking planks, below longitudinal decking and above or near a stringer.	stringer 70	41 mm	Temp: 27.7°c; Humidity: 62.4% Same as ambient conditions below bridge	-
C21	1	4	Large-footed Myotis	Adult sized bats only.	3	Bridge decking - between two transverse decking planks, below longitudinal decking and above or near a stringer.	Stringer 2796	33 mm	Temp: 26.0°c; Humidity: 60.9% Same as ambient conditions below bridge.	-

Table C3 Alternative drainage structure survey results – 03/02/2014 and 04/02/2014

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1692	-29.488003	153.19244	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1693	-29.502588	153.19073	Pipe culvert	2	2000	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	No	Yes
1694	-29.517585	153.1846	Box culvert	2	2000 x 2000	No	No	Low	Highly susceptible to inundation.	No	Yes
1695	-29.539961	153.17162	Pipe culvert	1	1800	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1696	-29.538319	153.1594	Pipe culvert	1	900	Cell joins and lift holes	Yes - minor guano deposits present	Low	No permanent water directly adjacent to culvert.	No	Yes
1697	-29.537942	153.15314	Pipe culvert	3	1600	Cell joins and lift holes	Yes - minor guano deposits present	Low	No permanent water directly adjacent to culvert.	No	Yes
1698	-29.555301	153.1373	Pipe culvert	1	750	Cell joins	No	Low	Highly susceptible to inundation; barbed wire fence along outlet; overgrown vegetation at inlet; no open permanent water.	No	Yes
1699	-29.568973	153.07768	Wingfield Bridge over the Clarence River South Arm at Brushgrove/ Cowper	-	-	Exposed roosting opportunities mainly provided by rough concrete and bird nests.	No	Low - moderate	Not able to be comprehensively inspected. Ability to support a large Myotis breeding colony (>100 individuals) appears low.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1700	-29.569362	153.07811	Pipe culvert	1	2000	Cell joins; rough concrete	Yes - 3 x Chocolate Wattled bats (*C. gouldii*). Moderate guano accumulations throughout.	Moderate	Floodgate at outlet. Flooding susceptibility may reduce suitability.	No	Yes
1701	-29.572031	153.07314	Pipe culvert	2	1500	Cell joins and lift holes	No	Low	Highly susceptible to inundation and no deep cavities.	No	Yes
1702	-29.551485	153.13796	Pipe culvert	2	600	Cell joins	No	Low	Highly susceptible to inundation; no open water; dense vegetation at inlet and outlet.	No	Yes
1703	-29.535751	153.13693	Pipe culvert	2	1200	Cell joins; Fairy Martin nests	No	Low	Highly susceptible to inundation; open water present.	No	Yes
1704	-29.536089	153.13911	Pipe culvert	1	600	Cell joins; Fairy Martin nests	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1705	-29.536228	153.14221	Pipe culvert	2	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1706	-29.512485	153.13082	Pipe culvert	1	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1707	-29.509843	153.13161	Pipe culvert	1	2200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1709	-29.514074	153.13877	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation; no open water present.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1711	-29.506937	153.13106	Pipe culvert	2	1200	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1712	-29.511571	153.12019	Box culvert	2	1400	Cell joins	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1713	-29.528436	153.1095	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1714	-29.494808	153.1189	Box culvert	1	2000	Cell joins; rough concrete	Yes - 9 x Chocolate Wattled bats (*C. gouldii*).	Moderate	Floodgate at outlet. Flood susceptibility may reduce suitability.	No	Yes
1715	-29.493684	153.14439	2 x pipe culvert; 2 x box culvert	4	900 pipes; 1200 x 75 boxes.	Cell joins and lift holes	No	Low	Highly susceptible to inundation; no open water present.	No	Yes
1716	-29.579662	153.07787	Pipe culvert	1	450	Cell joins	No	Low	Susceptible to inundation.	No	Yes
1717	-29.586708	153.08916	Pipe culvert	1	600	Unknown	Unknown	Low	Inlet and outlet covered with vegetation.	No	Yes
1718	-29.571645	153.09171	Pipe culvert	1	450	Unknown	Unknown	Low	Inlet and outlet covered with vegetation.	No	Yes
1719	-29.590924	153.10071	Bridge	-	-	Fairy Martin nests; exposed roost features	No	Low	Good foraging habitat.	No	Yes
1720	-29.593064	153.10962	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	Highly susceptible to inundation	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1721	-29.584732	153.12122	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1722	-29.573967	153.11879	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1723	-29.574805	153.11115	Pipe culvert	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: inlet and outlet access on private property.	Unknown	Yes
1724	-29.570107	153.11068	Bridge	-	-	Exposed roost features.	No	Low	Good foraging habitat.	No	Yes
1725	-29.566914	153.12985	Coldstream Bridge	-	-	Scuppers, stringer chambers; Fairy Martin nests	Yes - guano present.	High	Unable to be comprehensively inspected. Previously recorded supporting Large-footed Myotis colony (Alison Martin pers. comm.).	Yes (probable breeding colony)	Yes
1726	-29.563564	153.14667	Box culvert	1	2200	Exposed roost features on rough concrete	No	Low	-	No	Yes
1727	-29.558608	153.15001	Box culvert	1	1500 x 1100	Fairy Martin nests; exposed roost features	No	Low	-	No	Yes
1728	-29.509531	153.19059	Shark Creek Bridge	-	-	New Bridge: gaps between concrete planks (large breeding group in a cavity 15 mm wide at the bottom; 30 mm wide at the top and about 300 mm deep;	Yes - >300 Large-footed Myotis (including young) recorded in new bridge. Large guano deposits and staining. Numbering >300 southern span; unknown middle	Known	-	Yes (breeding colony)	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
						also a step/ lip at the base of the concrete blanks which is likely to be important for allowing the bats to enter the roost). Existing timber truss bridge: exposed roosting features.	span; 10 northern span.				
1729	-29.491756	153.19693	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Floodgate on outlet. Highly susceptible to inundation.	No	Yes
1730	-29.496653	153.19635	Pipe culvert	Unknown	Unknown	Unknown	Unknown	Low	Inundated	No	Yes
1731	-29.533098	153.18688	Pipe culvert		Unknown	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Half inundated. Highly susceptible to inundation.	No	Yes
1732	-29.541998	153.17175	Pipe culvert	4	Unknown	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Half inundated. Highly susceptible to inundation.	No	Yes
1733	-29.499398	153.08498	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1734	-29.514446	153.09543	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1735	-29.520354	153.09086	Pipe culvert	2	750	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1736	-29.528909	153.09298	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1737	-29.530856	153.09474	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1738	-29.530165	153.09013	Pipe culvert	1	900	Cell joins and lift holes	No	Low	Highly susceptible to inundation.	No	Yes
1739	-29.539196	153.09092	Bridge	-	-	Exposed roost features.	No	Low	Good foraging habitat.	No	Yes
1740	-29.542241	153.09043	Pipe culvert	1	1500	Cell joins; lift holes and exposed roost	No	Low	-	No	Yes
1741	-29.560613	153.07395	Pipe culvert	2	600	Unknown	Unknown	Low	Unable to be comprehensively surveyed. Mostly inundated. Highly susceptible to inundation.	No	Yes
1742	-29.540584	153.10019	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes
1743	-29.522152	153.10357	Pipe culvert	-	-	Unknown	Unknown	Low	Not inspected: outlet blocked by floodgate; inundated inlet.	No	Yes
1744	-29.512313	153.10277	Culvert (unknown type)	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: outlet blocked by floodgate; inlet access on private property.	Unknown	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1745	-29.46899	153.086	Pipe culvert	4	1800	Cell joins and lift holes	Yes - 1 x Little Bentwing Bat in lift hole (northern cell); > 20 Large-footed Myotis including young in lift holes (4 in one group in northern cell; one dead juvenile in southern cell; 3 in lift hole in 2nd from north cell; two breeding groups in lift holes numbering 5 and 6; and one single male in 3rd cell from the north). Large guano accumulations.	Known	Open water for foraging at outlet.	Yes (breeding colony)	Yes
1746	-29.46778	153.08491	Pipe culvert	3	1500	Cell joins and lift holes	No	High	Open water for foraging at outlet. Habitat similar to 1745, however inlet and outlet covered with vegetation.	No	Yes
1747	-29.462722	153.07772	Pipe culvert	1	1200	Cell joins and lift holes	No	Low	-	No	Yes
1748	-29.427254	153.08472	Broadwater Creek Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1749	-29.415424	153.08648	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1750	-29.462072	153.11955	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes
1751	-29.454297	153.13738	Bridge	-	-	Exposed roost features	No	Low	Good foraging habitat.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1752	-29.476221	153.12682	Box culvert	Unknown	Unknown	Unknown	Unknown	Unknown	Not inspected: partly inundated and deep channel.	Unknown	Yes
1754	-29.487818	153.13239	Pipe culvert	1	1800	Cell joins and lift holes	Yes - < 5 bats present. Species and breeding status unknown.	Unknown	Channel too deep at inlet and outlet for inspection.	Unknown	Yes
1755	-29.480892	153.13974	Box culvert	1	2000	Unknown	Unknown	Unknown	Floodgate on outlet; inlet channel too deep to access. Susceptible to flooding.	Unknown	Yes
1756	-29.460164	153.16844	Pipe culvert	1	1200	Cell joins and lift holes	Yes - 1 x Large-footed Myotis (probable male).	Low	Floodgate at outlet. Flooding may reduce suitability.	No	Yes
1757	-29.462476	153.16982	Pipe culvert	1	1200	Unknown	Unknown	Unknown	No inspected. Channel too deep to access. Susceptible to frequent inundation.	Unknown	Yes
1758	-29.465625	153.17252	Poverty Creek Bridge	-	-	Rough concrete and bird nests	Yes – about 5 x Large-footed Myotis roosting in Welcome Swallow nest. Large staining on rough roof; large guano accumulations.	Low - moderate	-	Yes (status unknown but unlikely to comprise a breeding colony).	Yes
1759	-29.467177	153.19339	Pipe culvert	5	900	Unknown	Unknown	Low	Floodgate on outlet; inlet half inundated. No comprehensively inspected. Susceptible to flooding.	No	Yes

Ref. No.	Latitude	Longitude	Feature	No. of cells (culverts only)	Approx. culvert cell diameter (mm)	Microbat roosting features	Bats/evidence of occurrence	Suitability for breeding Myotis	Comment	Known Large-footed Myotis roost sites	Re-survey during contingency monitoring
1760	-29.468693	153.18977	Pipe culvert	5	1200	Unknown	Unknown	Low	Half inundated. No comprehensively inspected. Susceptible to flooding.	No	Yes

Table C4 Summary of McFarlane Bridge survey results

Bridge Span	Pre-exclusion (pre-nest box installation; during and outside breeding season)	Pre-exclusion (post nest box installation; during and outside breeding season)	During S10 Exclusion (outside breeding season)	During S11 Exclusion (outside breeding season)	Post Exclusion (outside breeding season – 15/8/2013)	Post Exclusion (during breeding season – 8/10/2013)	Phase 2 Pre-exclusion (outside breeding season - 13/08/2015-30/09/2015)
S1	No	No	N/A	No	N/A	No	No
S2	No	No	N/A	No	N/A	No	No
S3	No	No	N/A	No	N/A	No	No
S4	No	No	N/A	No	N/A	No	No
S5	No	No	N/A	No	N/A	Yes – breeding colony of about 15 bats (including young).	No
S6	Yes – non-breeding, small numbers, temporary usage.	No	N/A	No	N/A	No	No
S7	Yes – non-breeding, small numbers, temporary usage.	No	N/A	No	N/A	No	No
S8	No	No	Yes – > 62 bats in bat boxes.	Yes – about 40 bats in decking and 74 bats in bat boxes.	Yes – about 25 bats in decking and 76 bats in bat boxes.	Yes – about 110 bats in bat boxes, including two breeding colonies.	Yes – about 53 in bat boxes only.
S9	No	Yes – about 30 in a bat box (temporary, breeding status unknown).	No	No	Yes – about 25 bats in bat boxes.	Yes – about 36 bats in bat boxes, including one breeding group.	Yes - about 50 in bat boxes only.
S10	Yes – large (>100 bats) permanent breeding colony in	Yes – large (>100 bats) permanent breeding colony in	No	Yes – about 60 bats in bridge decking and 60	Yes – >27 bats in bridge decking and about 55 bats	Yes – about 145 bats; breeding colony in bridge	Yes – 37 in bat boxes only.

Bridge Span	Pre-exclusion (pre-nest box installation; during and outside breeding season)	Pre-exclusion (post nest box installation; during and outside breeding season)	During S10 Exclusion (outside breeding season)	During S11 Exclusion (outside breeding season)	Post Exclusion (outside breeding season – 15/8/2013)	Post Exclusion (during breeding season – 8/10/2013)	Phase 2 Pre-exclusion (outside breeding season - 13/08/2015-30/09/2015)
	bridge decking.	bridge decking.		bats in bat boxes.	in bat boxes.	decking (93) and bat boxes (52).	
S11	Yes – large (>100 bats) permanent breeding colony in decking.	Yes – large (>100 bats) permanent breeding colony in decking.	Yes – large number of bats (>100) in decking.	No (excluding temporary breach of exclusion).	Yes – no bats in the decking; 8 bats in bat boxes.	Yes – about 24 bats in bat boxes, including one breeding colony.	Yes – 33 in bat boxes only.
S12	N/A	N/A	No	No	No	N/A	No
S13	No	No	N/A	Yes – individual	No	No	No
S14	No	No	N/A	No	No	No	N/A
S15	No	No	N/A	No	No	No	N/A
S16	No	No	N/A	No	N/A	No	N/A
S17	No	No	N/A	No	N/A	No	No

Note: N/A indicates locations that were not inspected

Appendix D

Bird survey results

Table D1 Birds observed during dawn and dusk spot count undertaken from north and south abutment of Sportsmans Creek Bridge on 3 and 26 August 2015

Scientific name	Common name	Comment
Anas superciliosa	Pacific Black Duck	In Sportsmans Creek
Artamus cyanopterus	Dusky Woodswallow	In Sportsmans Creek
Artamus leucorynchus	White-breasted Woodswallow	Flying over Sportsmans Park
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	In riparian vegetation
Corvus coronoides	Australian Raven/ Crow	Flying over Sportsmans Park
Corvus orru	Torresian Crow	Flying over Sportsmans Park
Cracticus nigrogularis	Pied Butcherbird	Flying over Flo Clark Park
Cracticus torquatus	Grey Butcherbird	Within Flo Clark Park
Cuculus pallidus	Pallid Cuckoo	Within landscaped vegetation of Flo Clark Park
Egretta garzetta	Little Egret	In riparian vegetation
Gallus gallus	Red Junglefowl	Within Sportsmans Park
Gymnorhina tibicen	Australian Magpie	Within Sportsmans Park
Haliastur indus	Brahminy Kite	Flying above Sportsmans Creek
Hirundo neoxena	Welcome Swallow	On Sportsmans Creek Bridge
Lichmera indistincta	Brown Honeyeater	Flying above Sportsmans Park
Malurus cyaneus	Superb Fairy-wren	Within Flo Clark Park
Pelecanus conspicillatus	Australian Pelican	Flying above Sportsmans Creek
Phalacrocorax carbo	Great Cormorant	In Sportsmans Creek
Phalacrocorax sulcirostris	Little Black Cormorant	In Sportsmans Creek
Philemon citreogularis	Little Friarbird	In riparian vegetation
Philemon corniculatus	Noisy Friarbird	In riparian vegetation
Porphyrio porphyrio	Purple Swamphen	In riparian vegetation
Rhipidura leucophrys	Willie Wagtail	On Sportsmans Creek Bridge
Sphecotheres viridis	Figbird	Within landscaped vegetation of Flo Clark Park
Sterna hirundo	Common Tern	In Sportsmans Creek
Threskiornis molucca	Australian White Ibis	Within Sportsmans Park
Threskiornis spinicollis	Straw-necked Ibis	Within Sportsmans Park
Trichoglossus haematodus	Rainbow Lorikeet	Flying above Flo Clark Park
Vanellus miles	Masked Lapwing	Within Flo Clark Park

Appendix E

Seven-part test of significance

Seven-part test for Large-footed Myotis

Species background

The Large-footed Myotis (*Myotis macropus*) gleans prey from the surface or near surface of smooth water by trawling with its disproportionately large feet, hooking aquatic insects on the surface of pools of water and small fish just below the surface with its claws and assisting the prey to its mouth by scooping with its tail membrane (Jones and Rayner, 1991; Dwyer, 1970; Thompson and Fenton, 1982; Robson 1984). Foraging habitat for this species includes large and small wetlands, estuaries, forest streams, lakes, dams and reservoirs (Richards *et al*., 2008). The Large-footed Myotis has been recorded travelling up to 22 kilometres in one night, presumably for foraging purposes (Caddle, 1998 in Campbell, 2009) with other studies recording regular feeding distances of 10 kilometres (Barclay *et al*., 2000) and 3 kilometres (Anderson *et al*., 2006). It is expected that the average foraging foray by this species is 6.0 to 12 kilometres per night. It is unclear how far the Large-footed Myotis travel to shift roosting sites. It is thought that this species forms stable populations that have a number of roosting sites available or known to the group and that they switch between these roosting sites as required or desired (eg to avoid detection by prey, as a response to weather or season or perhaps as required based on breeding requirements). However it is possible that some groups may be reliant on a small number of roosting sites. Structures such as the timber truss Sportsmans Creek Bridge provide multiple roost sites within a single structure and it is unclear of the relationship of such populations with other known/ potential roost sites within the locality.

The Large-footed Myotis is a polyestrus species that breeds up to three times per breeding season across its northern range. In south-eastern Queensland (Dwyer, 1970) and north-eastern NSW (pers. obs, Hoye pers. comm.), Large-footed Myotis has two breeding events, whilst in Victoria, only one breeding event occurs per season. Observations made by Mr Glenn Hoye with regard to breeding cycles for Large-footed Myotis north of the Hunter are as follows:

- 1 October – 28 October; pregnant.
- 27 October – 26 January; lactating.
- 15 January – 10 February; pregnant.
- 10 February – 12 April; lactating.
- 9 March – 29 May; post-lactation.

This indicates that, whilst the first breeding event is relatively synchronous, the second is not. Also perhaps not all females produce two young per season, explaining the detection of post-lactation and non-pregnant females in March.

The Sportsmans Creek Bridge population is considered the subject population of this assessment.

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

Potential impacts of the proposal on the Large-footed Myotis are provided in Section 4.2.

The proposal would result in the removal of the existing timber truss Sportsmans Creek Bridge which supports a large breeding colony, with about 300 individuals. It is considered to be the core roosting habitat occupied by the subject population. Breeding sites are critical and limited due to the requirement for Large-footed Myotis to be able to maintain warmth and humidity for developing young. Existing alternative potential breeding roosting habitat in the locality is uncommon. The main alternative roosting habitat within 10 kilometres of Sportsmans Creek Bridge comprises flood susceptible culverts associated with table drains. In addition to this, McFarlane Bridge (located 10.3 kilometres north-east) and Shark Creek Bridge (located 8.8 kilometres east) are known to support large breeding colonies of Large-footed Myotis.

The colony's response to the loss of roosting habitat is unknown. Safeguards however would be implemented to minimise potential impacts, including installation of compensatory roosting habitat on the new bridge and staged exclusion from the existing bridge outside the breeding period. The methods proposed have been successful on other similar bridge and culvert work projects involving breeding Large-footed Myotis colonies (Ecotone, 2001; Hoye and Hoye, 1999; Marshall, 2011; GeoLINK 2014c, 2014d, 2014e). Records of Large-footed Myotis colonies in artificial structures (such as concrete bridges like Shark Creek Bridge Pacific Highway), demonstrate the species ability to locate and occupy new roosting opportunities.

Mortality or injury during removal or entrapment during bridge exclusion poses the other main potential impact, though these threats would be immediately reduced or avoided, because work would follow the safeguards described in Section 5.2. Should mortality or injury occur, only small numbers of bats are likely to be affected. Hence, a significant impact from direct mortality or injury is highly unlikely, and a viable local population would not be placed at risk of extinction.

Fly-way and foraging habitat degradation are low risk potential impacts and unlikely to significantly affect the foraging habitat values of the study area (refer to Table 4.1). Disruption to the breeding (mating or birthing) cycle are high risk potential impacts which would be mitigated by proposing to undertake staged exclusion of microbats from the existing timber truss bridge outside the Large-footed Myotis breeding period, when juveniles are flightless and dependent. May to September is the optimal time to exclude microbats to avoid impacts on the Large-footed Myotis breeding population.

Overall, there is reasonable evidence to indicate that, provided that the proposed compensatory roosting habitat is installed, there is high potential for the subject Large-footed Myotis colony to take-up the compensatory roosting habitat provided on the new bridge. The new habitat would be located only about 100 metres from the existing bridge and would also be located above the same water body. The new bridge deck would be about 1.5 metres higher than the existing timber bridge therefore external conditions are expected to be similar.

Elsewhere within the region, exclusion and provision of compensatory Large-footed Myotis breeding roosting habitat as part of bridge and culvert maintenance projects (for example at Marom Creek and Binna Burra culverts) has proven to be successful.

Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use (in this case, in the new bridge), is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program.

If the mitigation measures are not implemented, the proposal has the potential to have an adverse effect on the life cycle of the species such that the viable subject Large-footed Myotis local population is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No consideration under this part of the assessment is required for the subject threatened species being Large-footed Myotis.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

No consideration under this part of the assessment is required for the subject threatened species being Large-footed Myotis.

(d) *in relation to the habitat of a threatened species, population or ecological community:*

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

The proposal would result in the removal of the existing timber truss Sportsmans Creek Bridge which supports a large breeding colony with about 300 individuals and comprises the core roosting habitat for the subject population.

Permanent compensatory roosting habitat is proposed within the new concrete bridge about 100 metres to the west along Sportsmans Creek. This bridge would incorporate microbat breeding habitat features as well as opportunistic roosting habitat features. Four microbat roosting habitat features are proposed to be incorporated into the new bridge:

- Three targeted microbat breeding habitat features:
  - Microbat habitat 1: Walkway Super-T join void.
  - Microbat habitat 2: Walkway void.
  - Microbat habitat 3: Pre-cast parapet.
- One opportunistic alternative microbat roosting habitat feature:
  - Microbat habitat 4: Super-T girder joins.

Potential impacts on foraging habitat ie water quality of waterways for Large-footed Myotis which eat aquatic insects, small fish and prawns etc of the study area and locality would be managed through best practice and general safeguards such as erosion and sediment control outlined within the REF for the proposal including RMS QA *Specification G36 Environmental Protection* and *G38 Soil and Water Management* (refer to KBR 2016).

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

The study area comprises a mostly cleared area utilised for open space and agriculture. No direct habitat fragmentation would occur as a result of the proposal and barriers to fly-ways for microbats moving along Sportsmans Creek are unlikely to be created.

Removal of the timber truss bridge would see the loss of breeding habitat known to be occupied by the Large-footed Myotis and capable of supporting dispersing bats along the lower Clarence River system. Permanent compensatory roosting habitat would also be provided on the new bridge. This and recorded large movements (Caddle, 1998, cited in Campbell *et al*., 2009) indicates that areas of habitat are unlikely to become fragmented or isolated from other areas of habitat as a result of the proposal.

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

The existing timber truss Sportsmans Creek Bridge provides important roosting and breeding habitat for the subject Large-footed Myotis population. It provides a range of potential roosting opportunities within the one structure and supports a large breeding colony. Other known breeding Large-footed Myotis colonies in the locality are uncommon and are not in close proximity to the site (refer to Section 3.2.5). Those colonies are similarly vulnerable to disturbance from bridge/ culvert maintenance and repair projects. As the locality comprises a mostly cleared landscape, hollow-bearing trees are not common and unlikely to support large Large-footed Myotis populations. Overall, the existing Sportsmans Creek Bridge is considered important to the long-term survival of the species in the locality. Permanent compensatory habitat would be provided on the new bridge which would alleviate impacts of the proposal on the subject population.

(e) *(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

No areas of critical habitat are listed under the TSC Act for Large-footed Myotis.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Part 4 of the TSC Act states 'The object of a recovery plan is to promote the recovery of the threatened species, population or ecological community to which it relates to a position of viability in nature.' Any action which adversely affects threatened species or their habitat, or contributes to relevant key threatening processes (KTP) may be interpreted as being inconsistent with this general objective.

No draft or approved recovery plans have been prepared under the TSC Act for Large-footed Myotis.

The following Priority Action Statements (PAS) have been prepared for Large-footed Myotis:

LOW PRIORITY

1 Ensure the largest hollow-bearing trees in riparian zones are given highest priority for retention in PVP assessments or other land clearing assessment tools.

2 Identify the spatial population structure, including genetic isolation, movement and persistence across the species range.

3 Prepare environmental impact assessment guidelines which address the retention of hollow-bearing trees maintaining diversity of age groups, species diversity, and structural diversity. Give priority to largest hollow-bearing trees.

4 Undertake long-term monitoring of populations cross tenure in conjunction with other bat species to document changes.

5 Identify, protect and enhance roost habitat beneath artificial structures (eg bridges), especially when due for replacement, and assess effectiveness of the actions.

6 Better regulate pollution of waterways eg sewage and fertilizer run-off (eutrophication) and pesticide/ herbicide leakage (chemical pollution) and thermal pollution.

MEDIUM PRIORITY

7 Research to identify important foraging range and key habitat components for this species. Identify the importance of riparian vegetation to the species.

8 Determine susceptibility to logging.

9 Investigate the effectiveness of logging prescriptions.

10 Promote roosting habitat in new artificial structures within the species range.

11 Encourage recovery of natural hydrological regimes, including retention and rehabilitation of riparian vegetation.

HIGH PRIORITY

12 Survey large inland waterways for this species to determine distribution in Murray Darling Basin.

13 Resolve species taxonomy by morphology/ genetics and reassess conservation status.

14 Assess the importance by survey of estuaries and other tidal waterways for the species across its range.

15. Study the ecology, habitat requirements and susceptibility to logging and other forestry practices of this little-known species.

Two PAS (PAS 5 and 10 highlighted **bold**) relate directly to the proposal. The proposal aims to be consistent with these actions by installing alternative artificial roosting habitat for the Large-footed Myotis within the new bridge, based on designs of artificial roosting habitat that is known to be used as breeding habitat.

Proposed amendments to the NSW Threatened Species PAS include draft recovery and threat abatement strategies (*Saving our Species* conservation program). Large-footed Myotis has been assigned to the 'landscape species' management stream under the *Saving our Species* conservation program. Actions listed within Table E1 are proposed for Large-footed Myotis. These proposed actions generally duplicate the proposed PAS.

Table E1 Action toolbox

Action description	Scale
Retain and protect live and standing dead trees likely to contain suitably sized hollows, or that have the potential to develop these in the future (eg through the loss of limbs) particularly in riparian zones. Ensure the largest hollow-bearing trees, including dead trees, are given highest priority for retention in property vegetation plan assessments. Offsets should include remnants in high productivity and riparian zones. Raise public awareness of the importance of hollow-bearing trees and promote strategies for retaining these in the landscape.	Area
Identify sites, particularly in riparian zones, where hollows are limiting due to exotic species inhibiting recruitment and changing the vegetation structure. Ensure the future replacement of large old trees by facilitating regeneration or undertaking replanting at sites where they presently occur. Protect recruit trees that will be able to provide hollows in the future.	Site
Liaise with the Roads and Maritime Authority and other relevant authorities and land managers regarding wooden bridges, wharves, tunnels, aqueducts and other structures acting as bat habitat. When undertaking any major works, replacing wooden bridges with concrete bridges or upgrading wharves, this be done at a time outside of the breeding (October-February) and overwintering period. A wooden structure should be placed under new bridges or wharves where bats are known to provide a roost.	State
Encourage land managers to enter into land management agreements that protect and restore key areas such as riparian habitat and including the retention of suitable hollow-bearing trees and recruitment trees in these areas.	Site
Check that in caves utilised by bats, entrances are not blocked in a way that prevents easy continual access by bats. Monitor the density of vegetation (native or exotic) at the entrance to any active or potential maternity or hibernation roost cave and manually remove (do not use chemicals) as necessary to ensure bats have ready access year-round.	Site
Discourage recreational users from roosting areas such as caves, culverts, and storm water drains by erecting signs or blocking preventing human access whilst still allowing access to bats. In caves where public access is permitted, restrict access during breeding season (November-March) and winter to approved management and scientific research only. Provide information to users in the form of brochures and signage about appropriate care and behaviour whilst at the site. Provide this information to caving, climbing, abseiling and bushwalking groups.	State
Promote roosting habitat in new artificial structures within the species' range and monitor their use.	Site
Raise awareness amongst landholders in close proximity (approximately 15 kilometre radius) to maternity or roost sites, of the potential impacts of using harmful pesticides and other chemicals and discourage their use in or adjacent to foraging habitat, particularly in riparian zones around waterways such as rivers, creeks, lakes and dams.	Site, Area

Action description	Scale
Liaise with agricultural landholders to promote land management that minimises disturbance to waterways likely to be foraging habitat (eg restore riparian vegetation and carefully manage stormwater and polluted run-off). Monitor and maintain adequate water quality in water systems known to be used for foraging. Liaise with relevant authorities with respect to limiting the impacts of waste disposal and runoff in these systems.	Site, Area
Control or remove exotic weeds, particularly in riparian zones, that degrade habitat and alter the structure of the vegetation community in areas of the species' distribution. Ensure that such weed control work be undertaken in a staged manner and minimises disturbance to the habitat of the species. Develop and implement a bush regeneration strategy (which includes monitoring and reporting requirements) targeting the removal of weeds significantly compromising habitat values such as the repression of future hollow-bearing trees. Care should be taken to avoid widespread removal of vegetation without replacement. Manual weed removal is preferable and the use of herbicides should avoid non-target impacts. Leave dead trees standing. Encourage land managers and bushcare groups to undertake weed control.	Site
Undertake restoration and augmentation planting and/ or direct seeding, including species from the ground layer and understorey in areas of degraded and/ or potentially suitable habitat particularly in riparian zones. Revegetation should focus on expanding existing smaller areas of suitable habitat and connecting areas of suitable habitat to create corridors for movement. A diversity of local native species should be planted. Dead trees should not be removed.	Site
Manually remove and appropriately dispose of invasive aquatic weeds in waterways in foraging areas (weeds inhibit the species' ability to forage over water).	Site
Liaise with relevant authorities and/ or land managers to discourage the destruction of caves. If mine sites are to be closed or previously abandoned mines reopened, they should first be checked for the presence of bats (during summer) and access should still be provided for the bats to safely enter and leave. Closure technique should be discussed with relevant microbat experts to ensure that possible habitat for bats is maintained. If gates are used, they should be bat friendly with horizontal bars at least 15 centimetres apart and preferably with a larger gap across the top. Bats should be excluded prior to closure (and this should not occur during the breeding season from October to February or in winter). The impact of closure on bat usage should be monitored for several seasons.	Site, Area

The Action Plan for Australian Bats recommends the following actions for the Large-footed Myotis (Duncan *et al*., 1999):

1 Complete the review of taxonomy and distribution of this species and its congeners. In particular confirm the placement of northern New South Wales specimens. Morphological parameters of New South Wales specimens should be incorporated into the study of Kitchener et al. (1995). Genetic studies are currently underway at the South Australian Museum.

2 Conduct targeted surveys to clarify the status of the inland populations along the Murray River and in northern New South Wales.

3 Assess whether this species is adequately represented in conservation reserves and ensure the security of known maternity sites.

4 Carry out ecological research to determine:

- *Habitat requirements.*

- *Roost and maternity site selection, particularly the relative dependence on caves versus tree hollows.*
- *Sensitivity to changes in water quality.*
- *Population dynamics.*
- *Threatening processes.*

5 Encourage State and local government authorities with responsibility for construction and maintenance of roads to inspect bridges/culverts prior to demolition to reduce impact on colonies utilising these structures.

Those in bold relate directly to the proposal. The proposal aims to be consistent with these actions by:

- Installing compensatory roosting habitat for Large-footed Myotis within the new bridge, based on designs of artificial roosting habitat that is known to be used as breeding habitat.
- Excluding microbats from the existing bridge outside the breeding season prior to removal and after installation of the new bridge containing compensatory roosting habitat.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal was assessed with regards to the potential contribution towards or operation of KTP listed under Schedule 3 of the TSC Act as provided in Table E2.

Table E2 Key Threatening Processes

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic climate change			✓
Bush rock removal			✓
Clearing of native vegetation			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition and habitat degradation by feral goats (*Capra hircus*)			✓
Competition from feral honeybees (*Apis mellifera*)			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants (*Solenopsis invicta*)			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Infection of native plants by *Phytophthora cinnamomi*			✓
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae			✓
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Rhinella marina*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*)			✓
Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)			✓
Invasion of native plant communities by exotic perennial grasses			✓
Invasion of the yellow crazy ant (*Anoplolepis gracilipes* (Fr. Smith)) into NSW			✓
Loss of hollow-bearing trees			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Loss or degradation (or both) of sites used for hill-topping by butterflies			✓
Predation and hybridisation of feral dogs (*Canis lupus familiaris*)			✓
Predation by the European red fox (*Vulpes vulpes*)			✓
Predation by the feral cat (*Felis catus*)			✓
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)			✓
Removal of dead wood and dead trees			✓

Overall, the proposal is not considered likely to contribute significantly towards any listed KTP. Use of equipment and heavy machinery would contribute to a minor extent to anthropogenic climate change, particularly when viewed in conjunction with other carbon emitting/ fossil fuel burning/ greenhouse gas emitting activities in the locality. The incremental extent to which the proposal may contribute to anthropogenic climate change is unlikely to put the local occurrence of the subject species at significant risk of extinction.

Conclusion

Based on the detailed assessment undertaken through the SIS process and consideration of alternatives and/ or ameliorative measures proposed, it is considered that the impact upon the Large-footed Myotis population has been minimised.

Overall, there is reasonable evidence to indicate that, provided that the proposed compensatory roosting habitat is installed, there is high potential for the subject Large-footed Myotis colony to take-up the compensatory roosting habitat provided on the new bridge. The new habitat would be located only about 100 m from the existing bridge and would also be located above the same water body. The new bridge deck would only be about 1.5 metres higher than the existing timber bridge therefore external conditions are expected to be similar. Elsewhere within the region, exclusion and provision of compensatory Large-footed Myotis breeding roosting habitat as part of bridge and culvert maintenance projects (for example at Marom Creek and Binna Burra culverts) has proven to be successful.

Further, promoting roosting habitat in new artificial structures within the species' range and monitoring their use, is a site specific management action recommended by OEH in the Action Toolbox for the Large-footed Myotis under the *Saving our Species* conservation program.

It is expected that the local population to be impacted by removal of the existing timber truss bridge would occupy the compensatory roosting habitat provided within the new concrete bridge and avoid a significant impact. However, a level of uncertainty warrants application of the precautionary principle.

If a significant impact is identified from the post exclusion monitoring results, Roads and Maritime would consult with OEH with regard to the implementation of appropriate adaptive mitigation/ contingency measures.

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Seven-part test for Eastern and Little Bent-winged Bats

Little Bent-winged Bat

Species profile

Little Bent-winged Bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day (Dwyer, 2008a; OEH, 2012). Maternity colonies form in caves during spring. Only five maternity caves are known in Australia (OEH, 2014).

Little Bent-winged Bats forage at night for small insects beneath the canopy of densely vegetated habitats. They forage in a broad range of habitats ranging including moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub (OEH, 2014).

Subject population and local habitats

No breeding roosting habitat for the Little Bent-winged Bat occurs in the locality. Sportsmans Creek Bridge provides non-breeding roosting opportunities. The study area forms a fraction of the potential foraging habitat available within the locality for this species.

The range of the local population of this highly mobile species extends well beyond the confines of the site and locality, and would be expected to be largely associated with the key maternity caves in north-east NSW.

Eastern Bent-winged Bat

Species profile

Eastern Bent-winged Bats roost in caves, derelict mines, culverts, bridges tunnels, buildings and other man-made structures. They form discrete populations centred on maternity caves, used annually in spring and summer (OEH, 2014; Dwyer, 2008b). At other times of the year, populations disperse within about 300 kilometres range of maternity caves. Eastern Bent-winged Bats forage for flying insects above the tree tops. They forage in a broad range of habitats, including rainforest, dry, wet and swamp sclerophyll forests, heath, forested wetlands and water bodies (OEH, 2014).

Subject population and local habitats

As for the Little Bent-winged Bat.

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

No maternity sites for the subject species would be affected by the proposal. The proposal would see the existing available roosting habitat provided by Sportsmans Creek Bridge removed and replaced by the new bridge. Non-breeding roosting opportunities would be provided in the new bridge by the Super T Girder joins and habitat designed into the bridge structure.

Overall, with consideration of the above, the high mobility of these species as well as the presence of alternative potential non-breeding roosting habitat in the locality; an adverse effect on the life cycle of the subject species such that a viable local population of the species is likely to be placed at risk of extinction is not likely to occur as a result of the proposal.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No consideration under this part of the assessment is required for the subject threatened species.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

No consideration under this part of the assessment is required for the subject threatened species.

(d) (d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of the existing timber truss Sportsmans Creek Bridge. The existing bridge provides potential opportunistic non-breeding roosting habitat for the subject species. No maternity habitat would be affected and the new bridge and other known/ potential roosting habitats within the locality will remain available to support non-breeding aggregates when in the locality.

Forest habitat used for foraging would not be directly impacted by the proposed bridge removal. Best practice and general safeguards such as erosion and sediment control would minimise indirect impacts to these areas.

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

The locality comprises a mostly cleared agricultural environment. No direct habitat fragmentation would occur as a result of the proposal and barriers to fly-ways for bats moving along Sportsmans Creek are unlikely to be created.

Removal of the existing bridge would result in loss of opportunistic non-breeding roosting habitat and capable of supporting dispersing bats along the lower Clarence River system. Alternative roosting habitat would be provided on the new bridge. This and recorded large movements by all of the subject species indicates that areas of habitat are unlikely to become fragmented or isolated from other areas of habitat as a result of the proposal for the subject species.

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

The existing bridge provides potential opportunistic non-breeding roosting habitat for the subject species, which primarily breed in caves. No maternity habitat would be affected and the new bridge and other known/ potential roosting habitats within the locality will remain available to support non-breeding aggregates when in the locality. Overall thus no habitat important for the long-term survival of the subject species in the locality would be affected by the proposal.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat are listed under the TSC Act for the subject species.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Part 4 of the TSC Act states ‘The object of a recovery plan is to promote the recovery of the threatened species, population or ecological community to which it relates to a position of viability in nature.” Any action which adversely affects threatened species or their habitat, or contributes to relevant key threatening processes may be interpreted as being inconsistent with this general objective. Specific recovery and threat abatement strategies are discussed below.

No draft or approved recovery plans have been prepared under the TSC Act for the subject species. The proposed work does not affect the aims or proposed actions of any of the prepared threat abatement plans.

Under the OEH *Saving our Species* conservation program, the Little Bent-winged Bat and Eastern Bent-winged Bat fall under the 'Site-managed species'. The proposal would not affect any of these sites. The recommended actions of the Action Plan for Australian Bats (Reardon *et al.,* 1999) for the Eastern Bent-winged Bat are not relevant to the proposal.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Table E3 Key Threatening Processes

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic climate change	✓		
Bush rock removal			✓
Clearing of native vegetation			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition and habitat degradation by feral goats (*Capra hircus*)			✓
Competition from feral honeybees (*Apis mellifera*)			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants (*Solenopsis invicta*)			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Infection of native plants by *Phytophthora cinnamomi*			✓
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae			✓
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Rhinella marina*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*)			✓
Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)			✓
Invasion of native plant communities by exotic perennial grasses			✓
Invasion of the yellow crazy ant (*Anoplolepis gracilipes* (Fr. Smith)) into NSW			✓
Loss of hollow-bearing trees			✓
Loss or degradation (or both) of sites used for hill-topping by butterflies			✓
Predation and hybridisation of feral dogs (*Canis lupus familiaris*)			✓
Predation by the European red fox (*Vulpes vulpes*)			✓
Predation by the feral cat (*Felis catus*)			✓
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Removal of dead wood and dead trees			✓

Overall, the proposal is not considered likely to contribute significantly towards any listed KTP. Use of equipment and heavy machinery would contribute modestly to anthropogenic climate change, particularly when viewed in conjunction with other carbon emitting/ fossil fuel burning/ greenhouse gas emitting activities in the locality. Whilst modest, the cumulative impacts of such small emissions are significant. Currently, it is not feasible to undertake the work using green energy sources only.

Conclusion

A significant impact on these species is considered unlikely. No breeding habitat would be affected by the proposal and alternative potential roosting habitat in their non-breeding range in the lower Clarence is available to support the local potential occurrences of these species.

References

Dwyer, P. (2008a). Little Bentwing-bat *Miniopterus australis* in T*he Mammals of Australia*, edited by S. Van Dyke & R. Strahan. Reed New Holland, Sydney.

Dwyer, P. (2008b). Eastern Bentwing-bat *Miniopterus schreibersii* in T*he Mammals of Australia*, edited by S. Van Dyke & R. Strahan. Reed New Holland, Sydney.

Office of Environment and Heritage [OEH], (2012). Threatened Species Profiles. Available online: http://www.environment.nsw.gov.au/threatenedSpeciesApp/SpeciesByType.aspx

Accessed December 2015.

Seven-part test for Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

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

No consideration under this part of the assessment is required.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No consideration under this part of the assessment is required.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

The proposal involves removal of the timber truss Sportsmans Creek Bridge and associated work. No trees from within the community would be removed as a result of the proposal. Indirect impacts would be minimised through the implementation of safeguards listed within Section 5. It is not expected that the proposal would result in a significant negative impact on this community such that its local occurrence is likely to be placed at risk of extinction.

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

As indicated above, the proposal involves removal of Sportsmans Creek Bridge and does not require access to or modification of this vegetation community. Indirect impacts would be minimised through the implementation of safeguards listed within Section 5. The work would therefore not substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

No habitat is likely to be removed or modified as a result of the action proposed.

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

The proposal involves removal of Sportsmans Creek Bridge as well as ancillary work such as establishment of site compound/ stockpile area. None of these activities involve removal of native vegetation from within the EEC located east of the bridge. No areas of habitat are likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

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

The Swamp Oak floodplain forest present is of importance for bank stability and habitat for small birds. It also provides foraging resources particularly when plants are fruiting.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat are listed under the TSC Act for Swamp Oak floodplain forest.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Part 4 of the TSC Act states "*The object of a recovery plan is to promote the recovery of the threatened species, population or ecological community to which it relates to a position of viability in nature*." Any development which adversely affects threatened species or their habitat, or contributes to relevant key threatening processes (KTP) may be interpreted as being inconsistent with this general objective.

No recovery plan or threat abatement plans have been prepared for Swamp Oak floodplain forest. The recovery planning process has now been incorporated into Priority Action Statements (PAS). The proposal would not create barriers to the implementation of the PAS for the subject EEC.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal was assessed with regards to the potential contribution towards or operation of KTP listed under Schedule 3 of the TSC Act as provided in Table E4.

Table E4 Key Threatening Processes

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic climate change	✓		
Bush rock removal			✓
Clearing of native vegetation			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition and habitat degradation by feral goats (*Capra hircus*)			✓
Competition from feral honeybees (*Apis mellifera*)			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants (*Solenopsis invicta*)			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Infection of native plants by *Phytophthora cinnamomi*			✓
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae			✓
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Rhinella marina*)			✓
Invasion, establishment and spread of *Lantana camara*			✓
Invasion of native plant communities by African Olive (*Olea europaea L. subsp. cuspidata*)			✓
Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)			✓
Invasion of native plant communities by exotic perennial grasses			✓
Invasion of the yellow crazy ant (*Anoplolepis gracilipes* (Fr. Smith)) into NSW			✓
Loss of hollow-bearing trees			✓
Loss or degradation (or both) of sites used for hill-topping by butterflies			✓
Predation and hybridisation of feral dogs (*Canis lupus familiaris*)			✓
Predation by the European red fox (*Vulpes vulpes*)			✓
Predation by the feral cat (*Felis catus*)			✓
Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish)			✓

Listed Key Threatening Process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)			✓
Removal of dead wood and dead trees			✓

Anthropogenic Climate Change: There is evidence that modification of the environment by humans may result in future climate change. Human induced activities as a result of energy use, industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste cause greenhouse gas emissions (OEH 2014). The incremental extent to which the proposal may contribute to anthropogenic climate change is not significant.

Effective implementation of the safeguards within Section 5 would ensure the proposal does not contribute to other KTP.

Overall, the proposal is not considered likely to contribute significantly towards any listed KTP.

Conclusion

The proposal is not expected to result in a significant adverse impact on Swamp Oak floodplain forest EEC that would put at risk the local viability of this community.

References

NSW Scientific Committee (2011). *Swamp Oak Floodplain Forest in NSW North Coast, Sydney Basin and South East Corner Bioregions - endangered ecological community listing*. OEH, Hurstville, NSW. Available online: http://www.environment.nsw.gov.au/determinations/SwampOakFloodplainEndSpListing.htm Accessed December 2015.

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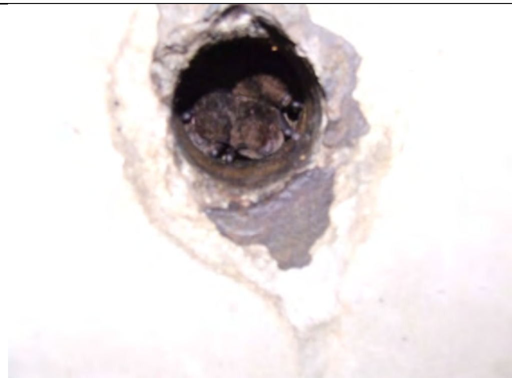
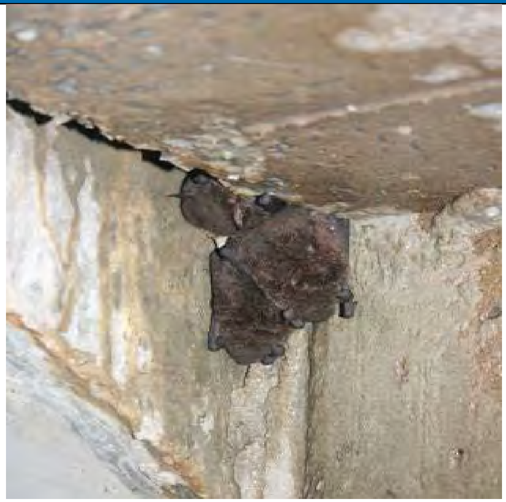
Appendix F

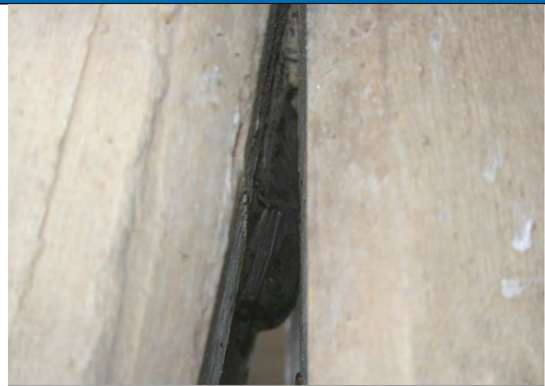
Known and likely concrete Large-footed Myotis breeding roosts in the region

Table F1 Known concrete Large-footed Myotis breeding habitat sites in the region

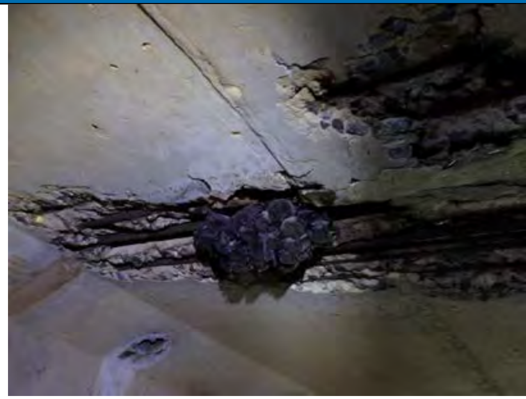
Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Shark Creek Bridge, Pacific Highway (8.8 km east of Sportsmans Creek Bridge)	Concrete plank bridge	Gaps between concrete planks: 15-30 mm wide; 300 mm deep; also a step/lip at the base of the concrete blanks which is likely to be important for allowing the bats to enter the roost.	Known breeding site. >300 bats observed.	Cavities are dark and some are wedge ('V') shaped. The main occupied cavities are near the centre of the bridge.	 
Pringles Way culvert, Lawrence (4.1 km north, north-west of Sportsmans Creek Bridge)	4 cell 1,800 mm diameter pipe culvert	Breeding colonies in culvert cell lift holes (about 90 mm diameter and 150 mm deep).	>20, breeding habitat confirmed	-	

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Pacific Highway culvert, 60 m south of Halfway Creek Bridge (46 km south of Sportsmans Creek Bridge)	4 cell 3000 x 2400 mm box culvert	Culvert lift holes (8 in total) about 150 mm wide x 150 mm long, with 4 (east) to 200 mm deep (non-earth) and 4 (west) with earth cavities between 300 and 1,000 mm deep.	40-50, breeding confirmed	Has since been removed as part of Highway upgrade however bat boxes have been installed.	
New Serpentine Creek Bridge, Pacific Highway (17 km north-east of Sportsmans Creek Bridge)	Concrete plank bridge	17 horizontal gaps 1-5 cm wide with foam at the top. Cavities around 150 mm depth.	10, breeding confirmed	-	

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Pacific Highway culvert south of Ballina (Oakey Flat No. 3) (45 km north-east of Sportsmans Creek Bridge)	Box culvert	Cavity (3 x 4 cm opening) where new joins old.	5, breeding confirmed	-	
Mororo Bridge (21.1 km north-east of Sportsmans Creek Bridge)	Concrete Bridge	Blocked scuppers (about 100 mm diameter, 400 mm deep with cavity at top). Cavity pier cavity (see photo).	~20, breeding confirmed	Pier roost sites are atypical, with bats quite exposed.	

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
					 

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
					
Bruxner Highway, Marom Creek culvert (81 km north-east of Sportsmans Creek Bridge)	3 cell 1800 x 2400 box culvert	Culvert lift points (55 mm diameter, 10-300 mm deep); possible also rough surfaces on the obvert.	-135, breeding confirmed	-	

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
					
Summerland Way culvert 9257 (12 km west of Sportsmans Creek Bridge)	3 cell x about 1200 mm pipe culvert	Lift holes (650 mm diameter and between 150 and 600 mm deep, some opening into earth cavities)	>73, likely breeding habitat	Habitat no longer available following emergency works undertaken in 2013.	

Feature	Structure	Breeding roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Binna Burra culvert, Bangalow Road (95.5 km north-east of Sportsmans Creek Bridge)	3 cell 1200 mm pipe culvert	Culvert cell joins, up to about 60 mm wide. Depth unknown.	73	-	

Table F2 Other concrete bridges that are likely Large-footed Myotis breeding sites in the region

Feature	Structure	Roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Coldstream Bridge, Brushgrove	Concrete Bridge	Breeding not confirmed, but Large-footed Myotis colony reported. Potential breeding roosting habitat features include: scuppers and girder chambers.	Unknown. Guano present.	Investigation in to microbat usage at this bridge may help confirm suitability of girder chambers.	-
Connells Creek Bridge, Waterfall Way	Concrete and timber plank bridge	Concrete join on top of central pier			 

Feature	Structure	Roosting habitat features	Numbers of Large-footed Myotis	Comment	Photos
Tabulam, Clarence River Overflow No.1 and No. 2.	Concrete plank bridges.	Gaps between concrete planks: about 20-50 mm wide and 150-200 mm depth.	Species un-confirmed but about 91 bats recorded at Clarence River Overflow No.1 and 54 bats recorded at Clarence River Overflow No.2.	-	 

Appendix G

Bird survey results

Table G1 Birds observed during dawn and dusk spot count undertaken from north and south abutment of Sportsmans Creek Bridge Area on 3 and 26 August 2015

Scientific name	Common name	Comment
Anas superciliosa	Pacific Black Duck	In Sportsmans Creek
Artamus cyanopterus	Dusky Woodswallow	In Sportsmans Creek
Artamus leucorynchus	White-breasted Woodswallow	Flying over Sportsmans Park
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	In riparian vegetation
Corvus coronoides	Australian Raven/ Crow	Flying over Sportsmans Park
Corvus orru	Torresian Crow	Flying over Sportsmans Park
Cracticus nigrogularis	Pied Butcherbird	Flying over Flo Clark Park
Cracticus torquatus	Grey Butcherbird	Within Flo Clark Park
Cuculus pallidus	Pallid Cuckoo	Within landscaped vegetation of Flo Clark Park
Egretta garzetta	Little Egret	In riparian vegetation
Gallus gallus	Red Junglefowl	Within Sportsmans Park
Gymnorhina tibicen	Australian Magpie	Within Sportsmans Park
Haliastur indus	Brahminy Kite	Flying above Sportsmans Creek
Hirundo neoxena	Welcome Swallow	On Sportsmans Creek Bridge
Lichmera indistincta	Brown Honeyeater	Flying above Sportsmans Park
Malurus cyaneus	Superb Fairy-wren	Within Flo Clark Park
Pelecanus conspicillatus	Australian Pelican	Flying above Sportsmans Creek
Phalacrocorax carbo	Great Cormorant	In Sportsmans Creek
Phalacrocorax sulcirostris	Little Black Cormorant	In Sportsmans Creek
Philemon citreogularis	Little Friarbird	In riparian vegetation
Philemon corniculatus	Noisy Friarbird	In riparian vegetation
Porphyrio porphyrio	Purple Swamphen	In riparian vegetation
Rhipidura leucophrys	Willie Wagtail	On Sportsmans Creek Bridge
Sphecotheres viridis	Figbird	Within landscaped vegetation of Flo Clark Park
Sterna hirundo	Common Tern	In Sportsmans Creek
Threskiornis molucca	Australian White Ibis	Within Sportsmans Park
Threskiornis spinicollis	Straw-necked Ibis	Within Sportsmans Park
Trichoglossus haematodus	Rainbow Lorikeet	Flying above Flo Clark Park
Vanellus miles	Masked Lapwing	Within Flo Clark Park

Appendix H

Flora survey results

Table H1 Flora recorded during random meander within the study area on 8 July 2014 and 3 August 2015

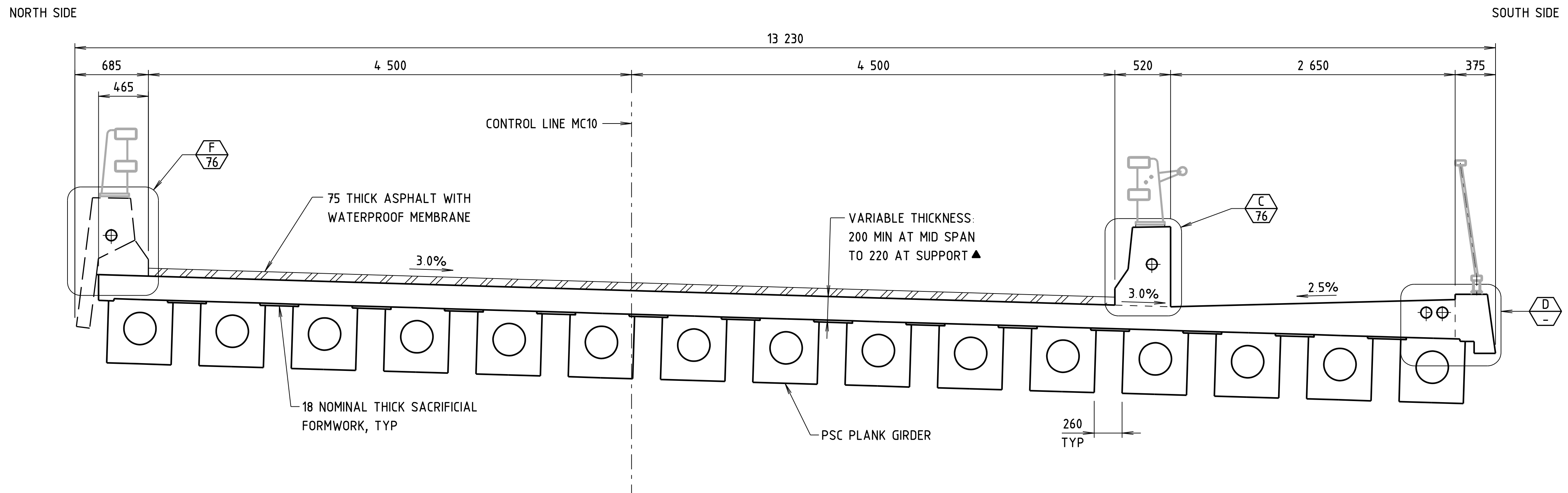
Family	Species	Common Name
Trees, palms and shrubs		
Bignoniaceae	*Jacaranda mimosaefolia**	Jacaranda
	*Spathodea companulata**	African Tulip Tree
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Fabaceae (Faboideae)	*Erythrina crista-galli**	Cockspur Coral Tree
Fabaceae (Mimosoideae)	*Acacia disparrima* var. *disparimma*	Brush Ironbark Wattle
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Meliaceae	*Melia azedarach*	White Cedar
Moraceae	*Ficus macrophylla*	Moreton Bay Fig
Myrsinaceae	*Aegicerus corniculatum*	River Mangrove
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Myrtaceae	*Corymbia torelliana**	Cadagi
Myrtaceae	*Callistemon* sp.*	Bottlebrush
Myrtaceae	*Syzygium moorei*	Durobby
Myrtaceae	*Tristaniopsis laurina*	Water Gum
Pinaceae	*Pinus* sp.*	A pine
Proteaceae	*Grevillea robusta*	Silky Oak
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush
Verbenaceae	*Lantana camara**	Lantana
Grasses, herbs and forbs		
Amaranthaceae	*Alternanthera* sp.*	A joyweed
Apiaceae	*Centella asiatica*	Pennywort
Asteraceae	*Ageratina adenophora**	Crofton Weed
Asteraceae	*Ageratum houstonianum**	Blue Billygoat Weed
Asteraceae	*Bidens pilosa**	Cobbler's Peg
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane
Asteraceae	*Gamochaeta americana**	Cudweed
Asteraceae	*Hypochaeris radicata**	Flatweed
Asteraceae	*Senecio madagascariensis**	Fireweed
Brassicaceae	*Rorippa palustris**	Yellow Cress
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Convolvulaceae	*Dichondra repens*	Kidney weed
Cyperaceae	*Cyperus odoratus*	Fragrant Flatsedge
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant

Family	Species	Common Name
Fabaceae (Faboideae)	*Desmodium sp.*	Fabaceae (Faboideae)
Fabaceae (Faboideae)	*Trifolium repens**	White Clover
Juncaginaceae	*Juncus* sp.	A rush
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Cynodon dactylon*	Common Couch
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Poaceae	*Paspalum conjugatum**	Sour Grass
Poaceae	*Paspalum vaginatum**	Salt-water Couch
Poaceae	*Paspalum wettsteinii**	Broad-leaved Paspalum
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass
Poaceae	*Phragmites australis*	Common Reed
Poaceae	*Saccharum* spp.*	Sugarcane
Poaceae	*Setaria sphacelata**	Setaria
Poaceae	*Urochloa mutica**	Para Grass
Polygonaceae	*Rumex crispus**	Curled Dock
Verbenaceae	*Verbena bonariensis**	Purpletop
Vines		
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Basellelaceae	*Anredera cordifolia**	Madiera Vine
Convolvulaceae	*Ipomoea cairica**	Coastal Morning Glory
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn
Passifloraceae	*Passiflora subpeltata**	White Passionfruit
Sapindaceae	*Cardiospermum halicacabum**	Balloon Vine
Mistletoe		
Loranthaceae	*Amylotheca dictyophleba*	Brush Mistletoe

* indicates a non-indigenous species

Appendix I

Microbat habitat design new Sportsmans Creek Bridge



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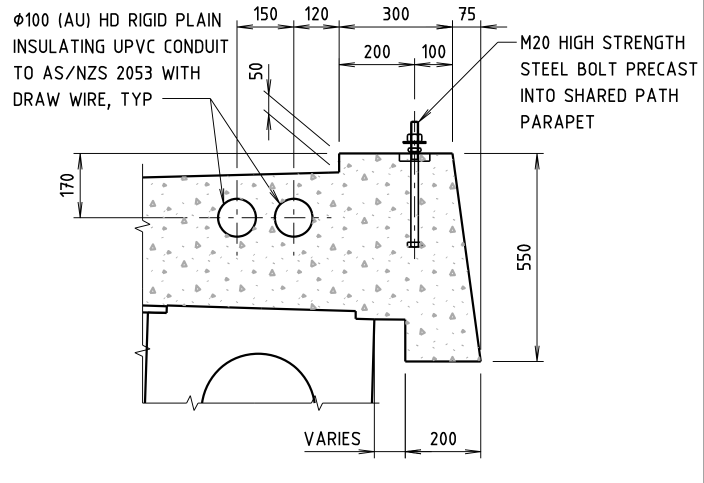

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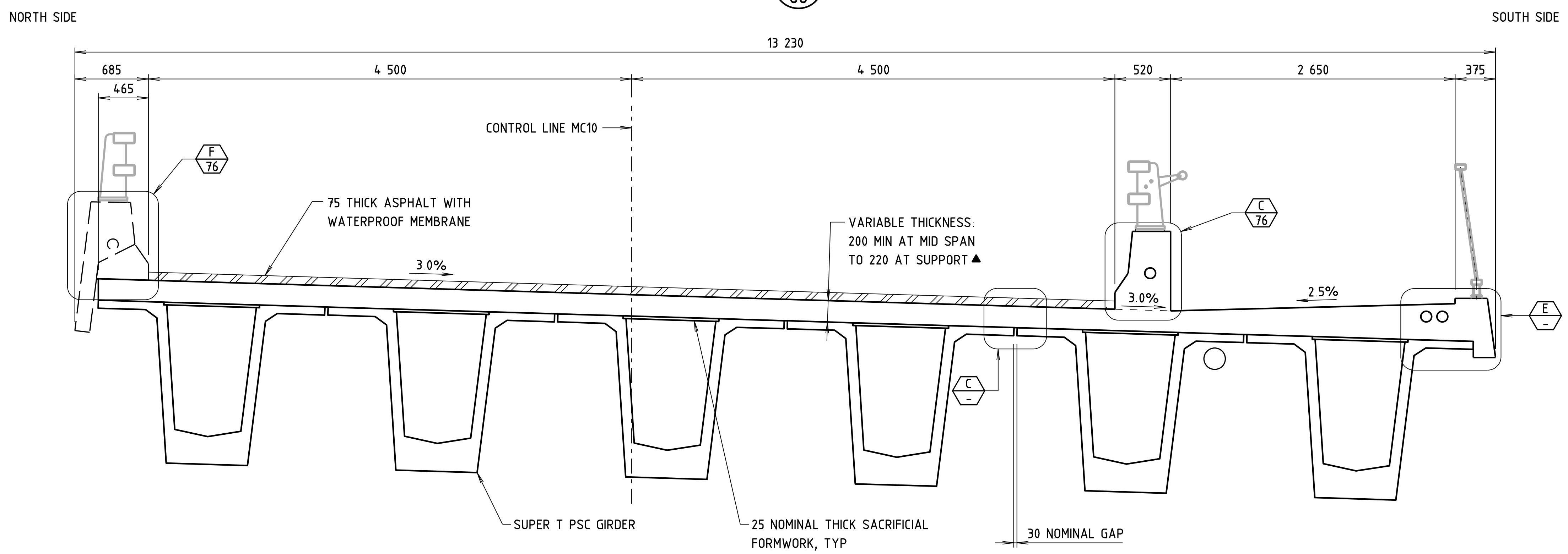

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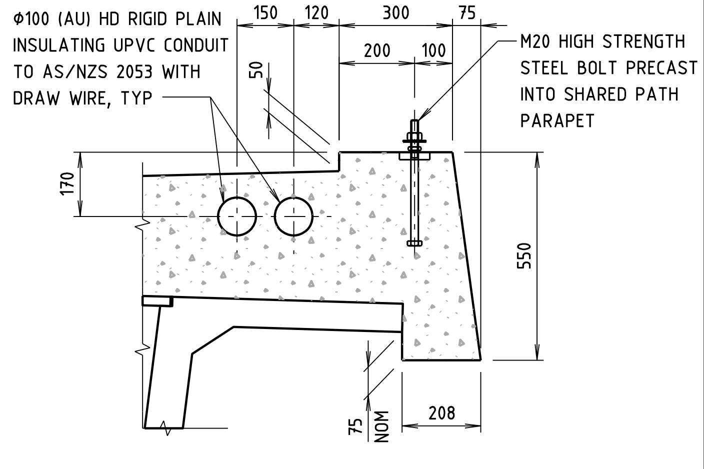

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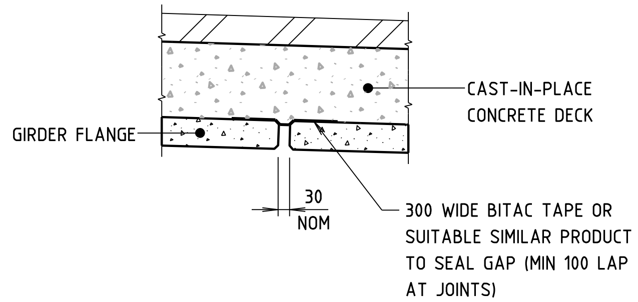

DETAIL C/–

GENERAL NOTES

SCALE 500 250 0 500 1 000 1 500mm OR AS SHOWN

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET No 66.

ISSUE	DATE	REVISION	PREP	CHECK	AUTH

MAIN ROAD No 152 — CLARENCE VALLEY LGA

BRIDGE OVER SPORTSMANS CREEK

AT LAWRENCE

DECK CONCRETE - SHEET B

NSW GOVERNMENT Transport Roads & Maritime Services

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	PREPARED	CHECKED
DESIGN	M.Cabnah	M.Siddique
DRAWING	C.Salmon MJ	M.Cabnah

S.Assi
BRIDGE ENGINEER (NEW DESIGN)

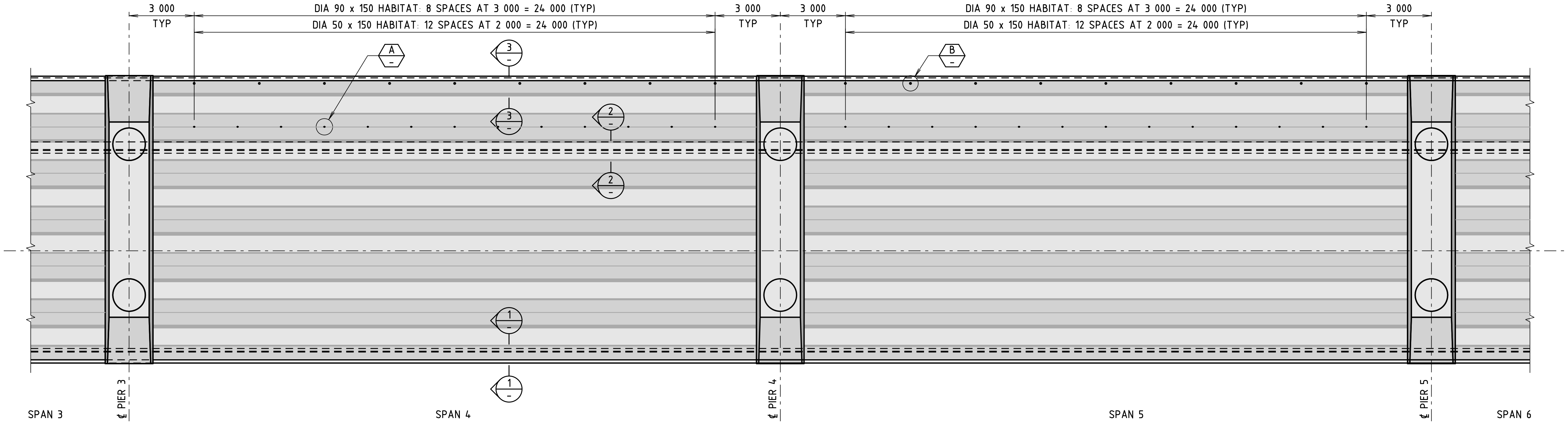
REGISTRATION No OF PLANS: DS2014/006042

BRIDGE NUMBER: 6152-BR-0008

ISSUE STATUS: FOR CONSTRUCTION

SHEET No 67 ISSUE A

CAD No D1050DCB.dgn



VIEW FROM UNDERSIDE OF DECK

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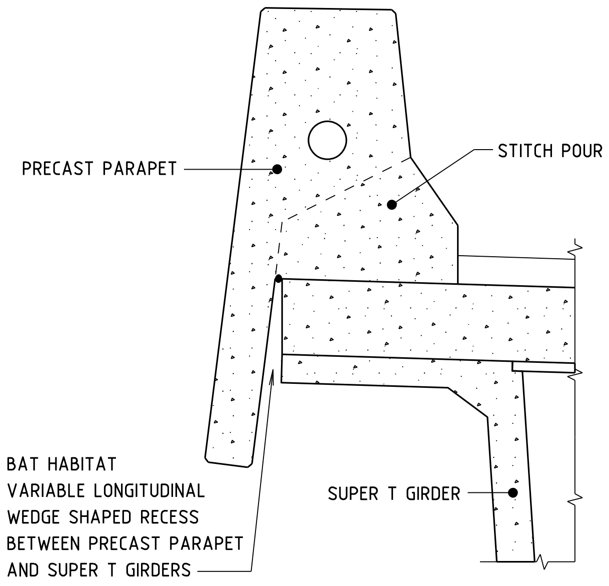

SECTION 1
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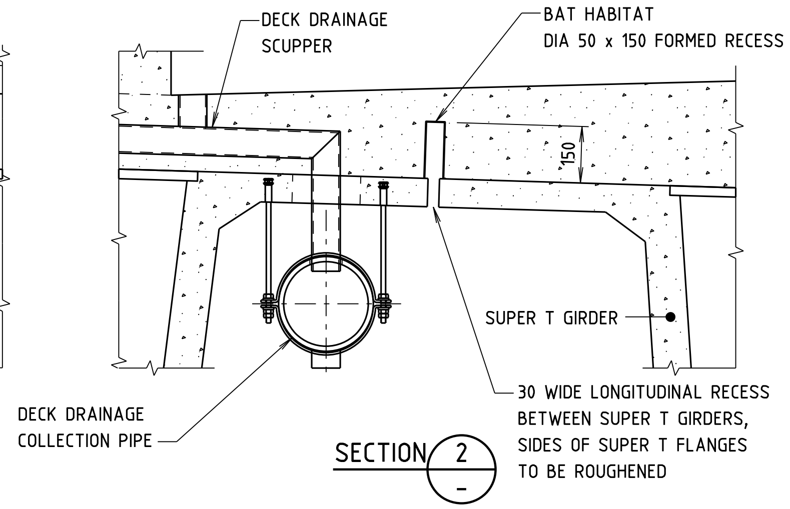

SECTION 2
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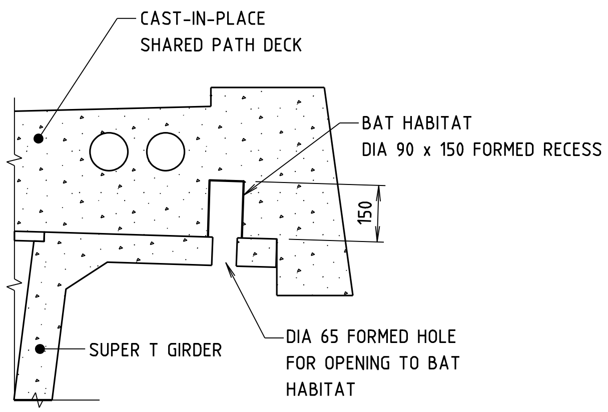

SECTION 3
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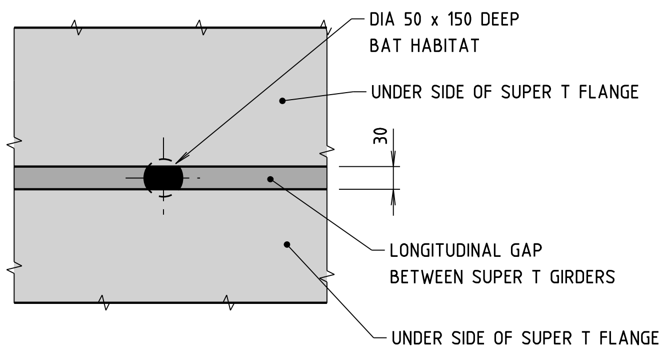

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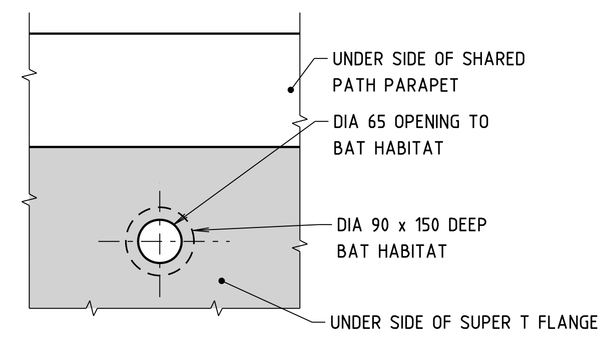

DETAIL B
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GENERAL NOTES

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ALL SURFACES FOR BAT HABITAT TO BE ROUGHENED TO A MIMIMUM TEXTURE VARIATION OF 1-2mm, ON A RANDOM OR HORIZONTAL PLANE.

ISSUE	DATE	REVISION	PREP	CHECK	AUTH

MAIN ROAD No 152 CLARENCE VALLEY LGA

BRIDGE OVER SPORTSMANS CREEK

AT LAWRENCE

BAT HABITAT PROVISIONS - SPAN Nos 4 AND 5

NSW GOVERNMENT Transport Roads & Maritime Services

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PREPARED	CHECKED	
DESIGN M. Cabnah	M. Siddique	REGISTRATION No OF PLANS DS2014/006042
DRAWING MJ	M. Cabnah	BRIDGE NUMBER 6152-BR-0008
S. Assi BRIDGE ENGINEER (NEW DESIGN)		ISSUE STATUS: FOR CONSTRUCTION
		SHEET No 79 ISSUE A

CAD No D1050BAT.dgn

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Appendix J

Microbat management plan

Microbat management plan

Sportsmans Creek Bridge removal, Lawrence

March 2016

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1 Microbat management plan

1.1 Aim and objective

The objective of the microbat management plan (MMP) is to minimise impacts to the Sportsmans Creek Bridge Large-footed Myotis (*Myotis macropus*) population while removing the existing timber bridge (the proposal). The management measures proposed are based on the methodology, observations made and outcomes achieved during similar work to concrete culverts and bridge projects.

More specifically, the MMP aims to:

- Provide advice for construction personnel on how to manage microbat conflicts during building work.
- Reduce potential for microbat injury or mortality.
- Avoid disturbances to breeding microbats.
- Provide exclusion techniques and management.

Compensatory breeding roosting habitat for Large-footed Myotis would be incorporated into the new concrete bridge and available for use by microbats before the start of exclusion and removal of the existing timber truss bridge.

Refer to the *Species Impact Statement: Sportsmans Creek Bridge removal, Lawrence* (GeoLINK 2016) for further information on the proposal, subject Large-footed Myotis population and compensatory roost habitat.

1.2 The approach

In general, management measures involve the following main components:

1. Monitor microbat numbers at the timber truss Sportsmans Creek Bridge and new concrete Sportsmans Creek Bridge.
2. Install temporary bat boxes under the timber truss Sportsmans Creek Bridge as a management tool.
3. Exclude microbats from the timber truss Sportsmans Creek Bridge and transfer occupied bat boxes to the new bridge prior to removal of the timber truss bridge.
4. Monitor.
5. Implement corrective actions if necessary.

Flexibility is required during the microbat exclusion process as well as during monitoring. The ecologist may determine that additional mitigation actions are required. In this section, an 'ecologist' refers to a person with:

- Minimum three years' experience working as an ecologist with extensive microbat experience.
- An OEH NPWS scientific licence and Animal Care and Ethics Committee approval.
- Current Lyssavirus vaccinations.

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, the need for additional exclusion or timing of exclusion to be changed etc.

The approach has been formulated from GeoLINK's previous experience with microbats and similar Roads and Maritime projects. Projects that GeoLINK have been involved in that have increased Roads and Maritime's understanding about Large-footed Myotis include Binna Burra culvert, Marom Creek culvert, McFarlane Bridge and Mororo Bridge.

2 Roost exclusion

Staged microbat exclusion from the timber truss bridge would be carried out following the building of the new bridge and prior to removal of the timber truss bridge to ensure that no microbats are able to gain access to the underside of the timber truss bridge. The aim is to have the existing timber truss bridge completely free of roosting microbats prior to bridge removal. An ecologist would be engaged to help manage and provide advice throughout the exclusion and bridge removal process. If microbats are present within the timber truss bridge, staged exclusion of the whole bridge is required.

2.1 Timing

Exclusion must be carried out outside the breeding season for the Large-footed Myotis (October to mid-April inclusive). Exclusion may therefore occur only from May to September (inclusive). Exclusion installation programming would allow for some flexibility (ie. 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.

Ten bat boxes with four chambers each would be installed below the timber truss bridge decking a minimum of one month prior to exclusion.

Staged microbat exclusion would be employed if >50 microbats are present. If <50 microbats are present, exclusion could be carried out to the whole bridge concurrently after dusk fly out. Depending on the distribution of microbats within Sportsmans Creek Bridge and the number of individuals present immediately prior to removal, exclusion would affect:

- A maximum of 35% of the population at a time if >150 individuals are present, with a minimum week period between these exclusion events.
- A maximum of 50% of the population at a time if >50 to 150 individuals are present, with a minimum week period between these exclusion events.

The potential for injury and death to microbats would be much higher during the breeding period due to the presence of dependant young and/or juveniles. Dependant young are less likely to vacate the roost and there is a high risk that juveniles would be abandoned in the roost by adults. There is a high risk that attempts to remove juveniles from the roost are more likely to result in death or injury due to stress. Exclusion of microbats outside of the breeding season therefore reduces potential impacts on dependant young and/or juveniles.

2.2 Methodology

The exclusion process would include the following stages:

1. Install temporary microbat roosting habitat below the timber truss bridge decking in the form of ten bat boxes with four chambers each, a **minimum** of one month prior to exclusion.
2. Install exclusion devices on sections of the bridge without roosting microbats (eg approach spans, rotted timber girder ends, potential roost sites in pier cavities). This would occur following inspections by an ecologist to confirm no microbats are present. The ecologist would ensure the exclusion is impenetrable for microbats before starting further exclusion work.
3. Exclude microbats from the remainder of the bridge potentially in stages depending on the number of microbats present (refer to Section 2.1).

   The ecologist would inspect the subject section of the bridge from a barge with scaffolding prior to installing the exclusion. Installation of exclusions in areas with no microbats or small groups of bats (<20) may occur during the day following removal of the microbats by the ecologist.

Installation of exclusions in areas with larger groups of bats (>20) or where smaller groups were not able to be removed would be carried out at night. Once the microbats have flown-out or are removed by the ecologist and the subject section of the bridge is confirmed to be bat free (following inspection with an inspection camera, torch and/or thermal imagery device), the exclusion can be installed, accompanied by ongoing inspection by the ecologist to ensure no microbats enter the exclusion area.

After the first night of exclusion when roosting microbats have been displaced, the ecologist would return to the 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 removed and released if still dark, or held until they could be placed into the bat boxes on the existing timber truss bridge, the bat habitat on the new bridge, or held for release the following evening.

When exclusion installation is carried out at night, the exclusion would be removed the following morning to allow inspection to ensure no microbats were trapped or were able to penetrate the exclusion. The exclusion would then be replaced.

By the end of this stage, the below deck area of the bridge should be effectively impenetrable for microbats, with only the temporarily installed bat boxes remaining accessible to the bats. The bat boxes may be moved around the bridge during the exclusion process and used as a tool to manage the location of bats while the exclusion is being installed.

4 Transfer occupied bat boxes from the timber truss bridge to the new bridge. The rate and timing of the transfer would follow advice from the ecologist and depend on the rate of microbat uptake on the new bridge. Should small numbers (<20 per bat box) of microbats be occupying the bat boxes, the base would be covered and sealed with a non-transparent breathable material (eg fabric), removed and installed directly onto the new bridge provided the process does not result in significant harm or stress to resident bats (eg from significant noise and vibrations).

Should large numbers (>20 per bat box) of microbats be present, the relocation would occur at night once the bats have flown out. If temporary bat boxes are used during the relocation process, the ecologist would assess the need to relocate the temporary bat boxes onto the new bridge.

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 bats in torpor and the need for the exclusion to be delayed, etc.

The ecologist would also need to identify if individual bridge structures (eg with deep cavities that would not be able to be confidently inspected to ensure they are free of bats) need to be fitted with a one-way exclusion device that allows bats to escape but not re-enter, prior to installing the non-penetrable exclusion which covers large sections of the bridge (*note: based on existing information of microbat usage at the site, this is unlikely to be necessary*).

The exclusion would aim to effectively seal/wrap the underside of the bridge to prevent microbat access using predominantly industrial plastic which bats are unable to grip onto (refer to Plate 2.1 and Plate 2.2), with only the temporarily installed roosting habitat remaining accessible. Other materials such as expandable foam and timber may also be used. If expandable foam is used (particularly at night), exposed areas would be covered 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 in place throughout the exclusion/bridge removal period.

Systematic inspection of both bridges would be carried out the morning prior to starting exclusion installation and the morning following each exclusion stage where >20 bats have been displaced to document microbat numbers and roost locations. Both bridges would be re-inspected prior to commencing removal and, prior to the start of the Large-footed Myotis breeding season (October to mid-April inclusive) if removal is proposed during the breeding season, to ensure no microbats are roosting on the timber truss bridge. The need for an ecologist to inspect the existing timber truss bridge and bridge timber sections during bridge removal would be determined upon completion of the exclusion process.

Plate 2.1 Effective plastic microbat exclusion installation at McFarlane Bridge, a similar structured timber bridge

Underneath is a single sheet of plastic with small holes to allow drainage. At the piers, smaller sheets of plastic hang down from the decking between the corbels and stringers to 'seal' the exclusion.

Plate 2.2 McFarlane Bridge microbat exclusion viewed from side-on

Timber was placed to cover the gaps between the stringers and transverse decking. This could be carried out in preparation for installation the plastic exclusion sheeting.

3 Contingency measures

3.1 Adaptive procedures

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 pace of the work, or results of inspections and monitoring. 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 is to facilitate the identification of the best course of action for the particular situation, including time and logistical constraints, as well as the biological constraints posed by the bats. This would require open communication between the work supervisor, project manager, Roads and Maritime environmental officer and an ecologist.

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, an OEH NPWS 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 and either:

- Relocated into the compensatory roosting habitat on the new bridge (preferred option).
- Relocated into the bat boxes on the timber truss bridge.
- Housed in a suitable location for nocturnal release on the evening/ night following capture.

The ecologist would determine the most appropriate option, giving consideration to the animal's welfare.

Bags containing microbats would be hung in a cool, dry place off the ground, preferably within a wire box, like a cat carry cage for safety. Microbats housed in this way can be taken off site if required. Microbats of the same species would be housed together with no more than five in any one bag. In the unlikely event that other species are captured, large bats (head and body 75-95 millimetres) would not be grouped with smaller bats (head and body <75 millimetres) as some larger species predate on smaller species. The ecologist is responsible for releasing the microbats in the evening at the site.

Housed microbats awaiting nocturnal release or relocation into the compensatory roosting habitat or bat box would be hung in a dry and undisturbed place out of the direct sun. Microbats would be kept in a cool, shaded environment (< 25 ^{o}C) and be assessed for heat stress as required. If temperatures exceed 30 degrees, a cooler location within a local building would be sort.

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 if it is likely to be successful. The longest anticipated holding time for microbats is 16 hours.

Note: *Any microbats captured during the work must be released at the site (ie released at Sportsmans Creek Bridge not released elsewhere within the study area or locality).*

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 Roads and Maritime's work supervisor, project manager and environmental officer 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 bat/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 Roads and Maritime.

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 Roads and Maritime 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 (eg 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 ie WIRES, ecologist or Roads and Maritime 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 (eg 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).

3.5 Roles and responsibilities

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 MMP.

Roads and Maritime 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. Roads and Maritime or the construction contractor would carry out daily bat checks prior to the commencement of work to ensure that microbats had not penetrated the exclusion devices or were roosting in exposed/unsafe locations. Any resident bats would be captured by the ecologist by hand and released in accordance with Section 3.2. Roads and Maritime and the ecologist would communicate proactively with the work supervisor and Roads and Maritime environmental officer if work needs to cease, be modified and/or to report all observations.

The ecologist is to provide guidance to Roads and Maritime such that the aims of the MMP are achieved and impact to microbats is minimised. Any decision relating to Roads and Maritime 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 Roads and Maritime's work supervisor, project manager and environmental officer immediately. Work may need to stop in the area of the find.

4 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 on the existing timber truss bridge. Baseline data would also include establishing data for McFarlane Bridge pre-exclusion of the timber truss bridge at Sportsmans Creek.
- Determining whether the proposal has been successful in relocating the subject Large-footed Myotis breeding colony from the existing timber truss bridge to the new bridge and thus avoiding a significant impact on the local population.
- Identifying whether and how the microbat management safeguards of this report have been implemented and their success.
- Identifying the need to implement additional contingency measures in consultation with Roads and Maritime and OEH to minimise impacts to the subject Large-footed Myotis colony should relocation to the new bridge not be successful.
- Providing further recommendations for consideration on future projects with similar impacts on threatened microbats.

The proposal would be considered successful if a significant proportion of Large-footed Myotis relocate to the new bridge and utilise the compensatory habitat as a breeding site. A significant proportion is regarded as 65% of the Large-footed Myotis numbers present from the baseline data collected at Sportsmans Creek Bridge recorded throughout the year pre-exclusion. The exact numbers are difficult to define as the estimated local population of about 300 bats previously observed is only based on two surveys in December 2013 and February 2014. Environmental variability and natural fluctuations would be considered when establishing baseline population numbers as well as quantifying the overall success of the project.

Throughout the monitoring and implementation of the proposal, the ecologist would be responsible for identifying the need to trigger and implement contingency/corrective measures, as outlined in Table 4.1. The monitoring strategy focuses on uptake by Large-footed Myotis of the new bridge with monitoring of alternative roosts within 10 kilometres (refer to drainage structures nominated for contingency monitoring in Table C.3 in Appendix C of the SIS) as a contingency measure only triggered if new bridge is not occupied by a significant proportion (>65%) of the subject Large-footed Myotis colony once exclusion has taken place on the existing timber truss bridge, and further information is required to determine success of the project. A reduction in numbers breeding on the new bridge may not mean a significant impact to the local population.

The results of each monitoring phase would be emailed to the Roads and Maritime project manager, environmental officer, and Environment Branch biodiversity specialist along with a summary of key outcomes/findings to date. A comprehensive report would be provided upon completion of the monitoring program.

Table 4.1 Monitoring schedule

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
Pre exclusion	Develop baseline data of the Large-footed Myotis population numbers over the 12 month period prior to exclusion at the existing timber truss Sportsmans Creek Bridge. Identify any uptake of the compensatory roosts on the new bridge prior to excluding the colony on the existing timber truss bridge.	Direct inspection of the entire existing timber truss bridge using torch and pole mounted camera from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land; documenting: • Species present. • Locations of roosting microbats. • Total number of individuals and groups per occupied roost site. • Locations of roosting microbats. • Description of occupied roost sites. • Breeding status of the colony, including approximate adult to juvenile ratios. Monitoring during this period would extend to the new bridge, if built, using the same methodology. Where alternative monitoring methodologies are proposed, the feasibility and practicality of them would be assessed and approved by Roads and Maritime in consultation with OEH.	Key seasonal times (winter, spring, summer/autumn) prior to exclusion. For one monitoring event per season.	N/A
Pre exclusion	Develop baseline data of Large-footed Myotis numbers in other local drainage structures prior to exclusion.	Drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge (plus McFarlane Bridge) would be monitored to record baseline data of microbat numbers within the locality prior to commencing exclusion (refer to Table C.3 of Appendix C of the SIS).	Key seasonal times (winter, spring, summer/autumn) prior to exclusion. For one monitoring event per season.	N/A

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
During exclusion	Monitor Large-footed Myotis roosting behaviour response to exclusion activities. Document exclusion activities and outcomes to identify the effectiveness of exclusion activities.	Direct inspection of the entire existing timber truss bridge and new bridge (targeting the compensatory habitat). Methodology as for pre exclusion monitoring or otherwise approved by Roads and Maritime in consultation with OEH.	• Prior to commencement of exclusion installation. • The morning prior to installing each exclusion stage where >20 bats are displaced. • The morning following installing each exclusion stage where >20 bats are displaced.	Following initial displacement of microbats from the bridge, if >20 microbats or 65% (based on pre-exclusion numbers) are not locatable in the compensatory roosting habitat on the new bridge or remaining available habitat in the timber truss bridge, the ecologist is to investigate the whereabouts of the microbats (breaches in the exclusion, inspect other drainage structures within a 10 kilometre radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C of the SIS) as well as additional management measures. This may include: • Modifying the compensatory roosting habitat. • Installing additional compensatory roosting habitat on the new bridge. Reviewing and modify the exclusion method (eg reducing the rate and extent of bridge excluded during each exclusion stage).
During exclusion	Record Large-footed Myotis numbers in other local drainage structures during exclusion if >20 microbats or 65% of microbat numbers (based on pre-exclusion numbers)	Inspect the drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C of the SIS) via direct inspection and document Large-footed Myotis roosts and bat numbers.	• As required during exclusion. • Prior to commencement of exclusion installation. • The morning following	Contingency measures as listed above.

Monitoring phase	Objective	Monitoring effort	Timing and frequency	Contingency triggers and potential measures
	are not locatable in the compensatory roosting habitat on the new bridge or remaining available habitat in the existing timber truss bridge.		installing each exclusion stage where >20 bats are displaced.	
Post exclusion	Document Large-footed Myotis population numbers within the new bridge over the 12 month period post exclusion.	Direct inspection of the new bridge (targeting compensatory roosting habitat). Methodology as for Pre-exclusion Monitoring or otherwise approved by Roads and Maritime in consultation with OEH.	Year 1 post exclusion: Key seasonal times (winter, spring, summer/autumn) for 12 months post exclusion for one monitoring event per season. Year 2 and 3 post exclusion: One monitoring event during the breeding season (summer/autumn).	Should <65% of microbats be present in the new bridge the ecologist is to investigate the whereabouts of the bats (inspect other drainage structures within a 10 km radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C of the SIS), as well as additional management measures. This may include the following measures: • Modifying the compensatory roosting habitat. • Installing additional compensatory roosting habitat on the new bridge. • Extend monitoring.
Post exclusion	Record Large-footed Myotis numbers in other local drainage structures post exclusion.	Inspect the drainage structures that support potential microbat roost features within a 10 km radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C) via direct inspection and document Large-footed Myotis roosts and bat numbers.	One event within one week of completion of exclusion installation and seasonal basis ONLY if required (see trigger).	Should <65% of microbats be present in the new bridge, the ecologist is to investigate the whereabouts of the microbats. If 65% of the microbats are not recorded within the drainage structures within a 10 km radius of Sportsmans Creek Bridge (refer to Table C.3 in Appendix C of the SIS), then surveys would also be carried out on McFarlane Bridge.

4.1 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 Roads and Maritime environmental officer for the project. The Roads and Maritime project manager and work supervisor would be informed throughout the implementation of the safeguards of this report. A log would be maintained of the decisions made and installation of exclusion devices to be included in formal monitoring reporting.

Table 4.2 Summary of management actions

Management measure	Details	Timing	Performance indicators	Responsibility
Monitor Large-footed Myotis numbers	Direct inspection of the entire existing timber truss bridge using torch and pole mounted camera from a boat with scaffolding at spans/piers over water; and a ladder at spans/piers over land; documenting: • Species present. • Locations of roosting microbats. • Total number of individuals and groups per occupied roost site. • Description of occupied roost sites. • Breeding status of the colony, including approximate adult to juvenile ratios. Monitoring during this period would extend to the new bridge, if built, using the same methodology. Where alternative monitoring methodologies are proposed, the feasibility and practicality of them would be assessed and approved by Roads and Maritime Services in consultation with OEH.	Quarterly throughout the year pre-exclusion. Key seasonal times (winter, spring, summer/autumn) prior to exclusion. For one monitoring event per season.	Accurately record numbers within existing timber truss Sportsmans Creek Bridge.	Ecologist
Provision of compensatory habitat	Compensatory breeding roosting habitat for the Large-footed Myotis would be incorporated into the new concrete bridge and available for microbat usage prior to the commencement of exclusion and removal of the existing timber truss bridge. Compensatory roosting habitat is discussed further in the *Species Impact Statement: Sportsmans Creek Bridge removal, Lawrence* (GeoLINK 2016).	During construction of the new bridge. At least three months prior to removal of existing timber truss bridge.	The new bridge is occupied as breeding roosting habitat by a significant proportion of the subject Large-footed Myotis colony upon completion of exclusion from the existing timber truss bridge. A significant proportion is regarded as 65% of the Large-footed Myotis numbers present from the baseline data recorded throughout the year pre-	Roads and Maritime construction team are responsible for provision of compensatory habitat. Ecologist is responsible for determining the significant proportion of

Management measure	Details	Timing	Performance indicators	Responsibility
			exclusion.	Large-footed Myotis.
Site induction	All construction personnel involved with bridge exclusion and removal would be trained regarding their responsibilities, signs of and how to search for microbats, what to do if microbats are encountered and personal safety practices.	Prior to existing timber truss bridge removal.	All relevant construction personnel receive, understand, signoff and adhere to the requirements of the MMP.	Construction manager
Staged microbat exclusion	Refer to Section 2.	• Following completion of the new bridge. • Between the months of May and September. • Prior to removal of the existing timber truss bridge. • A minimum of one month after installation of ten bat boxes with four chambers each below the existing timber truss bridge.	• Microbats completely excluded from the existing timber truss bridge prior to removal. • Exclusion carried out outside the Large-footed Myotis breeding season which is October to mid-April inclusive. Exclusion may therefore **occur only from May to September (inclusive)**. • No or very low morality/injury occurs as a result of exclusion. • The new bridge is occupied as breeding roosting habitat by a significant proportion of the subject Large-footed Myotis colony upon completion of exclusion from the existing timber truss bridge. Note: Sportsmans Creek Bridge population is considered a single population (the local population) being the subject Large-footed Myotis colony.	Roads and Maritime, contractors and ecologist

Management measure	Details	Timing	Performance indicators	Responsibility
Exclusion monitoring	Post exclusion installation and prior to commencement of bridge removal, exclusion monitoring and inspection would be carried out following any weather events that may compromise the exclusion (such as significant rain or strong winds). Any damage to the exclusion would be rectified, following ecologist inspection for microbats and input where needed.	As required post exclusion installation and prior to commencement bridge removal.	Bridge and exclusion monitored and maintained as required following significant weather events.	Roads and Maritime and ecologist where required.
Daily inspections during existing timber truss bridge removal	Work areas would be inspected daily during existing timber truss bridge removal, including: • Morning inspections to ensure exclusion is intact and no potential microbat breaches have occurred. An ecologist would carry out inspections if potential exclusion breaches have occurred. • Afternoon inspections carried out to ensure the exclusion is functional at the end of each day to prevent microbats accessing the bridge at night.	Daily during existing timber truss bridge removal.	• Exclusion inspected and remains intact. • Ecologist inspects bridge if potential exclusion breaches have occurred and provide appropriate management advice/actions if microbats are present.	Roads and Maritime, contractors and ecologist
Vet/ WIRES contact details	Injured fauna would be taken to WIRES. The contact details of WIRES (Clarence Valley – 02 6643 4055) would be known to the microbat exclusion and bridge removal work supervisor, and the ecologist.	Throughout exclusion and bridge removal work.	• Contact details of WIRES known to microbat exclusion and bridge removal work supervisor, and the ecologist. • Injured microbats are promptly collected and cared for.	Contact details of WIRES known to bat exclusion and bridge removal work supervisor, and the ecologist.
Monitor Large-footed Myotis numbers	Direct inspection of the new bridge (targeting compensatory roosting habitat). Methodology as for pre-exclusion monitoring.	Year 1 post exclusion: Key seasonal times (winter, spring, summer/autumn) for	• Accurately record numbers and breeding events within the new Sportsmans Creek Bridge. • Determine need for	Ecologist

Management measure	Details	Timing	Performance indicators	Responsibility
		12 months post exclusion. Year 2 and 3 post exclusion: One monitoring event during the breeding season (summer/autumn).	contingency triggers and measures (refer to Table 4.1).	

5 Certification

	Name	Signature	Date
Prepared by	Veronica Silver	V. Silver	07/09/2015
Reviewed by	David Andrighetto	DAndrighetto.	07/09/2015

UPR	Description	Date Issued	Issued By
2465-1013	Version 1	07/09/2015	Veronica Silver
2465-1015	Version 2	13/10/2015	Veronica Silver
2465-1025	Version 3	25/01/2016	Veronica Silver
2465-1027	Version 4	03/03/2016	Veronica Silver
2465-1032	Version 5	12/03/2016	Veronica Silver

Appendix A

Field data proforma

Table A1 Existing timber truss Sportsmans Creek Bridge baseline data monitoring

Roost no.	No. of bat clusters	No. of bats in each cluster	Species	Status (eg. adults, juveniles, furred/ unfurred)	Span no.	Roosting habitat	Timber no.	Gap size (mm)	Temp. (^{o}C)	Humidity (%)	Other comment

Table A2 Daily inspection checklist of exclusion (during removal of existing timber truss bridge)

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

Table A3 Sportsmans Creek new bridge monitoring

Ref. no.	Span no. (1, 2, 3 etc)	Super-T no. (ie. A, B, C etc)	Roosting habitat (parapet, girder join, walkway Super-T join void or walkway join)	No. of bat clusters	No. of bats in each cluster	Species	Status (eg. adults, juveniles, furred/ unfurred)	Guano	Staining/ bat bugs	Temp (^{o}C)	Humidity (%)	Comments

Table A4 Alternative drainage structure contingency monitoring

Ref. No.	Lat	Long	Feature (CPC, RCBC etc)	No. of cells (culverts only)	Cell diameter (mm)	Microbat roosting features	Guano	Staining	Species present	No. of bats	Comment

rms.nsw.gov.au/xxxxx

13 22 13

Customer feedback
Roads and Maritime
Locked Bag 928,
North Sydney NSW 2059

Month 201X
RMS XX.XXX
ISBN: XXX-X-XXXXXX-XX-X

Appendix K

Curricula vitae of personnel contributing to SIS

curriculum vitae

Veronica SILVER

BEnvSc, Grad Dip (UrbRegPlan)

Senior Associate / Ecologist / Planner

Qualifications

Bachelor of Environmental Science (Environmental Management),
The University of Newcastle, [2000]
Graduate Diploma of Urban and Regional Planning, The University of New England, [2007]
Graduate Diploma in Bushfire Protection, University of Western Sydney [currently studying]

Professional Affiliations

Member, Planning Institute Australia
Member, Environment Institute of Australia and New Zealand
Member, Ecological Consultants Association of NSW Inc
Member, Australian Network for Plant Conservation Inc

Professional Short Courses

- Planning for Bushfire Prone Areas
- Certificate IV Bushland Regeneration
- Certificate IV Workplace Training and Assessment
- Certificate II Australian Land Conservation and Restoration
- Project Management, Chifley Business School
- Effective Communication, Negotiation and Mediation, Chifley Business School
- Urban Design, Chifley Business School
- Acid Sulfate Soils: Identification, Assessment and Management
- Woodland Birds Identification and Ecology
- Signed English, TAFE Newcastle

Licences

- Scientific Licence (SL100152) issued by the Office of Environment and Heritage
- Animal Research Authority issued by the Animal Care and Ethics Committee of the Director-General of NSW Department of Primary Industries to undertake fauna surveys throughout NSW and SE Queensland

Certificates

- WHS Construction Induction Training Certificate
- Work Safely at Heights
- Enter and Work in Confined Spaces
- RailCorp Rail Industry Safety Induction
- ARTC National Track Safety Awareness

Experience

Veronica has been a key member of GeoLINK's ecology team since 2004. She specialises in flora/ fauna field surveys; ecological monitoring; bushfire assessment; environmental impact assessment and bushland regeneration. Veronica diversified her skills and knowledge in the built environment by completing a Graduate Diploma of Urban and Regional Planning through The University of New England in 2007, and is currently undertaking a Graduate Diploma of Bushfire Protection.

Veronica possesses high level project management skills, developed through working with a broad range of public and private sector clients on challenging environmental projects. Having project managed a variety of ecological and planning projects; she has significant skills in liaison and the management of multidisciplinary teams.

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Key Skills

- Peer reviewing ecological assessments.
- Managing GeoLINK's ecological team.
- Undertaking detailed systematic terrestrial flora / fauna surveys and vegetation / weed mapping.
- Preparing high quality ecological / environmental impact assessments for a broad range of projects in accordance with NSW, QLD and Federal environmental legislation.
- Preparing vegetation management plans and environmental management plans.
- Preparing bushfire hazard assessments.
- Preparing EIA reports including Statements of Environmental Effects, Environmental Impact Statements and Reviews of Environmental Factors.
- Delivering environmental awareness presentations.

Key Projects

Ecology

Veronica has been project manager for many ecological projects which have focused on management or monitoring of both flora and fauna. She has planned and undertaken extensive surveys for many species, including Hairy Joint Grass (*Arthraxon hispidus*), Oxleyan Pygmy Perch (*Nannoperca oxleyana*), Giant Barred Frog (*Mixophyes iteratus*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Koala (*Phascolarctos cinerus*) and Platypus (*Ornithorhynchus anatinus)*. Example projects include:

- Assessment of impacts on the Platypus resulting from lowering of water levels in Byron Creek due to the partial failure of Bangalow Weir (client: Byron Shire Council).
- Statement of Environmental Effects for the Oxleyan Pygmy Perch Habitat Regeneration Project (client: Richmond Valley Council).
- Ecological assessment at Clunes for the purposes of the Clunes Community Recycled Water Irrigation Scheme. The assessment provided baseline data on ecological attributes of the site, identified ecological constraints to the irrigation of recycled water and identified opportunities for rehabilitating the site (client: Lismore City Council).
- Lake Macquarie City Council Local Environmental Study - undertake ecological surveys to identify opportunities and constraints of a parcel of land which will inform a local environmental study (client: Lake Macquarie City Council).
- Maclean Flying-fox Management Strategy - undertake background research, liaison with the working group, recommend management actions for short, medium and long term and public consultation (client: Office of Environment and Heritage).

Environmental Impact Assessment

Veronica has prepared various Statement of Environmental Effects, Review of Environmental Factors, Part 3A Environmental Assessments and Environmental Impact Statements for projects including road and power line infrastructure, residential and industrial subdivision, educational establishments and quarries.

- Expert ecologist acting for Lismore City Council in Land and Environment Court case regarding Koalas for a proposed subdivision (client: Lismore City Council).
- Petersons Quarry Expansion Environmental Impact Statement (client: Richmond Valley Council).
- Review of Environmental Factors relating to bank stabilisation works on two severely eroded sections of the Brunswick River and rehabilitation works to reintroduce tidal inundation to the degraded oxbow off the Brunswick River at Mullumbimby (client: Byron Shire Council).
- Ecological assessments of proposed infrastructure at public schools throughout the North Coast and Mid-North Coast for the 'Building the Educational Revolution' project (client: REED).
- Assessment of power line installation at over 20 sites in Hastings Point, Coffs Harbour, Chambigne, Fortis Creek, Lennox Head, New Italy, Pretty Gully, Brunswick Heads, Cudgen and Byron Bay; preparation of Review of Environmental Factors including assessment of air, noise, water, acid sulfate soils, flora and fauna impacts (client: Essential Energy).
- Preparation of file notes, minor works Review of Environmental Factors and major works Review of Environmental Factors including assessment of Pacific Highway upgrades at New Italy, Shark Creek, Byrons Lane, Nortons Road, Nutmac, Binna Burra and Pimlico including community liaison, heritage assessment (European and Aboriginal), flora and fauna assessments (client: Roads and Maritime Services (RMS)).
- Preclearing assessments and monitoring at Franklins Road and Nortons Lane (client: RMS).
- Assessment of bridge upgrade works at Tabulam, Kemspey, Woolgoolga, Wardell, Harwood, Korns Crossing Bridge and Sportsmans Creek Bridge (client: RMS).
- Assessment of culvert replacements at Ten Mile Creek; Tenterfield, Seccombes Gully; Lismore and Middle Bend; west of Grafton (client: RMS).

Planning

- Preparation of Section 96 Modification for Ballina Shire Council industrial subdivision.
- Preparation of Statement of Environmental Effects and Development Application for new Richmond Valley Council works depot and removal of the existing Council works depot within the Evans Head Memorial Aerodrome curtilage.
- Preparation of a Statement of Environmental Effects and Development Application to expand coffee plantation, Newrybar.
- Preparation of a Statement of Environmental Effects and Development Application to undertake ecological enhancement works for acid frog habitat, Byron Bay.

Bushfire Assessments

- Bushfire hazard assessment of subdivision at Pacific Pines, Lennox Head
- Bushfire hazard assessment of community title proposal, Byron Bay
- Bushfire hazard assessment of subdivision at Durness Station, Tea Gardens
- Bushfire hazard assessments of proposed infrastructure at public schools throughout the North Coast and Mid-North Coast for the 'Building the Educational Revolution' project
- Bushfire hazard assessment of rezoning proposal for Local Environmental Study, Shearwater
- Assessment of bushfire protection measures for conversion of multiple-occupancy to community title (MO-CT)

Previous Employment History

September 2003 to August 2005
Ecologist
Greenloaning Biostudies

January 2003 to July 2003
Rainforest Regenerator
NSW National Parks and Wildlife Service

January 2002 to January 2003
Supervisor
Conservation Volunteers Australia

Pre 2002
Bush Regenerator / Environmental Scientist
Aspect North

Bush Regenerator
Environmental Training and Employment (Northern Rivers) Inc

Bush Regenerator / Farm Hand
Self Employed

curriculum vitae

David ANDRIGHETTO

BAppSci(EnvirResMgt)

Ecologist

Qualifications

Bachelor of Applied Science (Environmental Resource Management), Southern Cross University

Professional Affiliations

Member, Ecological Consultants Association of NSW

Other Relevant Certificates

- WHS Construction Induction Training Certificate
- RailCorp Rail Safety Induction Certificate and Rail Industry Safety Induction
- ARTC National Track Safety Awareness
- Work Safely at Heights

Experience

David has experience working as an ecological consultant, with specialist skills in environmental impacts assessment, habitat management and environmental construction management. Having worked as a project manager ecologist on a broad range of challenging environmental projects, he has gained wide experience in flora and vegetation community identification; fauna surveys; habitat evaluation; habitat clearing surveys; vegetation management plans; threatened species management plans; ecological monitoring; environmental impact assessment and biodiversity offset strategies.

David's experience includes working for both government and private clients, on infrastructure and urban development projects across the NSW North Coast, New England Tablelands and Western Plains and Slopes regions. He has quality project management skills and thorough knowledge and understanding of relevant state and federal legislation.

He has gained considerable experience in construction-site environmental consulting including managing WHS, resources, budgets and reporting. David has extensive on-site experience including construction ecological management and monitoring.

Key Experience and Skills

Environmental Impact Assessments

David has undertaken over 50 ecological and environmental assessment projects for NSW Roads and Maritime Services, predominantly as project manager. Major projects have included highway upgrades and reconstruction, utilities relocations for highway upgrades, intersection upgrades, and slip and road repairs. David has also undertaken numerous Environmental Impact Assessments for private developers and local Councils' for urban developments and growth investigations, quarries and subdivisions.

Environmental Construction Management and Ecological Monitoring

He has worked on a wide variety of construction projects, in roles including habitat and construction management advice and compliance; pre- and post-clearing surveys; spotter-catcher services; rare-plant relocation plans, implementation and monitoring; and terrestrial ecological monitoring.

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Vegetation and Threatened Species Management Plans

David has been involved in community consultation, development of vegetation management plans, flying-fox management plans, koala plans of management, microbat management plans, terrestrial ecological components of the estuarine ecological study, management study and management plan.

Key Projects

Environmental Impact Assessments

Ecological and Environmental Assessments for Road and Bridge Upgrade, Repair and Maintenance projects

The more than 50 ecological and environmental assessment projects David has undertaken for NSW Roads and Maritime Services have included Farlows Flat Pavement Reconstruction, Waterfall Way upgrade, Blackadder Curve Re-alignment, Martells Road Intersection Upgrade and Waterfall Way slip and road repairs.

Ecological Assessments for Urban and Rural Developments and Local Environmental Plans

David has been involved with numerous flora and fauna survey and impact assessments ranging from small two lot urban subdivisions, to a combined 18-hole golf course and retirement village. A sample of these projects includes:

- Coffs Harbour Airport Subdivision
- Carnegie Cove (an 18-hole golf course and retirement village) Species Impact Statement: Fauna survey and report
- Nine-lot Rural-Residential Subdivision, Coutts Crossing
- Local Environmental Study for Proposed Residential Rezoning and Development of Lot 2 DP 1091253, Beach Street, Bonny Hills
- Proposed 307-lot Residential Subdivision of Part of Lot 32 DP 809231, Phillip Charley Drive, Port Macquarie
- Proposed Effluent Irrigation Area / Sports Field on Portion of Lot 5 DP 558822, The Boulevard, Dunbogan

Environmental Construction Management

Project Ecologist - Devils Pulpit Pacific Highway upgrade

Client: John Holland Pty Ltd

Tasks undertaken included habitat and construction management advice; pre-clearing surveys; spotter-catcher services; rare-plant relocation plans, implementation and monitoring; and terrestrial ecological monitoring.

Project Ecologist - Keepit Dam Upgrade

Client: John Holland Pty Ltd

Tasks included pre- and during-clearing ecological surveys and compliance report, spotter-catcher services, and nest box monitoring.

Pre-clearing Surveys and Spotter-Catcher Services for Approximately 20 Road and Rail Infrastructure Repair Projects

Client: NSW Roads and Maritime Services, Bellingen Shire Council and ARTC

Microbat Plan of Management – McFarlanes Bridge

Client: NSW Roads and Maritime Services

This project involved the preparation and implementation of a Microbat Plan of Management to assist 18 months of construction works on McFarlane Bridge at Maclean. The bridge supports two breeding colonies of the threatened Large-footed Myotis.

Ecological Monitoring

Salty Lagoon Environmental Monitoring

Client: Richmond Valley Council

This is an ongoing (six-year) environmental monitoring project at Salty Lagoon near Evans Head, with David's involvement including terrestrial vegetation and seasonal frog monitoring, and the preparation of annual report documentation.

Devils Pulpit Pacific Highway Upgrade – Terrestrial Ecological Pre-Construction Monitoring

Client: John Holland Pty Ltd / NSW Roads and Maritime Services

The project involved refining and implementing the pre-construction monitoring for the highway upgrade to collect baseline data for subsequent post-construction monitoring.

Warrell Creek To Nambucca Heads – Koala, Giant Barred Frog and Grey-headed Flying-fox Monitoring

Client: NSW Roads and Maritime Service / Pacifico

The project involved assisting in preparation of the Koala Monitoring Plan; and undertaking Koala, Giant Barred Frog and Grey-headed Flying-fox monitoring.

Vegetation and Threatened Species Management Plans

Microbat Management Plan

Client: NSW Roads and Maritime Services

David has prepared and implemented numerous microbat management plans for bridge and culvert repair and replacement projects for NSW Roads and Maritime Services, including the 150 km Woolgoolga to Ballina Pacific Highway Upgrade Project.

Bowraville Flying-fox Management Plan

Client: Nambucca Shire Council

This project involved community consultation, development of a vegetation management plan and the overall flying-fox management plan.

Bielsdown Park Plan of Management

Client: Bellingen Shire Council

David was involved in the preparation of a Plan of Management for Bielsdown Park, Dorrigo. A Grey-headed Flying-fox camp had established in the park, and the plan aimed to resolve issues between the local community and the flying-foxes.

Terrestrial Ecological Input - Macleay Estuary Management Plan

Client: Kempsey Shire Council

David worked on the terrestrial ecological components of the Macleay Estuary Ecological Study, Estuary Management Study, and Estuary Management Plan.

Koala Plans of Management

David has prepared a number of site-specific Koala Plans of Management to satisfy the requirements of *State Environmental Planning Policy 44 – Koala Habitat Protection*. Projects have included:

- 28-lot rural-residential subdivision, Waterview Heights, Grafton
- 7-lot rural subdivision, Rodeo Drive, Kundabung
- Local Environmental Study for Proposed Residential Rezoning and Development of Lot 2 DP 1091253, Beach Street, Bonny Hills

curriculum vitae

David HAVILAH

BSc (Biol)

Ecologist

Qualifications

Bachelor of Science (Biology), Sydney University, 2003

Professional Affiliations

Member, Ecological Consultants Association of NSW
Member, NSW Wildlife Information, Rescue and Education Services Inc (WIRES-Northern Rivers)

Experience

David is an experienced ecological consultant who has developed a broad range of skills from working on a variety of small and large-scale projects. He specialises in undertaking terrestrial flora and fauna surveys and providing high quality ecological reports within Queensland and New South Wales. This work has included designing and implementing threatened species management plans and ecological monitoring programs. David has a detailed working knowledge of environmental legislation relevant to ecological impact assessment and an ability to balance practical applications of environmental requirements with good environmental outcomes.

Key Experience and Skills

A large focus of David's work has been providing ecological services on large infrastructure projects. He has been engaged as the Project Ecologist for construction contractors on a number of sections of the NSW Pacific Highway upgrade project. This work has included providing technical advice, ecological surveys and assessments and managing threatened species on these projects.

David's skills and key areas of expertise include:

- Design, implementation and management of ecological monitoring programs.
- Determining and documenting best practice and innovative management plans for threatened species occurring on infrastructure projects.
- Undertaking detailed systematic terrestrial flora / fauna surveys and vegetation / weed mapping.
- Preparing high quality ecological / environmental assessments for a broad range of projects in accordance with NSW, QLD and Federal environmental legislation.
- Preparing vegetation management plans and environmental management plans.
- Providing peer reviews of ecological assessments.
- Providing technical advice, ecological surveys and reporting in the role of project ecologist for large-scale infrastructure projects.
- Supervising and delivering pre-clearing surveys and spotter / catcher (fauna capture / relocation services) as part of large infrastructure projects.
- Delivering environmental awareness presentations.

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Selected Projects

Project Ecologist for the Tintenbar to Ewingsdale Pacific Highway Upgrade

David was engaged as the Project Ecologist for the construction stage of this project by Baulderstone Pty Ltd. This role involved working as part of the project team to deliver high level management of biodiversity associated with the project site and delivery of the project's conditions of approval relevant to ecology. This involved assisting with preparation of the Construction Environment Management Plan (CEMP), undertaking ecological surveys and assessments and providing ecological advice in relation to the project's detailed design and construction.

Extensive target threatened frog surveys were undertaken as part of this project which led to the discovery of the endangered Giant Barred Frog within the project site. Extensive liaison with government agencies was undertaken to develop a management plan and monitoring program for this species on the project. David is currently engaged by NSW Roads and Maritime Services (RMS) to monitor the ongoing health and presence of this species during and after completion of the project.

David's role on the project also involved providing ecology services including biodiversity assessment to RMS.

Project Ecologist for the Ballina Bypass Pacific Highway Upgrade

David was involved with this project for five years since the commencement of the construction stage and acted as Project Ecologist for a large portion of the project. The role involved providing high level ecological advice, surveys and assessments, as well as undertaking pre-clearing surveys and providing spotter / catcher services.

The project required provision of advice and management for a number of threatened species including the Eastern Grass Owl and Hairy Jointgrass. A detailed translocation plan was also prepared in consultation with government agencies for threatened plants occurring within the alignment.

Ecological Services for the Devils Pulpit Upgrade

David was engaged to provide ecological services on this project during the early stages of construction by John Holland which included provision of pre-clearing surveys, targeted surveys for the Green-thighed Frog and biodiversity assessments. David assisted the project ecologist (David Andrighetto-GeoLINK) with strategic advice related to the delivery of ecology services including implementation of an ecological monitoring program for the project.

Threatened Species Monitoring Program for the Shannon Creek Dam

David was responsible for the continuation of a large ecological monitoring project at the Shannon Creek Dam between 2007 and 2010. The monitoring program involved biannual monitoring of a number of threatened flora and fauna species, weeds and vertebrate pests within an area of high biodiversity. David's role was managing a large team of ecologists and field assistants to implement the monitoring program, which required extensive ecological surveys using a variety of survey techniques. This role also involved the compilation of all data collected and regular reporting of results.

The project also involved undertaking extensive pre-clearing surveys and spotter / catcher services during parts of the clearing required for the inundation area.

Environmental Management Plan for the Pacific Pines Residential Estate

David was responsible for preparing an Environmental Management Plan for the Pacific Pines Estate located at Lennox Head, NSW. This project required extensive target surveys and mapping of the distribution of the threatened flora species, Hairy Jointgrass and Square-stemmed Spike Rush as well as detailed mapping of endangered ecological communities occurring at the site. A detailed management plan was prepared in consultation with government agencies to prescribe the management and conservation of biodiversity at the site during construction and operation of the development.

Ecological Assessment for a Proposed New Bridge at Sportsmans Creek, Lawrence

David was involved in managing and undertaking flora and fauna habitat assessments for a proposed new bridge at Sportsmans Creek, Lawrence. This assessment identified potential impacts of the proposed new bridge and removal of the existing timber truss bridge which supports a large and important Large-footed Myotis breeding colony. This biodiversity assessment informed a Review of Environmental Factors and subsequently a Species Impact Statement for removal of the existing Sportsmans Creek Bridge.

Peer Review of a Terrestrial Ecology Impact Assessment for the Proposed Dunoon Dam

David was engaged by the local water supply authority, Rous Water, to undertake a peer review of an extensive terrestrial ecology impact assessment undertaken for the site of a proposed dam (Dunoon Dam). This involved undertaking a detailed review of the assessment to determine if the conclusions of the assessment were justified and that the assessment had addressed all of the requirements of relevant environmental legislation.

Ecological Surveys for a Proposed 120 km Gas Pipeline from Casino (NSW) to Ipswich (QLD)

David was involved with managing and undertaking detailed flora and fauna surveys along the proposed route of a proposed 120 km gas pipeline. This included conducting detailed surveys within the Border Ranges National Park, an area of particularly high biodiversity, over a number of weeks. Target surveys for a large number of threatened species were conducted including an intensive mammal trapping program, frog surveys, bird surveys and microbat surveys. Broad-scale vegetation mapping over this area was also prepared.

Ecological Assessment and Review of Environmental Factors for the Bruxner Highway Upgrade

David was responsible for preparing a detailed ecological assessment and REF for this upgrade which involved reconstruction and widening of a 3.6 km section of the Bruxner Highway, north-west of Tenterfield NSW. This involved undertaking intensive flora and fauna surveys of the alignment and surrounds over a week and preparing constraints and vegetation mapping. Assessment reports were prepared in accordance with the relevant environmental legislation.

Ecological Assessment for a Rail Freight Terminal, Casino

David was responsible for preparing a detailed ecological assessment for the site of a proposed rail freight terminal on the northern railway line, north of Casino (NSW). The assessment involved undertaking target surveys for locally occurring threatened flora and fauna species, vegetation mapping and wetland mapping. A detailed assessment was undertaken in accordance with the relevant environmental and planning legislation.

Professional History

2010 – present

Ecologist, GeoLINK, Lennox Head

2007 - 2010

Ecologist, Greenloaning Biostudies, Lismore.

2004 - 2007

Landscape Designer/ Gardener, Havilah Landscapes

Appendix L

Experience of primary author

Table L1 Examples of works of primary author

Report code	Project name	Report name
134-1023	PolePic Bangalow	Environmental Enhancement and Management Plan
291-188	Saul	Vegetation Monitoring Program V3
291-194	Saul	Revised Ecological Enhancement DA Version 4
371-377	Henderson	Annual report for HJG licence
717-1050	BalSC Russellton Design	Revegetation, Rehabilitation and Weed Control Plan
813-1007	RVC Petersons Quarry	Environmental Impact Statement
813-684	RVC Petersons Quarry	FINAL version of Environmental Impact Statement
885-883	RTA Ten Mile Creek REF	Review of Environmental Factors
896-635	RTA Grafton Bridge REF	Review of Environmental Factors
939-561	CE Fig Tree Hill REF	FINAL version of Review of Environmental Factors
947-968	CE Brunswick REF	FINAL version of Review of Environmental Factors
950-162	PMHC Town Centre Upgrade	Final version of Review of Environmental Factors
955-132	Petrac Pacific Pines	Seven-part part test of significance for ecological assessment
964-642	BSC Kallaroo Circuit Bund	FINAL Review of Environmental Factors Scour Protection Works
970-631	RTA Wardell Bridge REF	FINAL Review of Environmental Factors Osprey Works
997-842	Lucas Subdivision	FINAL Statement of Environmental Effects, supersedes 997918
1016-210	RTA Nambucca Lumsden Lane REF	Review of Environmental Factors
1030-825	Troppo 51 Shirley St	Ecological Assessment of Building envelope
1030-533	Troppo 51 Shirley St	Ecological Assessment report for tree removal
1031-794	BSC Mullum STP Culvert	FINAL version of Review of Environmental Factors
1048-110	RTA Woolgoolga Bridge REF	FINAL version of Review of Environmental Factors
1049-295	RTA Kempsey Bridge REF	FINAL version of Review of Environmental Factors
1050-703	Zentvelds Coffee Subdivision	FINAL version of Statement of Environmental Effects
1058-182	The Byron Regional Sport and Cultural Complex REF	Review of Environmental Factors

Report code	Project name	Report name
1058-502	Byron Regional Sport and Cultural Complex REF	FINAL Ecological Assessment
1082-226	RTA Harwood Bridge REF	FINAL Version of Review of Environmental Factors
1108-620	CE Tweed Coast Rd Cudgen REF	FINAL Review of Environmental Factors
1112-492	RTA Eureka Road REF	FINAL version of Review of Environmental Factors
1119-105	RTA Mindoo REF	Seven-part test of significance for EEC
1119-975	RTA Mindoo REF	Final version of Review of Environmental Factors
1129-702	BSC Byron Street, Bangalow Stormwater Upgrade	DRAFT Review of Environmental Factors
1140-702	RTA Tabulam Bridge File Note	Seven-part test for microbats and management plan
1140-389	RTA Tabulam Bridge File Note	FINAL file note environmental assessment for Tabulam Bridge
1147-642	RTA Middle Bend Culvert REF	FINAL version of Review of Environmental Factors
1161-749	RTA MR65 Binna Burra Retaining Wall	FINAL version of Review of Environmental Factors
1161-382	RTA MR65 Binna Burra Retaining Wall	Final version of preliminary environmental assessment report
1171-154	RVC Evans Works Depot DA	Statement of Environmental Effects for Works Depot
1193-586	Boarding House Bangalow Road DA	Revised Vegetation Management and Landscape Plan addressing consent condition 28
1198-193	Fortis Creek Ecology Assessment	FINAL version of Ecological Assessment
1204-155	RVC Aerodrome Vegetation Clearing SEE	Review of Environmental Factors
1209-737	CE Pretty Gully Powerline REF	FINAL version of Review of Environmental Factors
1227-654	RTA Sportsmans Creek Bridge File Note	File Note Assessment
1236-825	Naughton House Flora Survey	DRAFT Ecological Assessment
1252-582	RVC Works Depot Disassembly	Statement of Environmental Effects for Canteen Relocation
1254-205	RTA Bluff Point Ferry Ramp File Note	Final version of file note assessment
1259-251	Blackbutt Road Flora and Fauna Assessment	DRAFT Ecological Assessment
1273-468	RTA Imbreys - Hoffmans Culvert Rehabilitation REF	FINAL version of Review of Environmental Factors
1275-714	RTA Korns Crossing REF	FINAL version of Review of Environmental Factors

Report code	Project name	Report name
1283-435	CE New Italy Tieline REF	FINAL version of Review of Environmental Factors
1285-305	RTA Kochs Rd REF	FINAL version of Review of Environmental Factors
1287-498	RTA Meaneys Lane Culvert Ecological Assessment	DRAFT Ecological Assessment Report
1289-762	RTA Tyagarah Cycleway Minor REF	FINAL version of minor works REF
1302-425	ENSR Evans Aerodrome Ecological Assessment	FINAL Ecological Assessment
1338-648	RTA Cohens Bridge REF	FINAL version of Review of Environmental Factors
1351-533	RTA Glen Innes Drain Minor Works REF	FINAL version of Minor Works REF
1360-918	BER South West Rocks Multi-Purpose Hall	Vegetation Assessment and Desktop (Threatened Species) Assessment
1364-900	BER Chatsworth Island Library	Desktop (Ecology) Assessment
1366-101	SKM Nana Glen Railway Ecology Survey	FINAL version of Ecological Report
1369-549	RTA Grevillia Curves REF	DRAFT Review of Environmental Factors
1370-316	RTA Waterfall Way Boulder Removal	FINAL version of Review of Environmental Factors
1376-353	CE Tweed Coast Rd Pottsville REF	FINAL version of Review of Environmental Factors
1397-808	BER Dundurrabin	Vegetation and Desktop (Threatened Species) Assessments
1402-86	BER Gulmarrad	Native Vegetation Assessment
1425-503	BER Yamba	Amended Vegetation and Desktop (Threatened Species) Assessments
1427-1001	RMS Byrons Lane Slip REF	Final version of REF supersedes 1427608
1429-283	CE Whiteman Creek REF	DRAFT Review of Environmental Factors
1446-258	LCC Cullen Bridge REF	FINAL Review of Environmental Factors
1473-429	RTA Burdett Park Creek REF	FINAL Minor Works Review of Environmental Factors
1480-466	(S2W) Karangi Quarry EA	Flora & Fauna report
1484-578	KSC Macleay River Estuary Ecological Study	DRAFT Macleay River Estuary Ecological Study
1509-30	LCC Court Appeal	Joint Experts Ecological Report
1511-122	RTA Hogue’s New England REF	FINAL Version of Review of Environmental Factors

Report code	Project name	Report name
1536-302	BER Tuntable Creek Ecological Assessment	Final Ecological Assessment
1542-1006	RTA Binna Burra Culvert REF	Final Review of Environmental Factors
1542-1005	RTA Binna Burra Culvert REF	Final Bat Management Plan
1554-456	RTA Grovewood REF	FINAL Minor Works REF
1555-453	RTA Brown's Lane REF	FINAL Minor Works REF
1556-192	RTA Greenhatch Creek REF	FINAL REF
1571-869	RTA Summerland Way Culvert Repairs REF	FINAL Review of Environmental Factors
1577-550	RTA Shark Creek Riverbank Stability REF	DRAFT REF
1584-880	DECCW Maclean Flying-Fox Management Strategy	FINAL Flying-fox Management Strategy
1594-972	BER Threatened Species Assessments	Revised Evans River K-12 High School Access Road Ecological Assessment
1594-663	BER Threatened Species Assessments	Vegetation and Desktop (threatened species) assessments
1596-331	RTA Lismore-Bangalow Rd Slopes REF	DRAFT Minor Works REF
1606-330	RTA Springvale Slope REF	DRAFT Minor Works REF
1665-0	RTA Kempsey Rail Bridge Walkway REF	DRAFT REF
1675-1388	Epiq Lennox (formerly CP Pacific Pines)	Epiq Lennox Conservation Zone Management Plan v5
1675-1387	Epiq Lennox (formerly CP Pacific Pines)	Ecological Monitoring Report v1
1683-227	LCC Ruthven Bridge Microbat Assessment	Letter Report
1687-605	Seaview St Development Application	Statement of Environmental Effects
1691-753	TentSC Mount Lindesay Rd Reconstruction REF	DRAFT Review of Environmental Factors
1697-155	T2E Baulderstone	Giant Barred Frog Management Protocol
1716-756	RVC Woodburn Evans Head Road REF	FINAL REF to RVC
1879-388	RTA McFarlane Bridge Timber Works REF	FINAL RTA McFarlane Bridge Timber Works MW REF
1911-161	MCC Lorn Flying Fox Management Strategy	Draft Flying-fox Management Strategy
1930-1006	RMS Maclean Slip Ecological Inspection	FINAL version of Minor Works Review of Environmental Factors

Report code	Project name	Report name
1944-24	BSC Roadside Vegetation Management Plan	Draft Roadside Vegetation Management Plan v3
1966-353	BSC Bangalow Weir Ecological Assessment	FINAL version of Ecological Assessment Report
1999-965	RMS Dingo Gully Rd REF	FINAL Minor Works REF
2017-471	RMS Flocchini REF	FINAL version of Review of Environmental Factors
2019-1004	LCC Roadside Vegetation Implementation	FINAL Review of Environmental Factors
2066-1010	PMHC Kooloonbung Creek EIS	Draft 1 of Koala Plan of Management
2067-1004	RMS Middle Bend REF	FINAL version of Review of Environmental Factors
2067-609	RMS Middle Bend REF	DRAFT Minor Works Review of Environmental Factors
2086-1023	Wilson Park School Upgrade	FINAL version of Review of Environmental Factors
2086-1022	Wilson Park School Upgrade	Vegetation Assessment
2132-1004	EE Hyland Park Road REF	Draft Review of Environmental Factors
2149-1059	RMS W2G Targeted Bat Surveys	Microbat Management Plan Sections 1 and 2 Version 3
2150-1010	EE Waterview Heights REF	FINAL Review of Environmental Factors
2154-1015	BSC Wilsons Creek Slip	Wilson Creek Slip REF V2
2154-1004	BSC Wilsons Creek Slip	Ecological Assessment
2157-1012	RMS Mororo Bridge Minor Works REF	FINAL Bat Management Plan
2157-1011	RMS Mororo Bridge Minor Works REF	FINAL Review of Environmental Factors
2180-1011	BSC Belongil Estuary Entrance Management Reporting	Stage 3 Belongil Estuary Entrance Management Report April 2014-September 2014
2180-1009	BSC Belongil Estuary Entrance Management Reporting	Belongil Estuary Entrance Management Report Stage 2 October 2013 to March 2014 - 1st Issue
2185-1003	RVC Evans Head Tennis Court Relocation SEE	Statement of Environmental Effects
2228-1015	KBR Sportsmans Creek New Bridge	Biodiversity Assessment: Sportsman's Creek New Bridge
2311-1010	RMS Sportsmans Creek Bridge Microbat Assessment	Microbat Assessment
2330-1003	RMS West Ballina Levee Raising Consistency Assessment	Ecological Assessment

Report code	Project name	Report name
2343-1011	RMS Fossickers Way MW REF	FINAL Minor Works Review of Environmental Factors
2351-1006	RVC Casino Flying-fox Camp Part 5 Assessment	FINAL Review of Environmental Factors
2363-1009	GHD Tabulam Bridge Microbat Survey	Tabulam Bridge Microbat Management Plan Version 2
2363-1003	GHD Tabulam Bridge Microbat Survey	Tabulam Bridge Microbat Survey Results Letter Report
2364-1007	WC2NH Baseline Koala Surveys	Baseline Koala Monitoring Report
2369-1001	Hydrosphere - Rous Water St Helena Trunk Main Ecological Assessment	Ecological Assessment
2373-1020	RMS W2B Threatened Species Management - Bats	Serpentine Channel Flying-fox Roost Assessment
2373-1019	RMS W2B Threatened Species Management - Bats	Microbat Management Plan Version 2 Sections 3-11
2373-1004	RMS W2B Threatened Species Management - Bats	W2B Section 7 Winter - Microbat Survey Results
2376-1051	BSC North Ocean Shores Sports Fields	Ecological Assessment v2
2386-1009	RMS Gwydir Hwy Tree Removal MWREF	FINAL Minor Works Review of Environmental Factors (supersedes 2386-1003)
2389-1003	RMS Waterfall Way Slope Repair MWREF	DRAFT Minor Works Review of Environmental Factors
2421-1007	EE Pacific Highway - Woodburn Pole Replacement REF	REF Revised seven-part test not including erection of nest pole
2430-1007	BSC Clarkes Beach and Belongil Mouth EAs	Ecological Assessment: Belongil Lagoon Opening Works
2430-1003	BSC Clarkes Beach and Belongil Mouth EAs	Ecological Assessment: Clarkes Beach Lagoon Opening Works
2454-1011	RMS McFarlane Bridge Phase 2 REF	Review of Environmental Factors Version 3
2454-1009	RMS McFarlane Bridge Phase 2 REF	Draft Microbat Management Plan Version 2
2458-1005	EE Brombin Line Relocation	Review of Environmental Factors
2466-1007	RMS Halls Creek Bridge Addendum REF	Review of Environmental Factors Addendum Version 3
2478-1013	BSC Bangalow Weir REF	Review of Environmental Factors Version 4
2500-1014	RMS Marom Creek Microbat Survey and MWREF	Minor Works Review of Environmental Factors version 2
2500-1015	RMS Marom Creek Microbat Survey and MWREF	Microbat Management Plan Version 2
2500-1005	RMS Marom Creek Microbat Survey	Microbat Impact Assessment Version 2

Report code	Project name	Report name
2503-1009	RMS Kyogle Culverts Microbat Surveys	Minor Works REF
2503-1006	RMS Kyogle Culverts Microbat Surveys	Bailey Bridge Road Microbat Survey Version 2
2503-1007	RMS Kyogle Culverts Microbat Surveys	Lions Park Microbat Survey Version 2
2525-1007	RMS Gwydir River Bridge MWREF	Minor Works Review of Environmental Factors Version 2
2549-1007	Old Bundarra Road Widening Ecological Assessment	Old Bundarra Road Ecological Assessment Version 2
95194-664	Clunes Wastewater Project	FINAL Ecological Assessment Report

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