Appendix J
Biodiversity impact assessment

Townson Road Upgrade between Jersey Road and Burdekin Road – Stage 2

Biodiversity Assessment

October 2021

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Transport for New South Wales

Townson Road Upgrade between Jersey Road and Burdekin Road – Stage 2

Biodiversity Assessment

July 2021

Prepared by GHD Pty Ltd

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Definitions

Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014).
Indirect impact	Where an event or circumstance is a direct consequence of the action.
Locality	The area within a 10 kilometre radius of the study area.
Matters of NES	A matter of national environmental significance (NES) protected by a provision of Part 3 of the EPBC Act.
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact. (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Proposal/Proposed works	The proposed upgrade and construction of the new section of Townson Road as outlined in Section 1.2; shown broadly on Figure 1-1.
Proposal area/ Construction footprint	The area of land that is directly impacted on by a proposed Major Proposal that is under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014), shown on the figures as the 'construction footprint'.
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014), as shown on Figure 1-2.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.

Abbreviations

BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
CEEC	Critically endangered ecological community
CEMP	Construction environmental management plan
CMA	Catchment Management Authority
DAWE	The Commonwealth Department of Agriculture, Water and the Environment
DECCW	Department of Environment, Climate Change and Water (now the EES Group)
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment.
EEC	Endangered ecological community
EES	The Environment, Energy and Science Group (part of DPIE)
ENV	Existing Native Vegetation
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FBA	Framework for Biodiversity Assessment
FM Act	*Fisheries Management Act 1994* (NSW)
GDE	Groundwater dependent ecosystems
GIS	Geographic information system
ha	Hectare
IBRA	Interim Biogeographically Regionalisation of Australia
km	Kilometre
KTP	Key threatening process
LGA	Local Government Area
m	Metre
mm	Millimetre
MNES	Matter of national environmental significance
NSW	New South Wales
OEH	The former Office of Environment and Heritage (now the EES Group, part of DPIE)
PCT	Plant community type
PMST	Protected Matters Search Tool
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TEC	Threatened ecological community
TfNSW	Transport for New South Wales
TSC Act	The former NSW *Threatened Species Conservation Act 1995*
TSPD	Threatened Species Profile Database
VIS	NSW Vegetation Information System

1. Introduction

1.1 Overview

A a four-lane divided road is proposed along the Townson Road/Burdekin Road corridor linking Richmond Road, Marsden Park in the west with Burdekin Road, Schofields in the east. The length of the overall program of work is about 3.6 kilometres.

The overall program of work consists of two stages:

- Stage 1 involves an upgrade of about 1.6 kilometres of road extending from Richmond Road to south of Jersey Road. This stage is being delivered within an interim and final phase, subject to a separate planning approval.
- Stage 2 is about 2.0 kilometres in length involving the construction of a new road between the Stage 1 tie-in and Burdekin Road (referred to as 'the proposal' for the purposes of this assessment).

The proposal is located within the North West Growth Area which is about 37 kilometres north-west of the Sydney central business district and 3 kilometres west of Schofields. The proposal is situated between the Marsden Park Industrial and West Schofields precincts (see Figure 1-1).

The roads authority is the proponent of the proposal, and an environmental assessment in the form of a review of environmental factors (REF) is being prepared in accordance with the requirements of Division 5.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act).

Transport for NSW has prepared the concept design and BCC and will prepare the detailed design and will construct the proposal.This report assesses and documents the potential biodiversity impacts of the proposal.

A small portion of the western end of the Stage 2 contruction footprint (the proposal) overlaps with the eastern end of the Stage 1 construction footprint (refer to Figure 1-2). All impacts within the Stage 1 construction footprint were considered in the Biodiversity Assessment Report (BAR) (GHD, 2021) prepared for the Stage 1 project, and are not considered further in this report.

1.2 Proposal outline

The key features of the proposal are shown in Figure 1-2 and include:

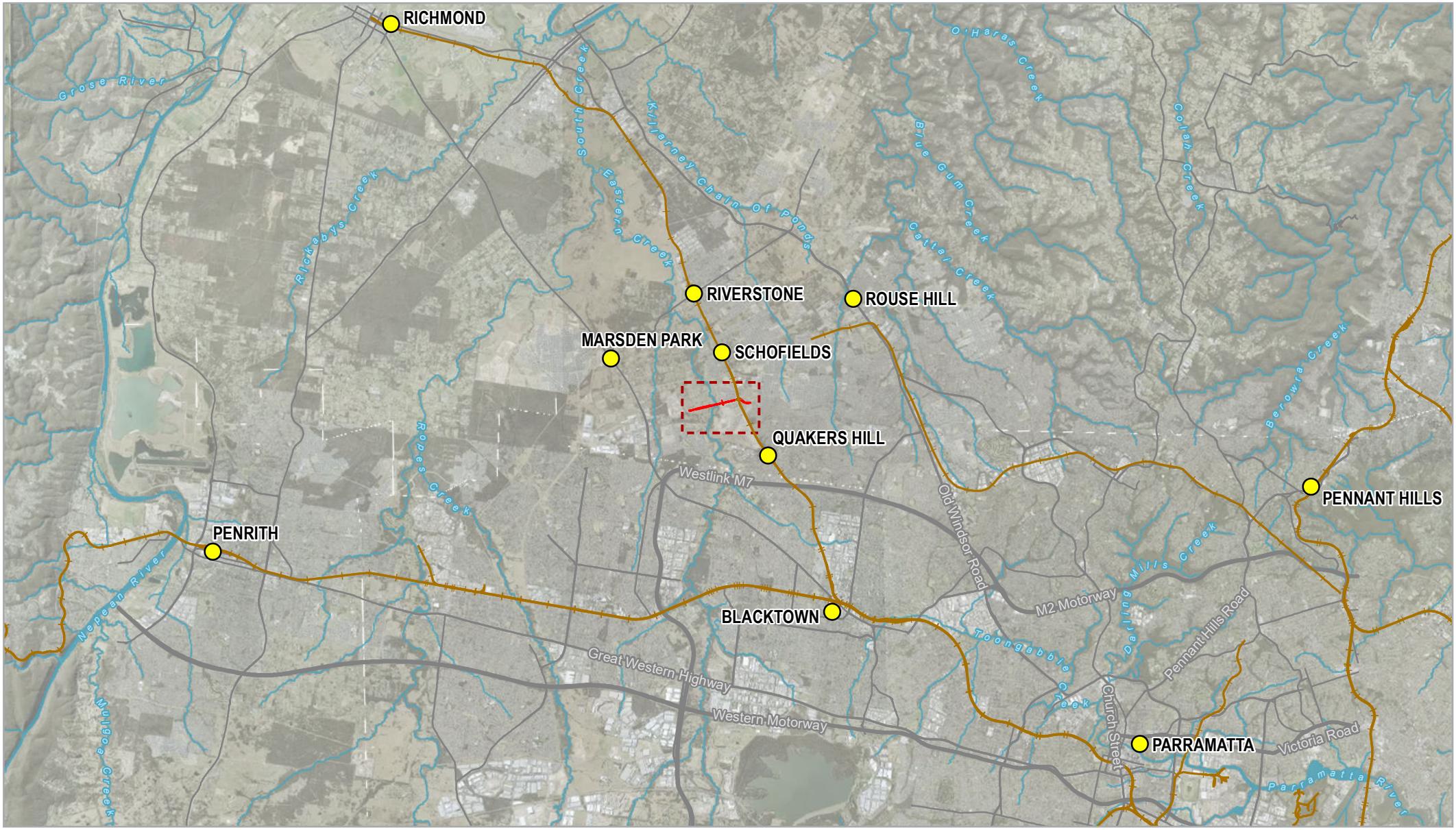
- Constructing a new median separated dual carriageway through greenfield sites that is approximately 2.0 kilometres in length connecting Stage 1 in the west with Burdekin Road in the east;
- Constructing a 300 metre long viaduct over Eastern Creek;
- Providing a signalised intersection at Veron Road with pedestrian crossing facilities;
- Providing a 2.5 metre wide shared path for pedestrians and cyclists on the southern side of the carriageway up to Veron Road, then 1.5 metre footpath to Burdekin Road;
- Providing a 1.5 metre wide footpath on the northern side of the carriageway along the length of the proposal;
- Railway Terrace would be terminated with a cul-de-sac; and
- Constructing a vehicular and pedestrian bridge over the western rail line with associated retaining walls and embankments before tying into Burdekin Road.

1.3 Purpose of this report

The aim of this Biodiversity assessment report is to:

- Describe the existing environment within the site, including vegetation types, fauna habitats and flora and fauna species known or likely to occur;

- Assess the value and conservation significance of native vegetation and habitats in the study area;
- Compile a list of threatened biota previously recorded or predicted to occur in the locality and assess their potential to occur in the construction footprint;
- Assess the likely impacts on threatened biota from the proposed works;
- Recommend mitigation measures to reduce impacts on biodiversity values; and
- Provide concluding statements regarding the likely significance of impact of the proposed works on threatened biota listed under the New South Wales *Biodiversity Conservation Act 2016* (BC Act) or Matters of National Environmental Significance (MNES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the requirement or otherwise for further assessment or approvals at the State or Federal level.



LEGEND

- Locality
- Railway
- Site location
- The proposal *Subject to detailed design
- Major road
- Minor road
- Watercourse

Paper Size ISO A4

0 1 2 3 4

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Transport for NSW
Townson Road Upgrade Stage 2
Burdekin Road

Location of the proposal

Project No. **21-12511195**
Revision No. **-**
Date **23/03/2022**

FIGURE 1-1

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Data source: MetroMap - Imagery (date extracted: 23/03/2022) . General topography - DPI 2015. Roads - DSFI 2019. . Created by: eibbertson

1.4 Legislative context

1.4.1 Environmental Planning and Assessment Act 1979

The EP&A Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to, amongst other things, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the Environmental Planning and Assessment Regulation 2000.

The proposed works are a Division 5.1 activity under the EP&A Act. The determining authority for the proposal is the roads authority.

The EP&A Act is subject to the provisions of Part 7 of the BC Act and Part 7A of the *Fisheries Management Act 1994* (FM Act). Part 7.3 of the BC Act and section 220ZZ of the FM Act list factors that must be taken into account when determining the significance of potential impacts of a proposed activity on listed threatened species, populations or ecological communities (or their habitats). The 'assessment of significance' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement (SIS) is required under the BC Act or FM Act. Under the BC Act, there is also the option to prepare a Biodiversity Development Assessment Report (BDAR) rather than an SIS, where a significant impact is likely.

Assessments of significance have been prepared for threatened biota that would be impacted or are likely to be impacted by the proposal and are provided in Appendix C.

1.4.2 State Environment Planning Policy (Sydney Region Growth Centres) 2006

State Environmental Planning Policy (Sydney Regional Growth Centres) 2006 (the Growth Centres SEPP) is the legal instrument that establishes the planning rules and objectives for Sydney's Growth Centres. Consent authorities must apply this policy when they make planning decisions about land within the Growth Centres areas. Parts of the study area are located within the North West Growth Centre.

Biocertification

Under section 126G of the now repealed *Threatened Species Conservation Act 1995*, the Minister applied the principle of Biodiversity Certification to the Growth Centres SEPP. Clause 18(2) of the *Threatened Species Conservation Amendment (Special Provisions) Act 2008* outlines that Biocertification applies to 'all development and activities that may be carried out under the Growth Centres SEPP, and, to all threatened species, populations and ecological communities.' Biodiversity certification that was conferred on land under the TSC Act and that was in force on the repeal of that Act is taken to be biodiversity certification conferred on the land under Part 8 of the BC Act.

Biocertification removes the need to undertake threatened species assessments or prepare species impact statements (SIS) for species and communities listed under the BC Act. Portions of the construction footprint are located within land certified under the Growth Centres SEPP. Activities in biocertified land are taken to be not likely to significantly affect any threatened species, population or ecological community, as these impacts have already been offset, and a determining authority is not required to consider the effect on biodiversity values of the activity.

Biocertification does not apply to threatened biota listed under the FM Act. As such, there is a requirement to assess impacts with respect to the FM Act in both certified and non-certified land.

Non-certified areas

Portions of the study area comprise non-certified lands, predominately associated with the riparian zone along Eastern Creek. Where present, riparian vegetation comprises River-flat Eucalypt Forest (listed as an endangered ecological community under the BC Act). There are also some areas of poor condition Cumberland Plain Woodland in the study area within non-certified land. The riparian corridor is also identified as 'existing native vegetation' (ENV) under the Growth Centres SEPP (see above) (see Figure 3-1).

There would be direct and indirect impacts on threatened ecological communities within non-certified land. The potential for impacts on threatened biota occurring within non-certified areas are discussed further in Section 4.

Under the *Biodiversity Certification Order for the Sydney Region Growth Centres*, offsets are developed in accordance with the relevant biodiversity measures (RBM) 10 and 11 detailed in Schedule 1 of the Biodiversity Certification Order (Minister for the Environment 2007). Offsets are only required for clearing of vegetation mapped as ENV within non-certified lands. Patches of ENV occur within the central portion of the construction footprint. These areas, along with offsetting requirements for impacts on ENV in non-certified land are discussed in Section 6.2

Commonwealth endorsement of Biocertification

On 28 February 2012, the Commonwealth Environment Minister approved all actions associated with development of the Sydney Growth Centres as described in the Sydney Growth Centres Strategic Assessment Program Report. This endorsement removes the requirement for site by site approvals under the EPBC Act as long as proposed actions are consistent with the endorsed Program. No approval under the EPBC Act is therefore required for impacts on threatened and migratory biota listed under the Act within certified areas.

1.4.3 Biodiversity Conservation Act 2016

The BC Act provides legal status for biota of conservation significance in NSW. The BC Act aims to, amongst other things, 'maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development'. It provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development, known as the Biodiversity Offsets Scheme (BOS), and establishes the Biodiversity Assessment Method (BAM), which is a scientific method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts, required if a significant impact on threatened biota is likely.

Part 7.3 of the BC Act lists five factors that must be taken into account when determining the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the BC Act. The 'five part test' or 'test of significance' is used to assist in the determination of whether a project is 'likely' to impose 'a significant effect' on threatened biota and thus whether a species impact statement (SIS) is required. There is also the option to prepare a Biodiversity Development Assessment Report (BDAR) rather than an SIS, where a significant impact is likely.

The BC Act has been addressed in this assessment through:

- Desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality and hence could occur in the study area, subject to the habitats present
- Field surveys for listed threatened species, populations and ecological communities
- Identification, assessment and mapping of listed threatened communities and threatened species (or their habitat)
- Assessment of potential impacts on listed threatened species, populations and ecological communities
- Identification of suitable impact mitigation and environmental management measures to minimise potential impacts on threatened biota, where required.

Threatened biota recorded or likely to occur in the study area are detailed further in Section 3.

1.4.4 Fisheries Management Act 1994

The objectives of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for the listing of threatened species, populations and ecological communities, key threatening processes and requirements or otherwise for the preparation of a SIS. One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, DPI has produced the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

The FM Act has been addressed in this assessment through undertaking:

- A desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality of the proposal and hence could occur in the study area, subject to the habitats present
- Assessment of potential impacts on aquatic habitats, including identification of key threatening processes of relevance to the proposal, impacts on key fish habitat and fish passage
- Assessment of the potential for impacts on listed threatened species, populations and ecological communities and the requirement or otherwise for an SIS
- Identification of suitable impact mitigation and environmental management measures to avoid or mitigate impacts on the aquatic environment.

Aquatic habitat is discussed in Section 3.6, and potential impacts are identified in Section 4.1.5.

1.4.5 Biosecurity Act 2015

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Legal requirements to minimise the potential for the introduction and/or spread of weeds as a result of the proposal are discussed in Section 3.10, however in many instances, these are not relevant to the proposal.

1.4.6 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on ‘matters of national environmental significance’ (MNES), or the environment of Commonwealth land, undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that ‘has, will have or is likely to have a significant impact on a matter of national environmental significance’ or a significant impact to the environment of Commonwealth land is deemed to be a ‘controlled action’ and may not be conducted without prior approval from the Australian Minister for the Environment.

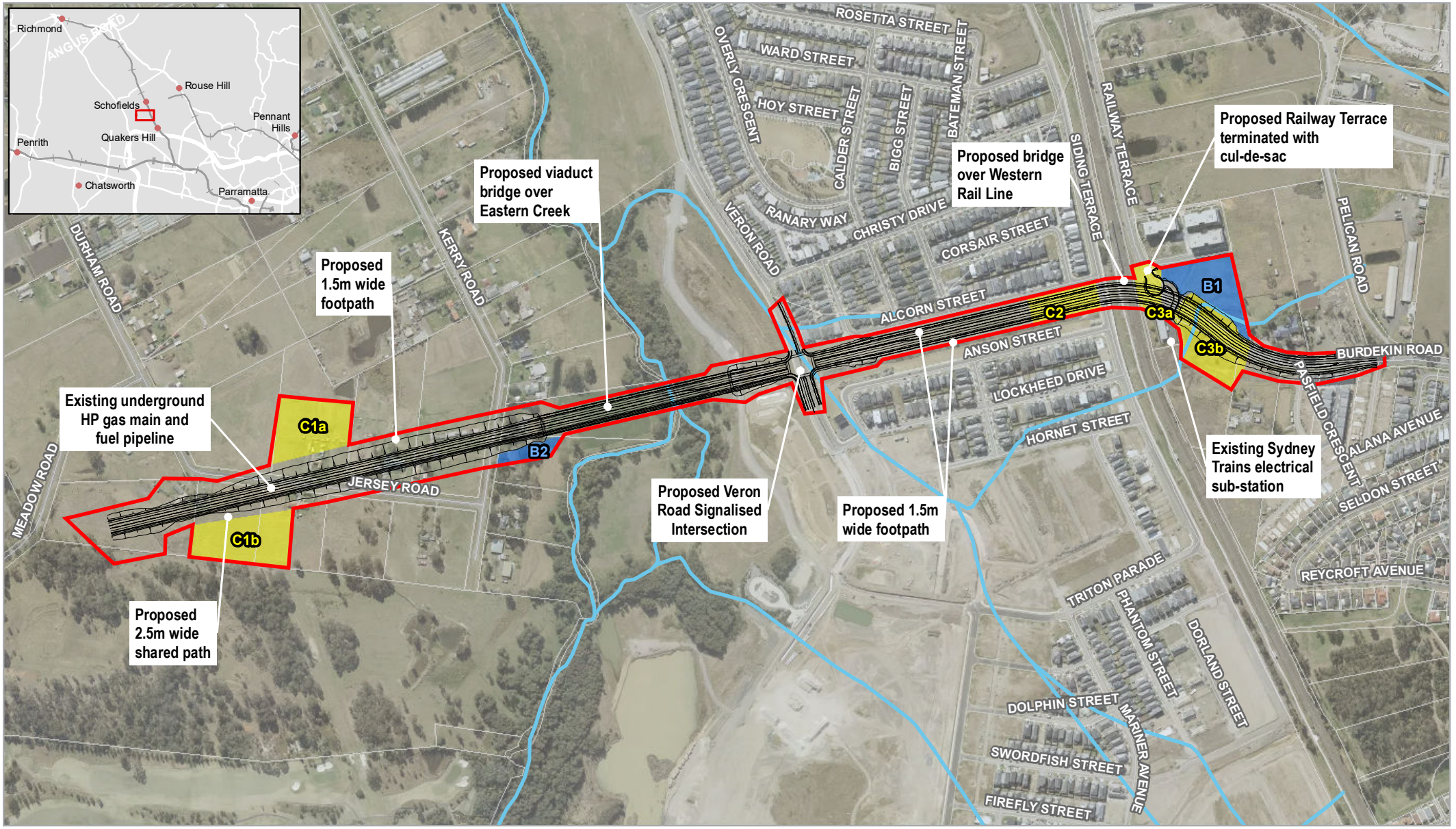
In September 2015, a ‘strategic assessment’ approval was granted by the Australian Minister for the Environment in accordance with the EPBC Act. The program applies to Roads and Maritime activities being assessed under Part 5 of the EP&A Act with respect to potential impacts on Specified Protected Matters (nationally listed threatened species, ecological communities and migratory species). The objective of the program is to ensure that road and traffic management activities undertaken by Roads and Maritime are assessed and delivered in a way that provides protection for these Specified Protected Matters. The ‘avoid, minimise, mitigate and offset’ hierarchy must be addressed. Potential impacts on Specified Protected Matters are subject to an assessment of significance pursuant to the EPBC Act Significant Impact Guidelines (DotE 2013), however there is no requirement to refer the project to the Minister for the Environment. If a significant impact is considered likely for a Specified Protected Matter, impacts must be offset using an endorsed method (eg. the BAM).

Potential MNES of relevance to this assessment include:

- Threatened species and ecological communities
- Migratory species.

Relevant MNES have been addressed in this assessment through:

- Desktop review to determine the listed threatened or migratory biota known or predicted to occur within the locality of the proposal which could occur in the study area, subject to the habitats present
- Field surveys to identify the presence of threatened or migratory species, or potential habitat for listed threatened biota and migratory species
- Assessment of potential impacts on threatened and migratory biota
- Identification of suitable impact mitigation and environmental management measures for threatened and migratory biota, where required.



LEGEND

- The proposal **Subject to detailed design*
- Construction footprint
- Compound site
- Drainage basin
- Watercourse
- Cadastre

Paper Size ISO A4

0 50 100 150 200

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Transport for NSW
Townson Road Upgrade Stage 2
Burdekin Road
Noise and Vibration Impact Assessment

The Stage 2 Proposal

Project No. **21-12511195**
Revision No. **-**
Date **28/10/2021**

FIGURE 1-2

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Print date: 28 Oct 2021 - 14:52

Data source: MetroMap - Imagery (date extracted: 28/10/2021) . General topography - DPI 2015. Roads - DSFI 2019. . Created by: eibbertson

2. Methods

2.1 Personnel

The project team are presented in Table 2-1.

Table 2-1 Staff qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Kath Chesnut	Senior Ecologist / desktop assessment, field surveys and primary author	BEnvSc (honours) Accredited BAM Assessor Accredited BBAM Assessor	12+ years
Kirsten Crosby	Technical Director Biodiversity / field surveys and reporting	BSc, PhD Accredited BAM Assessor Accredited BBAM Assessor	17+ years
Mal Weerakoon	Ecologist / desktop assessment, field surveys, reporting	BSc, MPhil	7+ years
Fanny Stricher	Ecologist / field surveys and reporting	BSc, Masters Ecology	3+ years
Isabel Lyons	Graduate Ecologist / desktop assessment, field surveys	BSc Cert III Conservation and Land Management	1+ year
Hannah Urwin	Environmental Scientist / field surveys	BSc	3+ years
Jayne Tipping	Technical Director Biodiversity / technical review	BSc Masters Environmental Law	28+ years

2.2 Background research

A desktop database review was carried out to create a list of threatened flora and fauna species, populations and ecological communities (biota) listed under the BC Act and FM Act, and MNES listed under the EPBC Act that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present. The database review assisted with focusing field survey techniques and effort. Biodiversity databases and existing literature and information pertaining to the study area and locality (i.e. within a 10 kilometre radius of the site) that were reviewed prior to conducting field investigations included:

- The NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas for records of threatened species listed under the BC Act and EPBC Act which have been recorded within the locality (DPIE 2021a)
- The Australian Government Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for MNES listed under the EPBC Act which may occur in the area, as well as nationally important wetlands (DAWE 2021a)
- DPIE threatened biota profiles for descriptions of the distribution and habitat requirements of threatened biota (DPIE 2021b)
- DAWE online species profiles and threats database (DAWE 2021b)
- DPI indicative distributions of threatened freshwater fish (DPI 2016)

- DPI threatened species lists (DPI 2021b)
- Existing regional-scale vegetation mapping of the study area (NPWS 2002a; b; Tozer *et al*. 2010)
- The NSW Vegetation Information System (VIS) Classification 2.1 - Community Identification (DPIE 2021c) to identify matching plant community types (PCTs) in the study area
- Priority weed declarations for Greater Sydney Region (DPI 2021c)
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (BOM 2021)
- DPIE register of declared areas of outstanding biodiversity value (DPIE 2021f)
- Aerial photography of the study area
- Existing reports relevant to the study area;
    - Townson Road Upgrade Stage 1 Between Richmond Road and Jersey Road Biodiversity Assessment (GHD 2021);
    - Schofields Road Upgrade - Stage 3 Veron Road to Richmond Road Biodiversity Assessment (GHD 2013);
    - West Schofields Precinct Biodiversity and Riparian Assessment (Eco Logical Australia 2018); and
    - Assessment of Consistency between the Relevant Biodiversity Measures of the Biodiversity Certification Order and the draft West Schofields Precinct Plan (DPE, 2018).

2.3 Habitat assessment

Following collation of database records and review of species and community profiles, a 'likelihood of occurrence' of threatened biota assessment was prepared with reference to the habitats contained within the study area. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DAWE 2021b, DPIE 2021b), recovery plans, journal articles, and the field staff's knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on records from the locality for the last 20 years (since 2001), species distribution and habitat preferences, and the suitability of potential habitat present in the study area. The results of this assessment are provided in Appendix B.

2.4 Field survey

Field surveys in the study area were conducted on 13-14 November 2019, 4 December 2019 and May 5, 2021. The field surveys focussed on the verification of vegetation types and extent of threatened ecological communities within the study area, identification and mapping of threatened species, and an assessment of the value of habitats present for threatened biota, with a particular focus on portions of the construction footprint in non-certified land. Rapid aquatic habitat assessments were also carried out.

2.4.1 Vegetation surveys

Vegetation mapping

Native vegetation within the study area was mapped based on observed species composition and vegetation structure according to the classification of Specht (1970). The Vegetation Information System (VIS) was used to assign the most appropriate Plant Community Type (PCT) (DPIE 2021c). This was done using the species composition, vegetation integrity and structural attributes recorded during the field survey. All vegetation zones were then mapped using aerial photographic interpretation within a geographical information system (GIS) as guided by the field survey results.

Vegetation within the site was assessed against identification criteria for State and Commonwealth listed threatened ecological communities (critically endangered ecological communities (CEECs), endangered ecological communities (EECs) and vulnerable ecological

communities (VECs)). Vegetation and habitats were compared with descriptions provided in published threatened species profiles and management plans.

Vegetation integrity survey plot/transects

Flora surveys were conducted with reference to both the Biodiversity Assessment Method (BAM) and Framework for Biodiversity Assessment (FBA), to gather sufficient data for maximum flexibility and efficiency for offset calculations (if necessary).

The number of plots completed for each identified vegetation zone was based on the requirements of the BAM and FBA, as summarised in Table 2-2 below.

Table 2-2 Minimum number of transects/plots required per zone area

BAM assessment		FBA assessment	
Vegetation zone area (ha)	**Minimum number of transects/plots for BAM assessment**	**Vegetation zone area (ha)**	**Minimum number of transects/plots for FBA assessment**
< 2	1 plot/transect	-	-
> 2–5	2 plots/transects	0–4	1 transect/plot per 2 ha (or part thereof) or 1 transect/plot if vegetation is in low condition
> 5–20	3 plots/transects	> 4–20	3 transects/plots or 2 transects/plots if vegetation is in low condition
> 20–50	4 plots/transects	> 20–50	4 transects/plots or 3 transects/plots if vegetation is in low condition

Areas of non-native vegetation were sampled (where access was available) and mapped throughout the study area, in addition to areas that supported native vegetation.

Two plots were completed within non-certified land in the study area, as shown on Figure 2-1, during the 2019 surveys (Plot 4 and Plot 5). Additional surveys were undertaken in 2021, with two plots completed in non-certified lands (Plot 2-1, Plot 2-2) and one plot completed in certified lands (Plot 2-3).

BAM plots

Plot surveys were conducted on site with reference to the Biodiversity Assessment Method (DPIE 2020) to confirm the condition and vegetation type across the site as necessary. The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation within a 50 m x 20 m plot. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement (OEH, 2017).

All flora species within a 20 m x 20 m quadrat, nestled within the 50 m x 20 m plot were identified according to the nomenclature of the RBGT (2021). Each species identified was allocated a growth form group and designated as either native, exotic or high threat exotic in accordance with lists provided by DPIE.

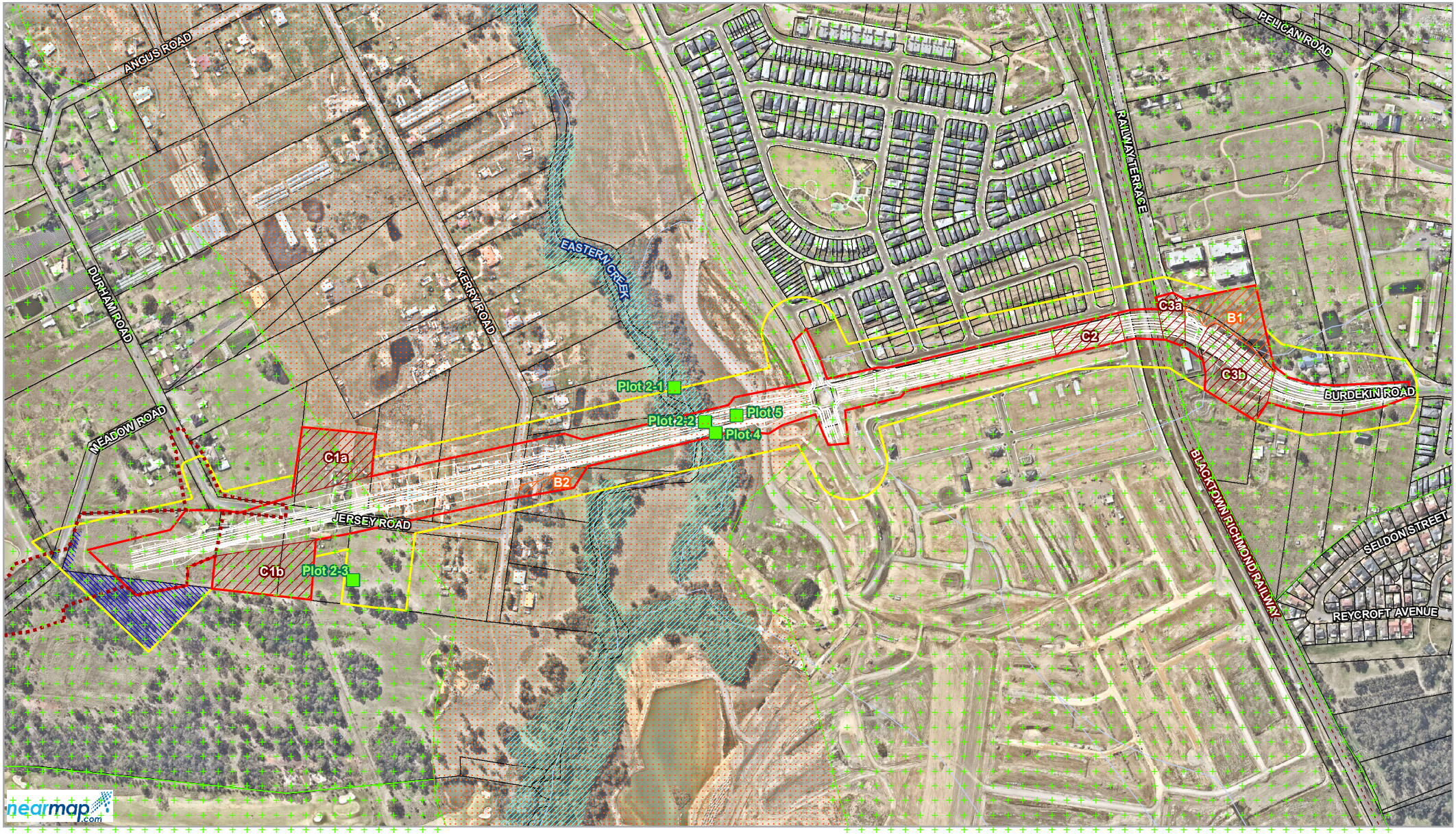
Vegetation plots were sampled within PCTs in the study area to confirm the identity of PCTs as needed. The location of survey plots is shown on Figure 2-1. Other PCTs were identified based on topographic or landscape position, in conjunction with floristic assemblage.

The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

FBA plots

Plot/transect surveys were conducted at the site in accordance with the FBA to confirm vegetation types and assess site condition. The site value was determined by assessing ten biometric habitat attributes against benchmark values. Cover and abundance data was collected for each flora species within the 20 m x 20 m portion of each plot/transect.

Species richness and biometric plot/transect data was recorded on pro forma data sheets for each vegetation zone.



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Random meander survey
- Flora plot location

Paper Size ISO A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2
Biodiversity Assessment

Vegetation survey locations

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

FIGURE 2.1

N:\AU\Sydney\Projects\21\12511195\GIS\Maps\Deliverables\Biodiversity\Stage2BiodiversityAssessment\12511195_Z003_Stage2BiodiversityAssessment_VegetationSurveyLocations.mxd

Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

2.4.2 Targeted flora surveys

Targeted surveys were undertaken for threatened flora species that could potentially occur within the study area given known distributions, previous records in the locality and habitat requirements for each species. Random meander transects, with reference to the methods of Cropper (1993), were focused on the construction footprint in areas of potentially suitable habitat and within immediately adjoining vegetation. As some target species are naturally cryptic, an assessment of the suitability of habitat present was undertaken for any such species, e.g., *Pimelea spicata*.

2.4.3 Verification of existing native vegetation (ENV)

When bio-certification was conferred on the Growth Centres, vegetated areas that met the specifications listed in Schedule 1 of the Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (definitions) were mapped and described as "*existing native vegetation (ENV)", which means "areas of indigenous trees (including any sapling) that:*

a) had 10% or greater over-storey canopy cover present,
b) were equal to or greater than 0.5 ha in area, and
c) *were identified as "vegetation" on maps 4 and 5 of the draft Growth Centres Conservation Plan, at the time the biodiversity certification order took effect*".

The study area contains patches of native vegetation on non-certified lands identified as ENV under the Growth Centres SEPP (see Figure 3-1). Due to the coarse scale and errors in the ENV mapping, areas mapped as ENV can sometimes include areas that are not vegetated, such as roads and buildings (refer to Figure 3-1).

The Order to confer biodiversity certification notes that with regard to ground-truthing of existing native vegetation, "*if new information becomes available after the biodiversity certification order took effect that demonstrates that the vegetation within an area does not otherwise meet the definition of existing native vegetation, then for the purposes of conditions 7 to 8 and condition 11 to 12 only the area of confirmed existing native vegetation shall be considered*".

Spatial data showing areas mapped as ENV in the *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* was overlaid on aerial photographs of the study area and patches of ENV were ground truthed during the field survey, to make sure the mapped areas met the definitions of ENV noted above.

2.4.4 Targeted fauna surveys

Techniques used for fauna surveys within the study area aimed to detect threatened and/or migratory species and assess habitat values present for potentially occurring threatened species (as identified in Appendix B). Fauna and fauna habitat survey techniques are described below. All observations were recorded on proforma field data sheets. Targeted fauna survey effort was concentrated in areas of non-certified lands; however habitat assessments were completed throughout the study area to determine the likelihood of species occurring in the area generally (refer to Figure 2-2).

Fauna habitat assessment

General fauna habitat assessments were undertaken throughout the study area, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, hollow-bearing trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the indicative construction area following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in DPIE and DAWE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists.

Habitat assessments included searches for resources of potential value to threatened fauna including:

- Trees with hollows, bird nests or other potential fauna roosts including stag trees;
- Culverts and drains that provide potential bat roosts;
- Rock outcrops or overhangs providing potential shelter sites for fauna;
- Burrows, dens and warrens;
- Distinctive scats or latrine sites, owl whitewash and regurgitated pellets under roost sites;
- Tracks or animal remains;
- Evidence of activity such as feeding scars, scratches and diggings; and
- Specific food trees and evidence of foraging (e.g. chewed *Allocasuarina* cones).

The locations and quantitative descriptions of habitat features were captured with a handheld GPS unit.

Active searches

Active searches for the endangered Cumberland Plain Land Snail (*Meridolum corneovirens*) were conducted in areas of high condition Cumberland Plain Woodland where present within the study area, with a focus on any areas of deep leaf litter at the base of large trees. Notably, there is no high condition Cumberland Plain Woodland within the construction footprint. Anthropogenic refuse such as sheets of corrugated iron, building rubble, or planks of wood were turned (if possible) to inspect for any species sheltering under them, including the Cumberland Plain Land Snail.

Microbat surveys

Microbat ultrasonic echolocation call recordings (Anabat surveys) were undertaken on three non-consective nights in 2019 and 2021. In November 2019, an Anabat detector within Eastern Creek failed to record any data, and was re-surveyed again in December 2019. In May 2021, one Anabat was fixed to a tree within a small patch of Cumberland Plain Woodland, off Jersey Road and also on the edge of a small dam off Burdekin Road within certified land. Another Anabat detector was also placed within non-certified lands within Eastern Creek (see Figure 2-2) during this period.

Culverts within the study area were visually inspected (where access was possible) for evidence of use by microbats, such as the presence of guano (bat droppings) and for any roosting microbats. The diameter of the culvert, presence or absence of scuppers or equivalent refuge or roosting features were noted, as well as the presence or absence of dense aquatic vegetation which would prevent microbats from accessing the culvert itself.

Calls recorded on the Anabats were identified using zero-crossing analysis and AnalookW software (version 4.1t, Chris Corben 2015). The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats (Pennay *et al*. 2004) was used to assist call analysis. Call identification was assisted by consulting species records from BioNet (DPIE 2021a).

Spotlighting and call playback

Spotlighting was conducted on the evenings of 13 November 2019, 4 December 2019 and 5 May 2021 in forest and woodland habitat, in non-certified land, along Eastern Creek within the study area, focussing on the construction footprint. A small patch of Cumberland Plain Woodland off Jersey Road outside of the construction footprint was surveyed, along with the dam adjacent to Burdekin Road.

Spotlighting involved walking along the interface between forest/woodland vegetation and cleared areas, as well as the more densely vegetated areas along Eastern Creek, and scanning trees and vegetation for fauna species or their eye shine. Any eye shine was checked using binoculars to identify the species, as necessary. Fauna species observed flying over or foraging within vegetation within the study area was identified and counted where possible.

Call playback was undertaken in the same locations (refer to Figure 2-2) and involved broadcasting calls for predicted threatened fauna species with the potential to occur, based on the habitats present. Calls were played for five minutes each, followed by ten minutes of silence. Species targeted included the Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*) and Green and Golden Bell Frog (*Litoria aurea*).

Nocturnal streamside/drainage line and dam searches

Diurnal and nocturnal active searches for the endangered Green and Golden Bell Frog and other frogs were conducted along the dirt access road off Aerodrome Driveway and the dam off Burdekin Road, where standing water or reed-like vegetation was present.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Survey effort was concentrated in suitable areas of habitat throughout the course of the survey, for instance fallen timber was scanned and/or turned for reptiles and mature trees and dams were scanned for roosting birds. Birds were identified by sight and call.

2.4.5 Aquatic habitat assessment

Rapid assessments of the in-stream physical habitat of Eastern Creek were conducted based on the NSW AUSRIVAS habitat assessment sheet (Turak *et al.* 2004). These entailed qualitative assessments of the substrata and water channel and an on-site assessment of habitat features and suitability for threatened taxa identified from the database and literature searches. The sensitivity of key fish habitat and the functionality of the creek was classified according to the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

2.4.6 Summary of survey effort

Table 2-4 provides a summary of the survey effort undertaken for this assessment. The rationale behind the selection of survey areas and effort was determined based on the presence/absence of intact native vegetation, property access, whether the land was certified or non-certified, and whether it was mapped as ENV.

Surveys completed for this project include those completed as part of the Stage 1 phase of works in 2019 (which extended into and across the Phase 2 study area). There has been substantial change to the local area since the initial Stage 1 field surveys were conducted, so another field survey focussing solely on the Phase 2 study area was completed in May 2021. This survey built upon the information gathered during the initial Phase 1 survey. The May 2021 field surveys were completed by three GHD ecologists.

Table 2-3 Targeted species survey details

Date	Method	Effort
13 November 2019	Vegetation mapping BAM and FBA survey plots Spotlighting Call playback Anabat recording Targeted threatened flora searches	4 person hours 6 person hours 6 person hours 2 person hours 15 hours (overnight) 4 person hours
14 November 2019	Vegetation mapping BAM and FBA survey plots Targeted threatened flora searches	2 person hours 4 person hours 6 person hours

Date	Method	Effort
4 December 2019	Vegetation mapping Spotlighting Anabat recording Targeted threatened flora searches	2 person hours 4 person hours 5 hours 10 person hours
5 May 2021	Vegetation mapping BAM and FBA survey plots Spotlighting Call playback Anabat recording Targeted threatened flora searches	4 person hours 9 person hours 3 person hours 2 person hours 3 hours 6 person hours

2.5 Assessments of significance

Determination of the species relevant for assessment was based on the results of the desktop database review (as per Section 2.2), the habitat assessment (refer to Section 2.3 for methods and Appendix B for results) and the results of the field survey. The habitat assessment identified the threatened and migratory biota with the potential to occur, and also identified the likely impact of the proposal on any threatened or migratory biota either recorded or considered to have a 'possible' or higher likelihood of occurrence.

The assessment of the likely impact of the proposal was used to determine which threatened biota required assessments of significance pursuant to Part 7.3 of the BC Act and/or the EPBC Act Significant Impact Guidelines (DotE 2013).

Assessments of significance have only been completed for impacts in non-certified lands, as they are not needed for impacts in certified lands.

2.6 Survey effort considerations and limitations

Surveys completed in 2019 were undertaken during a period of prolonged dry weather, with lower-than-average yearly rainfall recorded across the study area in the previous two years (BOM, 2019). Conditions immediately before the 2019 field survey included very dry and hot weather, with a catastrophic fire danger day immediately before the field survey, and continued low humidity, relatively strong winds, moderate to high levels of smoke in the air and hot days during the field survey period.

Surveys completed in May 2021 were undertaken on a cool, wet day. They followed a dry April, which overall, was one of the driest Aprils on record (BOM, 2021c). The previous month of March however, experienced more than a week of above average rainfall, and flooding occurred in the study area. A total of 387.2 mm of rain fell in March 2021, which is more than 260 mm more than is usually experienced in the local area in March (BOM, 2019b).

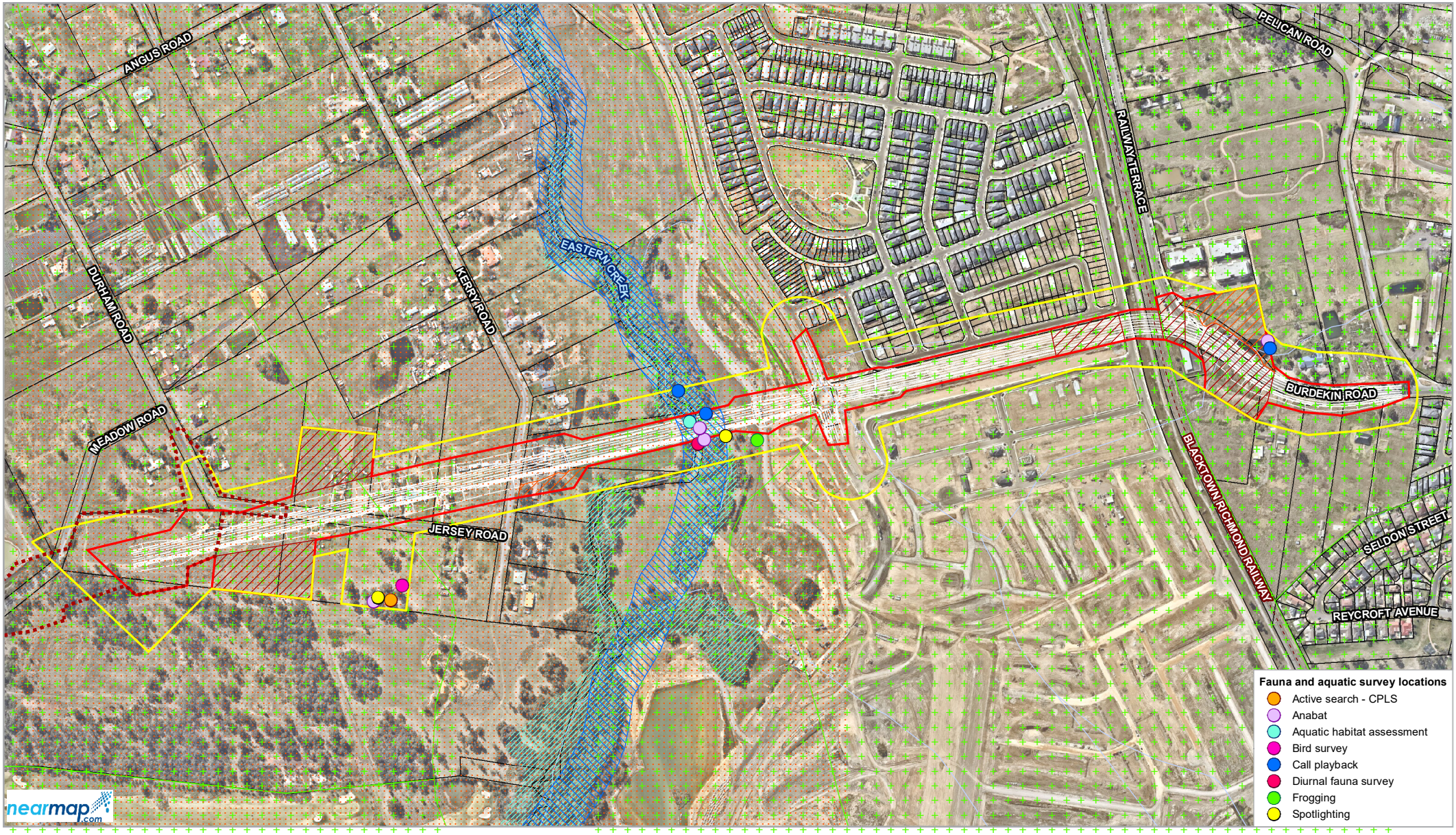
It is likely that some species that occur in the study area either permanently, seasonally or transiently were not detected during the surveys. These species may include annual, ephemeral or cryptic flora species; nocturnal fauna; birds and frogs that call at other times of year and mobile or transient fauna in general. Some species may have sought shelter from the extreme weather conditions around the time of the 2019 surveys, as well as from the ongoing climatic conditions (ie drought), meaning detectability at the time of the field survey was not possible. Mobile species may have relocated to other parts of the locality, or further afield, while species such as snails may have burrowed down into the soil to protect themselves from desiccation. Similarly, the heavy rainfall in March of 2021 prior to the most recent field survey may have displaced some individuals if they were washed away in floodwaters. These factors mean that some species that may use the construction footprint were not detectable at the time of the field surveys.

The habitat assessment conducted allows for identification of habitat resources for such species, to make an assessment of their likelihood of occurring within the study area. As such, the survey was not designed to detect all species, rather to provide an overall assessment of the ecological values and constraints within the study area. This information was used to predict potential impacts of the proposal on biodiversity values and to assist with the development of a design and approach to construction that specifically avoids and/or reduces impacts on threatened ecological communities and known and potential habitat for threatened species as far as possible.

Surveys focussed on areas of non-certified land around Eastern Creek, as areas that have been certified do not require assessment of impacts on species and communities listed under the BC Act or EPBC Act. Large portions of the construction footprint are located within land certified under the Growth Centres SEPP. Some survey and habitat assessment was undertaken in certified areas to assist in identifying species which may potentially occur in non-certified lands.

A full suite of targeted threatened fauna surveys was not considered necessary given the existing degree of disturbance and fragmentation within and around the study area, as well as the limited amount of impact to non-certified areas that require assessment.

The study area was occupied by multiple landowners and featured a variety of landuses at the time of the field surveys. Access was not obtained to properties between Kerry Road and Eastern Creek. These properties were assessed based on a combination of air photo assessment, direct observations from adjoiingig properties or public land and extrapolation of results from accessible areas.



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Key fish habitat

Paper Size ISO A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2 Biodiversity Assessment

Fauna and aquatic survey locations

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

FIGURE 2.2

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Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

3. Existing environment

Much of the study area and construction footprint has been modified in the past through vegetation clearing for agriculture, and the establishment of residential and industrial areas, and associated roads and infrastructure construction (refer to Figure 1-1). There are ongoing construction activities associated with the establishment of new residential areas within and around the study area. Remaining native vegetation in the study area occurs in scattered patches which are largely restricted to the non-certified lands along the Eastern Creek riparian corridor.

3.1 Landscape context

The landscape context of the study area is summarised in Table 3-1, and described in more detail in the following sections.

Table 3-1 Landscape context of study area

Landscape context	
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Cumberland
Mitchell landscape	Hawkesbury - Nepean Channels and Floodplains Cumberland Plain
Soil landscape	Blacktown South Creek
Catchment area	Hawkesbury Nepean
Rivers, streams and estuaries	The construction footprint spans Eastern Creek, which is a fourth order stream. Eastern Creek is mapped as Key Fish Habitat (DPI 2007).
Wetlands	None. There are a number of small farm dams within the study area.
Connectivity features	The construction footprint crosses a mapped biodiversity corridor associated with the riparian zone of Eastern Creek. This corridor is patchy and fragmented by existing roads and other development.
Critical habitat or areas of outstanding biodiversity value	There is no mapped critical habitat or areas of outstanding biodiversity value in or adjoining the study area.
Key fish habitat	Eastern Creek

3.1.1 Location and land uses

The study area is located in the suburb of Schofields in north-west Sydney. Eastern Creek runs perpendicular to and through the central portion of the study area. Bells Creek is located outside of the study area, about one kilometre to the west (refer to Figure 1-1). The study area overlaps with the existing Jersey Road, Kerry Road, Siding Terrace and Burdekin Road, as well as the rail line, road reserves, and portions of adjoining rural residential lots.

The majority of the study area has been certified (refer to Section 1.4.2), with the exception of the riparian corridor along Eastern Creek, which is non-certified and therefore subject to a full assessment of impacts (refer to Figure 1-1 and 1-2). There is a small area of ENV located in the centre of the study area, associated with the riparian corridor along Eastern Creek (refer to Figure 1-2).

The construction footprint primarily comprises the existing roads and road reserve, as well as scattered patches of native vegetation and portions of rural residential blocks which have largely been cleared of native vegetation. Land uses within the construction footprint are typical for the area, which has been subject to historical broad scale vegetation clearing for agriculture. There are some small market gardens, and land in the central portion of the study area was once part of the RAAF Schofields Aerodrome. Land surrounding this portion of the study area is now subject to substantial residential development as defence housing.

Much of the land around the construction footprint and wider study area has been cleared for infrastructure, residential and industrial development. The riparian zone associated with Eastern Creek supports modified stands of native vegetation that occur in a patchy mosaic throughout the locality, frequently bisected by roads, infrastructure and residential development.

3.1.2 Bioregion and IBRA subregion

The development area occurs within the Cumberland IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin IBRA bioregion (refer to Figure 1-1). The Sydney Basin IBRA bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 hectares which includes about 4.53 per cent of NSW. The region extends north from Batemans Bay to Nelson Bay and west to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems.

3.1.3 NSW landscape region (Mitchell Landscapes)

The study area is located within the Hawkesbury - Nepean Channels and Floodplains, and the Cumberland Plain Mitchell Landscapes (DECC 2008a), within the Sydney Basin Bioregion.

The DECC (2008a, 2008b) description of the geology and geomorphology at the study area was confirmed by GHD ecologists during the site inspection. The DECC (2008a, 2008b) description of vegetation at the study area broadly matches the survey results presented in Section 3.2.

3.1.4 Soil landscapes

The construction footprint falls within the Blacktown and South Creek soil landscapes (DPIE, 2021e).

The South Creek landscape comprises the valley flats and drainage areas of the channels of the Cumberland Plain. The geology is alluvial, derved from Wianamatta Group shales and Hawkesbury Sandstone. The Blacktown soil landscape is based on Wianamatta Group shales and features gently undulating topography, generally within the Cumberland lowlands.

3.1.5 Climate

The study area has a temperate climate. Based on data from the Collins Street Seven Hills weather station (067026) located approximately seven kilometres from the study area, the site has a mean annual rainfall of 910.3 mm, falling predominantly in summer and autumn. The site can reach mean daily maximum temperatures of 28.4 degrees and mean daily minimum temperature of 4.5 degrees Celsius (BOM, 2019b).

3.1.6 Hydrology

Eastern Creek is a Fourth order stream that runs perpendicular through the central portion of the study area. The catchment was described in GHD (2013) as follows: "*The surrounding catchment characteristics of Eastern Creek include rural, grazing and market gardening, and urban and industrial land uses. Eastern Creek receives tertiary treated effluent from Quakers Hill Sewerage Treatment Plant (STP), located approximately five kilometres upstream of site 1.*". About 700 metres to the north of the study area, Eastern Creek is spanned by South Street, and the M7 Motorway crosses Eastern Creek about 2.5 kilometres to the south of the study area.

The riparian corridor associated with Eastern Creek generally exists as a narrow strip of highly modified vegetation within a largely urban and rural residential landscape. GHD (2013) notes that "*the flow regime of Eastern Creek is already altered with the discharge upstream from tertiary treated effluent from Quakers Hill STP, as well as a number of pumps observed along Eastern Creek*".

The construction footprint sits around 20 kilometres from the headwaters of Eastern Creek. Upstream from the construction footprint, Eastern Creek exists as a meandering largely urbanised creekline, with occasional deeper pools.

A number of dams occur within the study area, primarily small to medium sized farm dams, as well as one one large dam in Blacktown Council-owned land near the intersection of Burdekin Road and Railway Terrace. The farm dams are generally used by livestock and have little surrounding vegetation. The large dam within Council land does not appear to be accessed or used by any livestock and supports fringing vegetation which provides some habitat for native species.

3.2 Plant community types

Existing regional vegetation mapping of the study area indicates occurrences of Shale Plains Woodland and Alluvial Woodland (NPWS 2002a; 2002b; DPIE 2015). This is broadly in line with the vegetation observed during the field survey. All of the Alluvial Woodland occurs within non-certified areas, while the Shale Plains Woodland occurs within both certified and non-certified areas.

Field surveys confirmed the presence of two native plant community types (PCTs) within the study area:

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT ID 849)
- Forest Red Gum – Rough-barked Apple grassy woodland (PCT ID 835)

These PCTs are described below. Key PCT attributes and the extent within certified and non-certified lands within the study area are summarised in Table 3-2. The mapped extents in the study area are shown on Figure 3-1.

The native vegetation within the study area is in a range of conditions, likely as a result of past and ongoing land uses in adjoining areas. Mature trees are scattered throughout stands of native vegetation within the study area, and there is regeneration of all canopy species evident within all stands of native vegetation. No hollow-bearing trees were recorded. There are a number of weed species, with higher numbers and densities in the most disturbed parts of the study area.

Two exotic vegetation zones (gardens and landscaped areas, and exotic pasture) were also identified in the study area, which do not conform to any native PCT.

Table 3-2 Plant community types within the study area (see Figure 3-1)

Plant community type (PCT)	Condition class	Threatened ecological community?	Total non-certified area (ha) in construction footprint	Total certified area (ha) in construction footprint	Total area (ha) in construction footprint	Area (ha) in study area
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT ID 849)	Poor	Yes – Cumberland Plain Woodland (CEEC, BC Act)	0.21	0.04	0.25	0.72
	High	Yes – Cumberland Plain Woodland (CEEC, BC Act)	0	0	0	0.35
Forest Red Gum – Rough-barked Apple grassy woodland (PCT ID 835)	Poor	Yes – River-flat Eucalypt Forest (EEC, BC Act)	0	0.03	0.03	0.15
	Moderate	Yes – River-flat Eucalypt Forest (EEC, BC Act)	0.35	0	0.35	1.13
Total			**0.56**	**0.07**	**0.63**	**2.35**

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (poor condition) (PCT ID 849)

Vegetation formation: KF_CH3 Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands

PCT: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

Other mapping sources: MU 10 Shale Plains Woodland (NPWS 2002a; b); GW p29 Cumberland Shale Plains Woodland (Tozer *et al*. 2010); PCT 849 (DPIE 2015).

Conservation status: Comprises an occurrence of Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a CEEC under the BC Act. Does not meet the condition thresholds for the EPBC Act-listed CEEC, as discussed further in Section 3.11.2.

Estimate of percent cleared: 93%

Condition: Poor

Plots completed in vegetation zone: Nil. Access was not available to the private properties that supported most of this vegetation zone. The small area that occurs within the patch of land that was accessible was too small to complete a plot/transect in.

Evidence used to define vegetation unit: Largely aligns with existing vegetation mapping of the study area by NPWS (2002 a; b), Tozer *et al*. (2010) and DPIE (2015). Characteristic shale-influenced soil types and geomorphology. The dominant plant species in adjacent better condition vegetation in comparable topographic situations are consistent with the Bionet Vegetation Classification (DPIE 2021c) and the diagnostic species list for the equivalent map unit in Tozer *et al*. (2010).

Landscape position: This community occurs on clay/loam soils derived from Wianamatta Shales on gently undulating low hills and flats. This vegetation zone occurs in the west of the study area to the south of Jersey Road and at the eastern end of the study area in certified land near the intersection of Pelican Road and Burdekin Road, and along Kerry Road, within non-certified land.

Structure	Average height range (m)	Average cover (%)	Typical species
Trees	10	10-15	*Eucalyptus tereticornis, Eucalyptus mollucana*
Small trees	N/A	N/A	N/A
Shrubs	N/A	N/A	N/A
Ground covers	N/A	N/A	N/A
Vines & climbers	N/A	N/A	N/A
Exotic species	0.1-1	60	*Bidens pilosa, Sida rhombifolia, Paspalum dilatatum, Bromus catharticus, Araujia sericifera, Plantago lanceolata, Pennisetum clandestinum, Ehrharta erecta, Sonchus oleraceus, Conyza bonariensis, Lolium perenne, Senecio madagascariensis, Cirsium vulgare, Eragrostis curvula, Modiola caroliniana, Hypochaeris radicata*

Description: This vegetation zone is in poor condition, resulting from previous and ongoing land uses and management such as thinning of canopy species, removal of midstorey species, mowing/slashing of the understorey, and weed invasion along property boundaries and road verges where it occurs. This poor condition form of this PCT exists as highly fragmented patches, including within residential areas where it occurs as canopy trees over exotic or planted horticultural garden species. The canopy is largely intact, and comprises juvenile and sub-mature individuals, that are likely to be regrowth. There are no stag trees or hollow-bearing trees in this vegetation zone. Fallen timber is absent, resulting from 'tidying up'

of properties where this vegetation occurs. The midstorey is absent, and the understorey is dominated by exotic perennial grass species that are actively maintained by mowing/slashing or other garden maintenance activities.

Photograph 1: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (poor condition)

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (high condition) (PCT ID 849)

Vegetation formation: KF_CH3 Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands

PCT: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion

Other mapping sources: MU 10 Shale Plains Woodland (NPWS 2002a; b); GW p29 Cumberland Shale Plains Woodland (Tozer *et al*. 2010); PCT 849 (DPIE 2015).

Conservation status: Comprises an occurrence of Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a CEEC under the BC Act. Does not meet the condition thresholds for the EPBC Act-listed CEEC, as discussed further in section 1.4.6.

Estimate of percent cleared: 93%

Condition: High

Plots completed in vegetation zone: Plot 2-3

Evidence used to define vegetation unit: Largely aligns with existing vegetation mapping of the study area by NPWS (2002 a; b), Tozer *et al*. (2010) and DPIE (2015). Characteristic shale-influenced soil types and geomorphology. The dominant plant species are consistent with the Bionet Vegetation Classification (DPIE 2021c) and the diagnostic species list for the equivalent map unit in Tozer *et al*. (2010).

Landscape position: This community occurs on clay/loam soils derived from Wianamatta Shales on gently undulating low hills and flats. There is one occurrence of this vegetation zone within the study area: south of Jersey Road, in certified land. This vegetation zone does not occur within the construction footprint.

Structure	Average height range (m)	Average cover (%)	Typical species
Trees	10-12	40	*Eucalyptus moluccana, Eucalyptus tereticornis*
Small trees	N/A	N/A	N/A
Shrubs	N/A	N/A	N/A
Ground covers	0-0.8	0.1-50	*Einadia nutans, Bothriochloa macra, Cynodon dactylon, Microlaena stipoides, Chloris truncata, Rytidosperma setaceum, Oxalis perennans, Alternanthera denticulata, Alternanthera nana*
Vines & climbers	N/A	0.1	*Glycine tabacina*
Exotic species	0.1-2	0.1-20	*Paspalum dilatatum, Sida rhombifolia, Setaria parviflora, Eragrostis curvula, Senecio madagascariensis, Opuntia stricta, Plantago lanceolata, Malva parviflora, Solanum sisymbriifolium, Capsella bursa-pastoris, Cenchrus clandestinus, Conyza bonariensis, Araujia sericifera, Bidens Pilosa, Cestrum parqui, Ehrharta erecta, Gomphrena celosioides, Crassula multicava, Talinum paniculatum.*

Description: This vegetation zone is in relatively high condition, with a moderately diverse understorey, despite the presence of exotic species infestations in both the understorey and midstorey. The small, isolated patch of this vegetation type within the study area is fragmented from other native vegetation by about 90 metres, with areas of cleared farming/grazing land in between. There is a larger patch of similar condition vegetation to the west of the study area.

This patch supports an intact canopy but lacks an intact native midstorey. The understorey comprises a mixture of exotic perennial and annual grass and herb species, as well as a range

of native grasses, herbs and climbers. Trees were generally mature, however did not contain any hollows.

Photograph 2: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (high condition)

Forest Red Gum – Rough-barked Apple grassy woodland (poor condition)

(PCT ID 835)

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation class: Coastal Floodplain Wetlands

PCT: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

Other mapping sources: MU 11 Alluvial Woodland (NPWS 2002a; b); FoW p33 Cumberland River Flat Forest (Tozer *et al*. 2010); PCT 834 (DPIE 2015)

Conservation status: Comprises an occurrence of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as an EEC under the BC Act. Does not meet the condition thresholds for the EPBC Act-listed CEEC, as discussed further in Section 3.3.2.

Estimate of percent cleared: 93%

Condition: Poor

Plots completed in vegetation zone: Nil. Access was not available to the private property that supported this vegetation zone. The vegetation was visually scanned from the nearest accessible land which was the street and adjacent Council-owned land.

Evidence used to define vegetation unit: Largely aligns with existing vegetation mapping of the study area by NPWS (2002 a; b), Tozer *et al*. (2010) and DPIE (2015). Characteristic alluvial soil types and geomorphology. The dominant plant species in adjacent better condition vegetation in comparable topographic situations are consistent with the Bionet Vegetation Classification (DPIE 2021c) and the diagnostic species list for the equivalent map unit in Tozer *et al*. (2010).

Landscape position: This community occurs on alluvial soils along drainage lines in the study area. There are very small, isolated patches of this vegetation zone in the eastern portion of the study area, in certified land.

Structure	Average height range (m)	Average cover (%)	Typical species
Trees	8-10	10	*Eucalyptus tereticornis, Casuarina glauca, Eucalyptus moluccana*
Small trees	N/A	N/A	N/A
Shrubs	N/A	N/A	N/A
Ground covers	N/A	N/A	N/A
Vines & climbers	N/A	N/A	N/A
Exotic species	N/A	N/A	N/A

Description: This vegetation zone is in poor condition, resulting from previous and ongoing land use and management, such as thinning (or removal) of canopy species, removal of midstorey species, mowing/slashing of the understorey, and weed invasion along property boundaries and the drainage line along which it occurs. The canopy is sparse, and comprised of sub-mature individuals, that are likely to be regrowth. No hollow-bearing trees were observed in this vegetation zone. The midstorey is absent, and the understorey is dominated by exotic perennial grass species.

Photograph 3: Forest Red Gum – Rough-barked Apple grassy woodland (poor condition) in background

Forest Red Gum – Rough-barked Apple grassy woodland (moderate condition)

(PCT ID 835)

Vegetation formation: KF_CH9 Forested Wetlands

Vegetation class: Coastal Floodplain Wetlands

PCT: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

Other mapping sources: MU 11 Alluvial Woodland (NPWS 2002a; b); FoW p33 Cumberland River Flat Forest (Tozer *et al*. 2010); PCT 834 (DPIE 2015)

Conservation status: Comprises an occurrence of River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as an EEC under the BC Act. Does not meet the condition thresholds for the EPBC Act-listed CEEC, as discussed further in Section 3.3.2.

Estimate of percent cleared: 93%

Condition: Moderate

Plots completed in vegetation zone: Plot 4, Plot 5, Plot 2-1, Plot 2-2

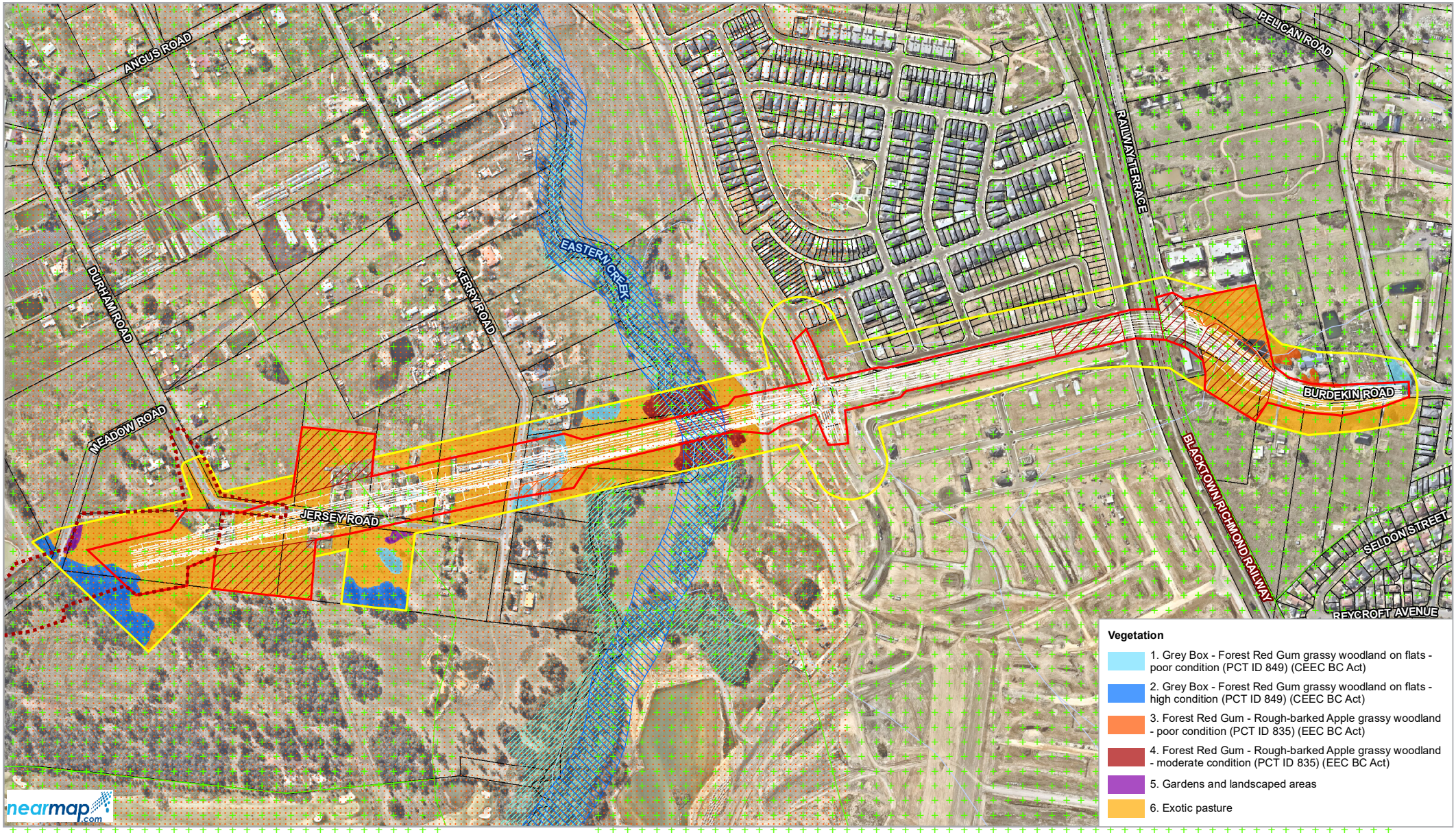
Evidence used to define vegetation unit: Largely aligns with existing vegetation mapping of the study area by NPWS (2002 a; b), Tozer *et al*. (2010) and DPIE (2015). Characteristic alluvial soil types and geomorphology. The dominant plant species are consistent with the Bionet Vegetation Classification (DPIE 2021c) and the diagnostic species list for the equivalent map unit in Tozer *et al*. (2010).

Landscape position: This community occurs on alluvial soils along drainage lines and waterways. Occurrences of this vegetation zone within the study area are associated with the riparian zone along Eastern Creek, all within non-certified land.

Structure	Average height range (m)	Average cover (%)	Typical species
Trees	10	30	*Angophora floribunda, Casuarina glauca*
Small trees	5-8	5	*Melaleuca styphelioides*
Shrubs	N/A	N/A	N/A
Ground covers	0-0.5	0.1-50	*Commelina cyanea, Microlaena stipoides, Oxalis perennans, Oplismenus imbecillis, Persicaria decipiens, Cynodon dactylon, Microlaena stipoides, Commelina cyanea, Cynodon dactylon, Einadia nutans*
Vines & climbers	N/A	N/A	N/A
Exotic species	0-8	0.1-60	*Araujia sericifera, Cardiospermum grandiflorum, Cenchrus clandestinus, Cestrum parqui, Erythrina crista-galli, Euphorbia peplus, Hypochaeris radicata, Ligustrum sinense, Malva parviflora, Nothoscordum borbonicum, Paspalum dilatatum, Ricinus communis, Rumex crispus, Setaria parviflora, Sida rhombifolia, Tradescantia fluminensis, Verbena bonariensis, Zantedeschia aethiopica*

Description: This vegetation zone is in moderate condition, resulting from previous and ongoing land uses, edge effects and management, such as selective logging, historical clearing and weed invasion. The canopy is patchy and is dominated by Casuarina glauca, possibly as a result of salinity issues, selective logging of eucalypt and angophora species, and ongoing disturbance in the local area. No hollow-bearing trees or stag trees were identified in this zone.

Photograph 4: Forest Red Gum – Rough-barked Apple grassy woodland (moderate condition)



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Key fish habitat

Paper Size ISO A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2
Biodiversity Assessment

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

Plant community types

FIGURE 3.1

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Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

3.3 Threatened ecological communities

All occurrences of native vegetation within the study area are commensurate with threatened ecological communities as listed under the BC Act. Table 3-3 below summarises the status of each PCT within the study area (refer to Figure 3-2).

Table 3-3 Threatened ecological communities within the study area

Plant community type (PCT)	Condition class	BC Act status*	EPBC Act status
Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849)	Poor	CEEC	Does not meet the key diagnostic characteristics or condition thresholds for the EPBC Act-listed community.
Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849)	High	CEEC	Does not meet the condition thresholds for the EPBC Act-listed community.
Forest Red Gum – Rough-barked Apple grassy woodland (PCT ID 835)	Poor	EEC	Does not meet the key diagnostic characteristics or condition thresholds for the EPBC Act-listed community.
Forest Red Gum – Rough-barked Apple grassy woodland (PCT ID 835)	Moderate	EEC	Does not meet the key diagnostic characteristics or condition thresholds for the EPBC Act-listed community.

*.CEEC = Critically Endangered Ecological Community; EEC = Endangered Ecological Community

3.3.1 Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849) – poor condition and high condition

Areas mapped as PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (poor condition) and (high condition) comprise an occurrence of the critically endangered ecological community Cumberland Plain Woodland in the Sydney Basin Bioregion listed under the BC Act.

These vegetation zones align with the NSW Scientific Committee's final determination for the BC Act-listed CEEC, in the following ways:

- Geology, soil association, topography, and landscape position;
- Floristic assemblage;
- Structure; and
- Equivalent map unit of DPIE (2015), Tozer *et al.* (2010) and NPWS (2002 a; b) (NSW Scientific Committee, 2020).

These vegetation zones do not meet the condition thresholds (outlined in the listing advice, TSSC, 2009) for the EPBC Act-listed form of this community (Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest) given that:

- The patch size is less than 0.5 ha; and
- Not more than 30% of the perennial understorey vegetation cover is made up of native species.

3.3.2 Forest Red Gum – Rough-barked Apple grassy woodland (PCT ID 835) – poor condition and moderate condition

Areas mapped as PCT 835 Forest Red Gum – Rough-barked Apple grassy woodland – poor condition comprise an occurrence of the EEC River-Flat Eucalypt Forest on Coastal

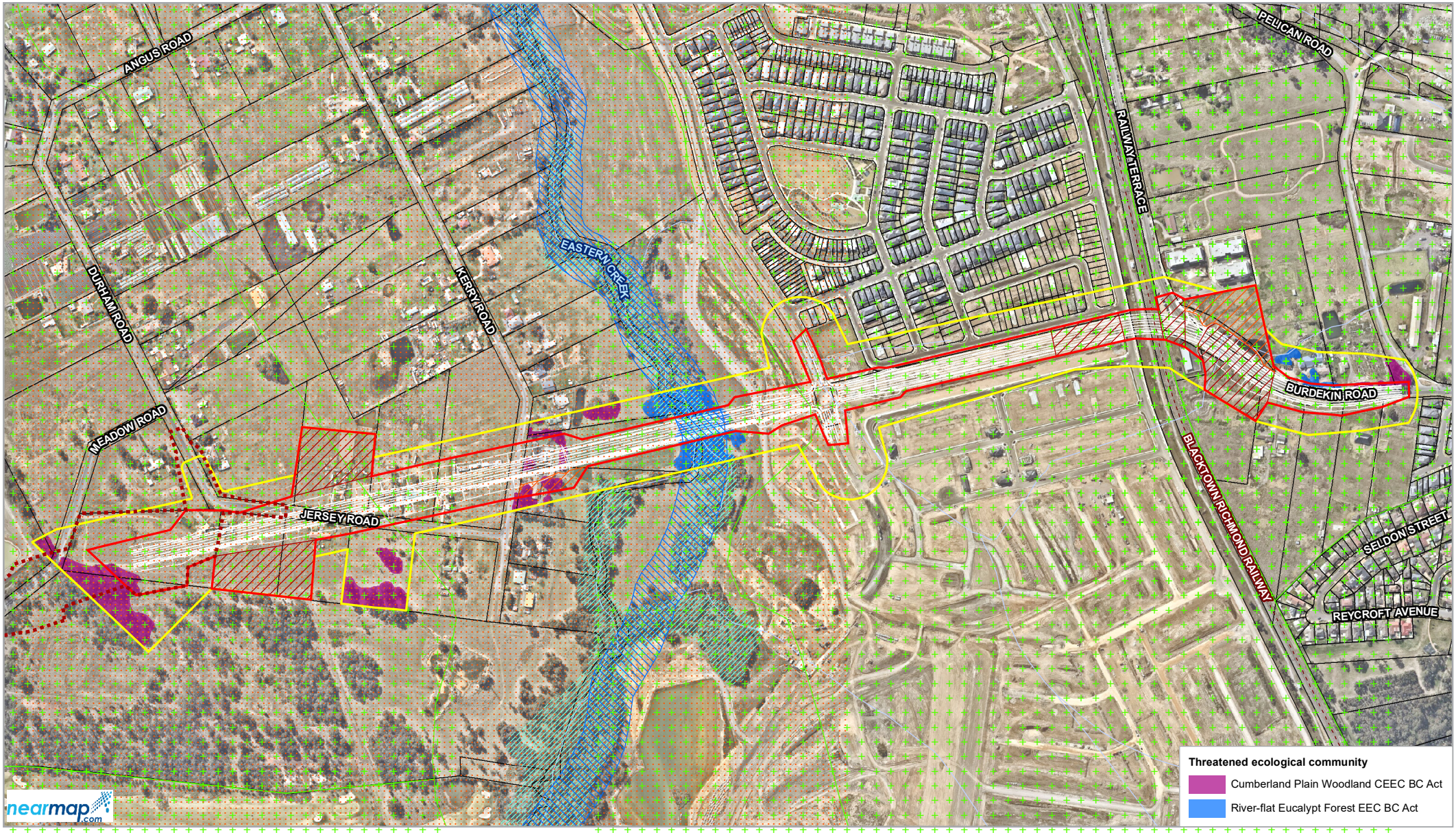
Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions listed under the BC Act.

These vegetation zones align with the NSW Scientific Committee's final determination for the BC Act-listed EEC, in the following ways:

- Soil association, topography, and landscape position;
- Floristic assemblage;
- Structure; and
- Equivalent map unit of DPIE (2015), Tozer *et al*. (2010) and NPWS (2002 a; b) (NSW Scientific Committee, 2019).

This vegetation zone does not meet the key diagnostic characteristic criteria or condition thresholds (outlined in the conservation advice, DAWE 2020) for the EPBC Act-listed form of this community (River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria) for the reasons outlined below:

- Lacks a canopy dominated by characteristic eucalypt or angophora species, with the canopy instead dominated by *Casuarina glauca*, with only scattered *Eucalyptus tereticornis* present.



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Key fish habitat

Paper Size ISO A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2
Biodiversity Assessment

Threatened ecological communities

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

FIGURE 3.2

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Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

3.4 Existing Native Vegetation

The only area of ENV within the construction footprint is located within Eastern Creek (refer to Figure 3-1). This vegetation has been mapped as Forest Red Gum - Rough-barked Apple grassy woodland, in moderate condition (PCT ID 835), and is commensurate with the BC Act endangered ecological community River-flat Eucalypt Forest. Areas mapped as ENV by the Growth Centres SEPP were ground truthed during the field survey (as per Section 2.4.3) and were found to comprise ENV as defined by the Growth Centres SEPP. The proposal would result in impacts to 0.20 hectares of confirmed ENV.

3.5 Fauna

3.5.1 Fauna species

Sixty-one species of fauna were recorded during the survey, of which 36 species were bird species (refer to Appendix A). Seven introduced species (five bird species and two mammal species) were recorded. Two threatened species were recorded during the survey (see Section 3.8.2). Species recorded were typical of modified rural-residential areas, and those capable of persisting in fragmented and modified landscapes.

3.5.2 Terrestrial fauna habitats

Fauna habitats in the construction footprint include cleared agricultural land, planted trees, remnant/regenerating vegetation, dams and creeklines. The various habitats and their biodiversity value are discussed in Tables 3-4 to 3-8 below with reference to their location in certified and non-certified lands.

Table 3-4 Fauna habitats of non-certified land - Exotic pasture

Fauna habitats of non-certified land – Exotic pasture	
Description	Exotic pasture was recorded throughout the construction footprint and comprises a grassy understorey with occasional canopy species and limited midstorey. Exotic pasture is the most common fauna habitat type within the study area. There are mown and unmaintained grassland areas in residential and rural portions of the study area. These areas would have historically supported Cumberland Plain Woodland and River-flat Eucalypt Forest vegetation but have been extensively modified by previous clearing and agriculture. Exotic grassland and cleared land contain few habitat resources of relevance to most native species due to low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species. Mown or maintained grassland has particularly low habitat value as these areas do not provide refuge and cover for smaller fauna species. Mown or maintained grassland was generally seen on roadsides and as garden lawns.

Fauna habitats of non-certified land – Exotic pasture	
Typical fauna species recorded or likely to occur	Fauna recorded in this habitat were largely ground-foraging birds capable of utilising open grassland areas. Bird species recorded include the Welcome Swallow (*Hirundo neoxena*), Willie Wagtail (*Rhipidura leucophrys*) and Common Starling (*Sturnus vulgaris*). Cattle Egrets (*Ardea ibis*) were recorded foraging in thick flooded grassland along Burdekin Road. Other species such as Australian Pipit (*Anthus novaeseelandiae*) were also recorded in dense exotic pasture. The Australian Hobby (*Falco longipennis*) was recorded perching on power poles and flying above exotic pasture along Jersey Road. A number of other raptors, including the Nankeen Kestrel (*Falco cenchroides*) are also likely to hunt over exotic pasture within the construction footprint. Exotic pasture provides foraging habitat for larger herbivorous species, including the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*). Common frogs such as the Common Eastern Froglet (*Crinia signifera*) and Brown Striped-frog (*Limnodynastes peronii*) may occur in small soaks within exotic grassland following rain. Grassland areas also provide habitat for a range of reptile species, including common snakes and small lizards.
Threatened and migratory fauna species recorded or likely to occur	Threatened microbats, including the Eastern Bentwing Bat (*Miniopterus oceanensis*), Little Bentwing Bat (*Miniopterus australis*) and Eastern Free-tailed Bat (*Mormopterus norfolkensis*) may forage on occasion in open areas comprising exotic pasture, or along the ecotone formed where woodland/forest meets areas of grassland. There is marginal habitat for the Green and Golden Bell Frog particularly where *Typha* spp. is present in small drainage depressions within exotic grassland, however this species is thought to be locally extinct in this area. There are only seven records in the locality over the last 20 years, with four records (dated between 2000 and 2016) in Riverstone, at least 3.1 km to the north of the construction footprint, and three records (dated between 2001 and 2012) from Lethbridge Park, Tregear and St Mary's, at least 6.2 km to the west of the construction footprint (DPIE 2021a).

Fauna habitats of non-certified land – Exotic pasture	
Photograph	 Exotic pasture in non-certified land

Table 3-5 Fauna habitats of non-certified land - River-flat Eucalypt Forest

Fauna habitats of non-certified land – River-flat Eucalypt Forest	
Description	River-flat Eucalypt Forest (RFEF) occurs along the banks of Eastern Creek. RFEF in the construction footprint is dominated by dense stands of Swamp Oak (*Casuarina glauca*) with scattered Rough-barked Apple (*Angophora floribunda*) and Prickly-leaved Tea-tree (*Melaleuca styphelioides*). Dense patches of Privet spp. also occur throughout. Habitat resources include sub-mature and mature canopy trees and associated nectar, fruits and leaves as well as foraging substrates for insectivorous species; a range of fruiting and flowering small trees and shrubs; and connectivity with Eastern Creek. No hollow-bearing trees were observed within RFEF in the construction footprint, however higher quality roosting and denning habitat for aboreal mammals, microbats and birds may be present in other parts of higher condition patches of RFEF elsewhere along Eastern Creek. Limited leaf litter was present at the base of eucalypts in RFEF. No nests or dens were observed during the field survey. RFEF vegetation in the construction footprint provides connectivity along the creekline. It would provide stepping-stones for movement of mobile species such as birds across the modified landscape. Native vegetation in these areas is degraded by edge effects associated with the presence of adjoining roads, residential areas, and agricultural clearing.

Fauna habitats of non-certified land – River-flat Eucalypt Forest	
Typical fauna species recorded or likely to occur	A higher diversity of woodland birds than that recorded elsewhere in the study area was recorded within RFEF associated with Eastern Creek, given the semi-intact native vegetation associated with these areas. Species recorded included the Silvereye (*Zosterops lateralis*), Red-browed Finch (*Neochmia temporalis*) and Yellow Thornbill (*Acanthiza nana*). RFEF would provide foraging resources for microbats, with larger trees providing potential habitat for arboreal mammals such as the Brush-tailed Possum (*Trichosurus vulpecula*). Privet thickets provide potnetial drey habitat for Ringtail Possum (*Pseudocheirus peregrinus*) and foraging resources for frugivorous and nectarivorous species. The Grey-headed Flying-fox was recorded foraging in this vegetation type within the study area. The Tawny Frogmouth (*Podargus strigoides*) was observed perching on a mature *Acacia* spp. on the edge of RFEF during nocturnal surveys and is likely to forage in this broad habitat type. Arboreal mammals, including the Sugar Glider (*Petaurus breviceps*) and Brush-tailed Possum may forage within riparian vegetation, and may also be resident in better condition RFEF outside of the study area. A number of reptiles, including skinks (ie *Lampropholis* spp.), Eastern Water Dragon (*Intellagama lesueurii*) and Red-bellied Black Snake (*Pseudechis porphyriacus*) are also likely to occur here. The Common Eastern Froglet (*Crinia signifera*) was recorded calling from standing pools of water within RFEF. The overflow and inundation of floodplain habitat adjacent to Eastern Creek would provide habitat for other common frogs, including the Brown-striped Frog (*Limnodynastes peronii*). Spotted Grass Frogs (*Limnodynastes tasmaniensis*) were heard calling in RFEF immediately adjacent to Eastern Creek. A small herd of feral Red Deer (*Cervus elaphus*) were observed browsing along the edge of RFEF during the field survey.
Threatened and migratory fauna species recorded or likely to occur	Grey-headed Flying-foxes (*Pteropus poliocephalus*) were observed foraging in the canopy of Swamp Oak. The species is also likely to forage within Privet patches and within the canopy of flowering eucalypts along Eastern Creek. RFEF would likely provide foraging habitat for threatened microbats, including the Eastern Bentwing Bat (*Miniopterus australis*) and areas of open water along Eastern Creek provide foraging/hunting habitat for the Southern Myotis (*Myotis Macropus*). RFEF would also provide potential roosting habitat for tree-roosting microbats, including the Eastern Free-tailed Bat (*Mormopterus norfolkensis*). While no hollow-bearing trees were observed within the study area, these species may roost under back or in crevices. The Cumberland Plain Land Snail is unlikely to occur on the margins of, or within areas of RFEF in the study area, as this species typically only occurs in RFEF when it is contiguous with Cumberland Plain Woodland in reasonable condition. Combined with the lack of suitable habitat (absence of woody debris and leaf litter) and poor vegetation condition, this species is unlikely to occur.

Fauna habitats of non-certified land – River-flat Eucalypt Forest	
Photograph	 Riparian habitat at Eastern Creek. Note the presence of emerging Privet and Sida in the foreground.

Table 3-6 Fauna habitats of non-certified land – Modified Cumberland Plain Woodland

Fauna habitats of non-certified land – Cumberland Plain Woodland	
Description	Highly modified Cumberland Plain Woodland in non-certified land occurs on residential properties off Kerry Street and provides low quality habitat resources. The vegetation is highly modified and very patchy, comprising a small number of Forest Red Gum and Grey Box interspersed withplanted exotic trees and shrubs, forming ornamental gardens. There is no intact native vegetation in any stratum, and habitat resources present reflect the degree of modification. Habitat resources include sub-mature and mature canopy trees and planted exotic shrubs, and associated nectar, fruits and leaves as well as foraging substrates for insectivorous species. Myrtaceous species may provide foraging resources for the Grey-headed Flying-fox and microbats, and larger trees provide potential habitat for arboreal mammals such as the Brush-tailed Possum. No hollow-bearing trees were observed in Cumberland Plain Woodland within the study area. Exotic grasses are present in the understorey and are typically slashed or mown regularly. Access was not available to this patch of vegetation during the field surveys, so the presence (and potential density, if present) of leaf litter at the base of eucualypts is not known. However, given that these trees occur within residential lots as part of well-maintained gardens, it is likely that, like the understorey, any leaf litter is also regularly maintained and removed, and therefore this vegetation type would not provide suitable habitat for the Cumberland Plain Land Snail. Modified Cumberland Plain Woodland would provide stepping-stones for movement of mobile species across the modified landscape. Native vegetation in these areas is degraded by edge effects associated with the presence of roads, residential areas, and agricultural clearing.

Fauna habitats of non-certified land – Cumberland Plain Woodland	
Typical fauna species recorded or likely to occur	Few bird species were recorded in this vegetation type during the field surveys. This is likely due to isolated nature and small patch size of this vegetation type, as well as the presence of domestic animals and relatively constance presence of humans. While access was not available to the properties where this vegetation type occurs, the area was scanned from the street for signs of animals, and in particular, birds. Birds recorded comprised those species typical of urban parks and gardens including the Noisy Miner (*Manorina melanocephala*) and Australian Magpie (*Cracticus tibicen*). Planted exotic shrubs would provide habitat for nectarivorous birds, including the Red-browed Finch and Double-barred Finch which which were recorded in nearby planted garden vegetation in certified lands.
Threatened and migratory fauna species recorded or likely to occur	These areas provile potential foraging habitat for threatened microbats, including the Eastern Bentwing Bat (*Miniopterus australis*) and Eastern Free-tailed Bat (*Mormopterus norfolkensis*). The Cumberland Plain Land Snail is unlikely to occur given ongoing garden maintenance and lack of necessary habitat components such as leaf litter and debris to shelter in. Grey-headed Flying-foxes (*Pteropus Poliocephalus*) may forage in the canopy of Forest Red Gum and Grey Box when in flower.
Photograph	 Modified Cumberland Plain Woodland off Kerry Road. Note patchiness of native canopy, presence of ornamental and garden plantings and mown understorey

Table 3-7 Fauna habitats of certified land

Fauna habitats of certified land	
Description	Certified land in the study area mostly comprises exotic pasture, however a small patch of Cumberland Plain Woodland is located off Jersey Road in the western portion of the study area, outside of the construction footprint. This woodland patch is small, isolated and occurs between larger patches of intact native vegetation in the broader study area. There is evidence of edge effects in this patch, with weed invasion, concrete foundations and farm rubbish present, but overall, this patch contains moderate quality habitat for a number of native fauna species. Habitat resources include one small patch of mature canopy trees and associated nectar, fruits and leaves as well as foraging substrates for insectivorous species; a range of fruiting and flowering small trees and shrubs. Myrtaceous species would provide foraging resources for the Grey-headed Flying-fox and microbats, and larger trees provide potential habitat for arboreal mammals such as the Brush-tailed Possum. While no hollow-bearing trees were recorded, some canopy trees were noted as senescent and starting to form hollows along Jersey Road, which may provide denning and roosting habitat for arboreal mammals, microbats and birds in the future. While the mid-storey is not intact, the African Boxthorn that dominates the midstorey of the small patch of Cumberland Plain Woodland would provide shelter, foraging and nesting habitat for small woodland birds. Scattered exotic midstorey species that have been planted or which have self-recruited along roadside verges would also provide similar habitat. Moderate densities of leaf litter were present at the base of eucalypts within the patch of Cumberland Plain Woodland, providing potentially suitable habitat for the Cumberland Plain Land Snail, as well as other small ground-dwelling species such as skinks and invertebrates. This patch is outside of the construction footprint. Exotic pasture includes some ornamental and garden plantings. Habitat resources in exotic pasture include grass seeds and basic refuge and shelter habitat for small reptiles, as well as fruits, nectar and leaves associated with midstorey plantings. There are two culverts within the study area, in certified areas surrounded by exotic pasture. These culverts were associated with ephemeral drainage lines or stormwater drainage infrastructure. Neither of these culverts supported features such as scuppers that would enable microbats to use them as roosting habitat. Both had small diameters and were clogged with aquatic vegetation which would prevent microbats from entering or exiting.

Fauna habitats of certified land	
Typical fauna species recorded or likely to occur	The species recorded in woodland in certified land were similar to those species recorded within the non-certified portions of River-flat Eucalypt Forest, namely generalist species able to persist in modified landscapes. Birds recorded included the Noisy Miner (*Manorina melanocephala*), Magpie-lark (*Grallina cyanoleuca*) and Australian Magpie (*Cracticus tibicen*). Small flocks (up to about 8-10 birds) of Double-barred Finch (*Taeniopygia bichenovii*) and Red-browed Finch (*Neochmia temporalis*) were recorded foraging in exotic shrubs along property boundaries and in self-recruited exotic shrubs growing along roadsides. Arboreal mammals, including the Sugar Glider and possums may forage within Cumberland Plain Woodland vegetation within the wider study area on occasion, as part of a larger home range. Reptiles such as skinks (i.e. *Lampropholis* spp.) and snakes are likely to occur with areas of overgrown exotic pasture as well as within vegetated areas, especially where the understorey is dense. A number of raptors including the Nankeen Kestrel and Australian Hobby would likely hunt over exotic pasture. Exotic pasture provides foraging habitat for larger herbivorous species, including the Eastern Grey Kangaroo and Swamp Wallaby. A small herd of feral Red Deer (*Cervus elaphus*) were observed browsing in exotic pasture during the field survey.
Threatened and migratory fauna species recorded or likely to occur	The grassland provides potential foraging habitat for threatened microbats, including the Eastern Bentwing Bat (*Miniopterus oceanensis*), Little Bentwing Bat (*Miniopterus australis*) and Eastern Free-tailed Bat (*Mormopterus norfolkensis*. The woodland provides potential roosting habitat for tree-roosting microbats, including the Eastern Free-tailed Bat (*Mormopterus norfolkensis*). While no hollow-bearing trees were observed within the study area, these species may roost under bark and in crevices of trees. The Cumberland Plain Land Snail may occur in areas of Cumberland Plain Woodland, where leaf litter and woody debris is present within the wider study area. Grey-headed Flying-foxes (*Pteropus Poliocephalus*) were observed foraging within non-certified lands within the survey. They are also likely to feed on myrtaceous trees and shrubs when in flower, in adjacent certified lands.

Fauna habitats of certified land	
Photographs	 Cumberland Plain Woodland off Jersey Road
	 Exotic grassland off Burdekin Road

3.6 Aquatic habitat

3.6.1 Non-certified areas

Only one waterway, Eastern Creek, intersects the construction footprint. Eastern Creek crosses the central portion of the stage 2 construction footprint between Kerry Road and Aerodrome Driveway. It has a Strahler Stream order of 4. Eastern Creek is classified as Key Fish Habitat according to the NSW Fisheries Data Portal (DPI, 2021) and is defined as Class 2 Moderate Key Fish Habitat according to the Policy and guidelines for fish habitat conservation and management (DPI 2013).

This creekline and the associated riparian zone (described in Section 3.5.2 above) provide potential habitat for aquatic macroinvertebrates and fish, birds, microbats, reptiles and amphibians.

Previous surveys completed about 750 metres north of the current construction footprint, along Eastern Creek, recorded 21 macroinvertebrate species, with very low numbers of species that are sensitive to changes in their environment, suggesting that the condition of the creekline was degraded at the time of the survey (GHD, 2013).

Aquatic habitats as they relate to the current survey and assessment are described in Table 3-8 below.

Table 3-8 Aquatic habitats in Eastern Creek

Eastern Creek	
Description	Eastern Creek is located within non-certified land in the central portion of the Stage 2 construction footprint. The reach of Eastern Creek creek was approximately six metres wide with relatively steep embankments between 1-1.5 metres during surveys. The embankment of the creek plateau into vegetated margins mostly comprising overhanging Swamp Oak which shade the creek. The creek substrate is silt, mud and sand. Turbid water was flowing at the time of survey. Some woody debris was present, particularly at bends in the Creek. No emergent aquatic vegetation was observed in the construction footprint. Eastern Creek is mapped as Key Fish Habitat (DPI, 2021), and as a Cumberland Conservation Corridor and regional biodiversity corridor (priority conservation land – BIO Map) (DPIE 2021b).
Typical fauna species recorded or likely to occur	The noxious fish Common Carp (*Cyprinus carpio*) were observed within Eastern Creek during the survey. Native fish species tolerant of disturbance such as the Firetail Gudgeon (*Hypseleotris galii*) may occur. The Eastern Long-necked Turtle (*Chelodonia longicollis*) is also likely to occur. GHD (2013) field surveys about 750 m north of the study area recorded three fish species within Eastern Creek comprising Anguila sp., Eastern Gambusia (*Gambusia holbrooki*) and Australian Smelt (*Retropina semoni*). Common Eastern Froglets (*Crinia signifera*) were heard calling from Eastern Creek. Spotted Grass Frogs (*Limnodynastes tasmaniensis*) were heard calling in RFEF immediately adjacent to Eastern Creek.

Eastern Creek	
Threatened fauna species recorded or likely to occur	No habitat for threatened fish is present within Eastern Creek. Microbats such as the Southern Myotis (*Myotis macropus*) and Little Bent-winged Bat (*Miniopterus australis*) would forage within and along the riparian corridor. The Southern Myotis would likely forage for fishin pools of open water. A maternity colony of the Southern Myotis was recorded in scuppers in the culvert under the bridge over Bells Creek, about 2 km to the west of Eastern Creek (GHD, 2021). No suitable habitat for creek dependent threatened frogs is present, as these are generally associated with clear, rocky streams located on sandstone substrates higher in the catchment. There is no emgerent aquatic vegetation along Eastern Creek that may provide habitat for the Green and Golden Bell Frog.
Photographs	 
	Aquatic habitat of Eastern Creek

3.6.2 Certified areas

A number of dams are present within the construction footprint within certified land, providing habitat for waterbirds, frogs, eels, turtles and other reptiles. Table 3-9 summarises the aquatic habitats in certified lands.

Table 3-9 Aquatic habitats in dams

Dams	
Description	There are several scattered, small dams in the construction footprint within certified lands. Some dams contain emergent and aquatic vegetation around their edges, providing habitat for a range of fauna species, including frogs and water birds capable of persisting in disturbed rural residential areas. No important breeding habitat for wetland birds is present. The dams are all small, with limited aquatic vegetation present, and subject to ongoing disturbances from vehicles, humans, domestic animals (eg dogs, cats), and/or industrial activities, that would deter or prevent wetlands birds from utilising them. All dams are isolated from any stands of intact native vegetetation, further reducing their suitability as an important fauna resource. Dams are likely to be a water source for species such as bats, birds and macropods.
Typical fauna species recorded or likely to occur	Birds recorded around dams included the Eurasian Coot (*Fulica altra*) and Australian Wood Duck (*Chenonetta jubata*). The Common Eastern Froglet was heard calling from dams and also in adjacent flooded exotic pasture. Other common frogs such as the Brown-striped Frog and Eastern Dwarf Tree Frog (I) are also likely to occur in dams. The noxious fish Eastern Gambusia (*Gambusia holbrooki*) and Common Carp are likely to be present in some dams. The Eastern Long-necked Turtle is also likely to occur.
Threatened fauna species recorded or likely to occur	Microbats such as the Southern Myotis (*Myotis macropus*) and Little Bent-winged Bat (*Miniopterus australis*) would forage on occasion above the dams, and species such as the Grey-headed Flying-fox would likely drink from them at times.

Dams	
Photo	 Aquatic habitat in dam off Burdekin Road

3.7 Groundwater dependent ecosystems

As outlined in the Surface Water and Groundwater Impact Assessment report completed for the proposal (GHD, 2021a), there are two high potential terrestrial GDEs located within and around the proposal area; Cumberland Shale Plains Woodlands, which is mapped as Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849) for this assessment, and Cumberland River Flat Forest, mapped as Forest Red Gum - Rough-barked Apple grassy woodland (PCT ID 835).

The Groundwater Dependent Ecosystems Atlas (BOM, 2021a) identifies a number of terrestrial groundwater dependent ecosystems (GDEs) within the study area. These are linked to vegetation communities, and their likelihood of being a GDE. The GDE Atlas identifies Cumberland River Flat Forest (mapped as Forest Red Gum - Rough-barked Apple grassy woodland (PCT ID 835) for this proposal) as being a high potential GDE, based on the national assessment. The small areas of the study area comprising a modified Cumberland Shale Plains Woodland (mapped as Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849) for this proposal) have not been mapped as potential GDEs, likely due to the small size of the patch and disturbance observed within residential Lots.

3.8 Threatened species and populations

3.8.1 Threatened flora

No threatened flora species were recorded within the Stage 2 construction footprint during the site inspection. Based on the results of the desktop review, 39 threatened flora species or populations have been previously recorded in the locality or are predicted to occur (DPIE 2021a; DAWE, 2021). All of the threatened flora species known or predicted to occur in the locality can be excluded from occurring in the Stage 2 construction footprint, because:

- Easily identifiable ones were not found despite targeted searches during field surveys;
- The construction footprint lacks their specific habitat requirements;
- The degree of existing modification within the proposal footprint is too substantial for them to occur; or
- The construction footprint lacks suitable habitat (refer to Appendix B).

There is a large population of *Grevillea juniperina* subsp. *juniperina* immediately to the west of the Stage 2 construction footprint, within the Stage 1 construction footprint, however no individuals of this easily identifiable species occur within the Stage 2 construction footprint.

There is no suitable habitat for any threatened flora species within the construction footprint.

There is broadly suitable habitat for the endangered population of *Marsdenia viridiflora* subsp. *viridiflora*, and the threatened flora species *Pimelea spicata* in the wider study area, within the area mapped as PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats (high condition), however no such habitat exists in the construction footprint. Surveys for *Pimelea spicata* were undertaken at a suboptimal time to detect this cryptic species, because while it can flower at any time of year, it is most often seen in summer, with flowering likely to be linked to rainfall. Given the survey of the area of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats (high condition) was undertaken in May, detection may have been unlikely. Surveys for *Marsdenia viridiflora* subsp. *viridiflora* can be undertaken at any time of year, as the species is not cryptic and is visible year-round.

3.8.2 Threatened fauna

Two threatened fauna species were observed or positively recorded during the field surveys (see Figure 3-3):

- Grey-headed Flying-fox. This species was recorded foraging in the canopy of fruiting Privet (*Ligustrum* spp.) and Swamp Oak, in vegetation mapped as Forest Red Gum – Rough-barked Apple Grassy Woodland adjacent to Eastern Creek. Up to four individuals were observed flying over the study area during nocturnal surveys. The study area does not contain roost camps for this species, with the nearest camp located about 15 kilometres to the west at Emu Plains (DotE, 2020). Grey Box –Forest Red Gum grassy woodland on flats and Forest Red Gum – Rough-barked Apple Grassy Woodland within non-certified and certified land provide suitable foraging habitat for this species.
- The Little Bent-wing Bat was recorded as a 'probable' occurrence based on Anabat recordings in the study area within non-certified lands. The Little Bent-wing Bat would not breed within the study area as it uses specific nursery caves for breeding. This species is likely to forage along riparian corridors and amongst other patches of native vegetation.

Based on the results of the desktop review, 53 fauna species have been previously recorded in the locality or are predicted to occur (DPIE 2021a; DAWE, 2021a). More than half of the species known or predicted to occur in the locality can be excluded from occurring in the current study area, given their specific habitat requirements and a lack of suitable habitat (refer to Appendix B). Those threatened fauna species recorded or that could possibly occur in the study area based on previous records and/or the presence of suitable habitat are presented in Table 3-10. A detailed assessment of the likelihood of occurrence of threatened fauna species in the study area is provided in Appendix B.

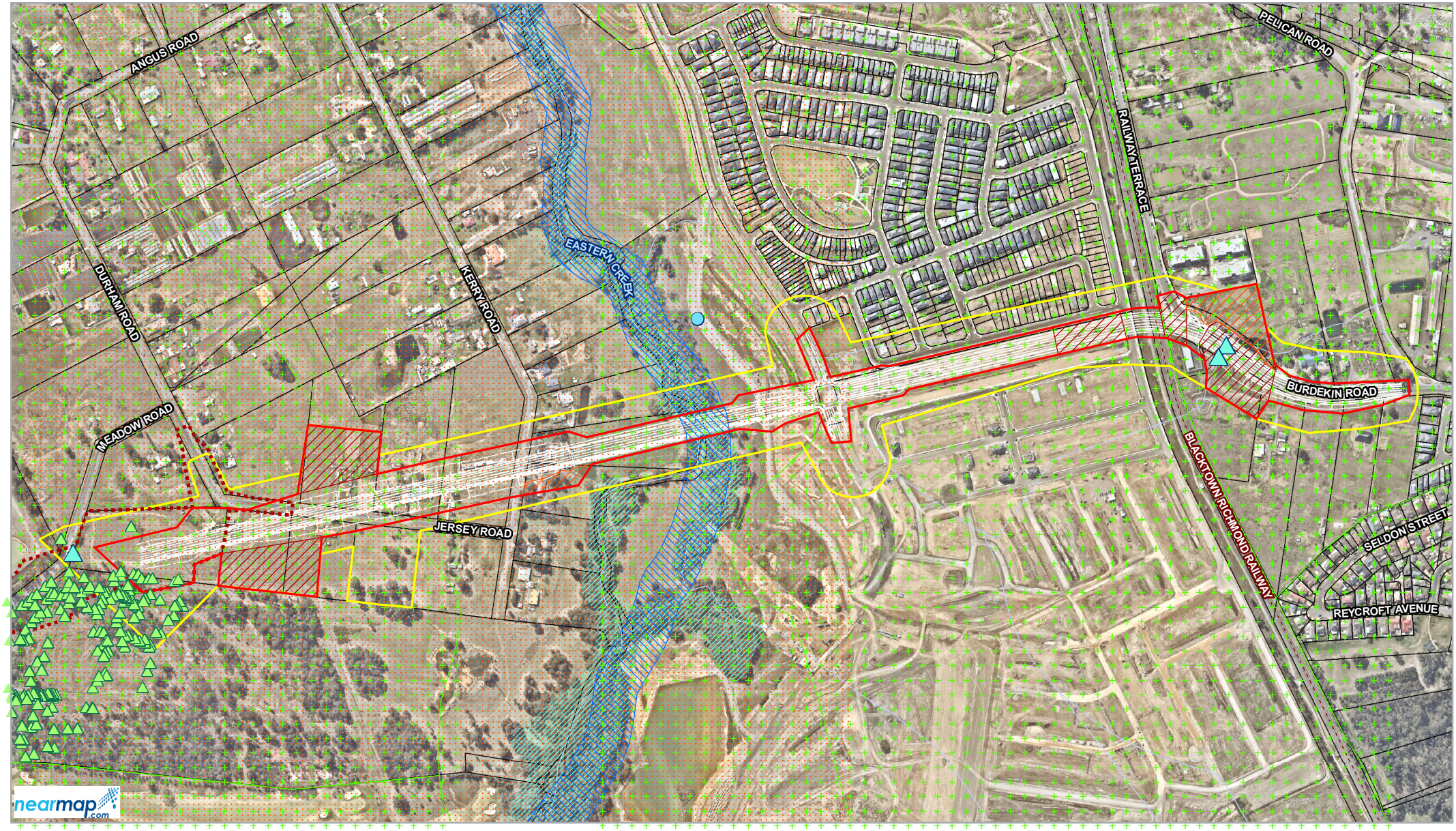
Table 3-10 Likelihood of occurrence of threatened fauna in the study area

Scientific name	Common Name	Status		Potential occurrence	Likelihood of impact
		BC Act	EPBC Act		
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		Possible	Low
Botaurus poiciloptilus	Australasian Bittern	E	E	Possible	Low
Circus assimilis	Spotted Harrier	V		Possible	Low
Hieraaetus morphnoides	Little Eagle	V		Possible	Low
Hirundapus caudacutus	White-throated Needletail		V,C,J,K	Possible	Nil
Ixobrychus flavicollis	Black Bittern	V		Possible	Low
Lophoictinia isura	Square-tailed Kite	V		Possible	Low
Ninox strenua	Powerful Owl	V		Possible	Low
Tyto novaehollandiae	Masked Owl	V		Possible	Low

Scientific name	Common Name	Status		Potential occurrence	Likelihood of impact
		BC Act	EPBC Act		
Litoria aurea	Green and Golden Bell Frog	E	V	Possible	Low
Meridolum corneovirens	Cumberland Plain Land Snail	E		Possible	Low
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Possible	Low
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Possible	Low
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V		Possible	Low
Miniopterus australis	Little Bent-winged Bat	V		Likely[1]	Low
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		Likely	Low
Myotis macropus	Southern Myotis	V		Likely	Low
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Present	Low
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Possible	Low
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Possible	Low

Notes: V=vulnerable, E= endangered, CE= critically endangered, C, J, K = migratory lists
[1] Probable call of this species was recorded in non-certified land st Eastern Creek during November 2019 field surveys

Eastern Creek is classified as Key Fish Habitat according to the NSW Fisheries Data Portal (DPI, 2021) and is defined as Class 2 Moderate Key Fish Habitat according to the Policy and guidelines for fish habitat conservation and management (DPI 2013). The indicative construction area does not contain any defined watercourses or waterbodies that provide suitable habitat for threatened fish listed under the FM Act. The species predicted to occur in the locality (Appendix B) are either associated with clear, deep streams with rocky or gravel substrates, or marine/coastal habitats. These species would not occur in Eastern Creek.



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Key fish habitat
- *Grevillea juniperina* subsp. *juniperina*
- Grey-headed Flying-fox
- Culvert

Paper Size ISO A4

0 100 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2
Biodiversity Assessment

Recorded threatened species

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

FIGURE 3.3

N:\AU\Sydney\Projects\21\12511195\GIS\Maps\Deliverables\Biodiversity\Stage2BiodiversityAssessment\12511195_Z007_Stage2BiodiversityAssessment_ThreatenedSpecies.mxd

Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

3.9 Critical habitat and AOBV

There are no areas of critical habitat or areas of outstanding biodiversity value (AOBV) as listed under the BC Act or EPBC Act of relevance to the study area.

3.10 Wildlife connectivity corridors

Vegetation within the study area and surrounding lands has been heavily modified and disturbed by agricultural activities and clearing for development, and as such there is limited habitat connectivity remaining, with most vegetation occurring as small patches in a predominantly cleared landscape. Key connectivity in the study area and the locality is provided by the riparian corridor along Eastern Creek and also Bells Creek to the west. There are some larger patches of vegetation adjoining or adjacent to Eastern Creek corridor to the north and south of the study area (refer to Figure 1-1).

Eastern Creek is mapped as a Cumberland Conservation Corridor and regional biodiversity corridor (priority conservation land – BIO Map) (DPIE 2021b). The construction footprint is perpendicular to this conservation corridor and interects Eastern Creek in the middle portion of the the study area. While vegetation within this corridor is generally continuous, it is partially fragmented by major roads and overpasses, including the M7 Motorway, Richmond Road and the rail corridor to the south and South Street and Garfield Road West to the north of the study area (refer to Figure 1-1). Further to the north of the intersection of Eastern Creek with Garfield Road West, vegetation associated with Eastern Creek is fragmented, discontinuous and generally narrower in width as it enters more cleared landscapes.

Despite this, Eastern Creek is one of the only remaining vegetated corridors in the locality and provides important connectivity for fauna and flora. Species such as the threatened microbat that was ‘probably’ recorded or those species considered likely to occur in the area (refer to Appendix B), would use this corridor to move between foraging and roosting habitat. This corridor also provides important habitat for small woodland birds.

Eastern Creek was flowing at the time of surveys and provides some connectivity for native fish and other aquatic fauna. As noted earlier, it is mapped as key fish habitat (DPI 2019), however there is no mapping of its status for freshwater fish communities (DPI 2019).

3.11 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) of relevance to the proposal are summarised in Table 3-11, and discussed in greater detail in the following sections.
No world heritage properties, national heritage places, wetlands of national or international importance occur within proximity of the study area.

Table 3-11 Matters of National Environmental Significance

Common name	Scientific name	EPBC Act Status	Potential occurrence within study area	Likelihood of impact
Threatened fauna species				
Australasian Bittern	*Botaurus poiciloptilus*	E	Possible	Low
White-throated Needletail	*Hirundapus caudacutus*	V, C,J,K	Possible	Nil
Green and Golden Bell Frog	*Litoria aurea*	V	Possible	Low
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	Possible	Low
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	Present	Low
Migratory species				
Fork-tailed Swift	*Apus pacificus*	C,J,K	Possible	Nil
Oriental Cuckoo	*Cuculus optatus*	C,J,K	Possible	Low
Latham's Snipe	*Gallinago hardwickii*	C,J,K	Possible	Low
White-throated Needletail	*Hirundapus caudacutus*	V, C,J,K	Possible	Nil
Black-faced Monarch	*Monarcha melanopsis*	M	Possible	Low
Yellow Wagtail	*Motacilla flava*	C,J,K	Possible	Low
Satin Flycatcher	*Myiagra cyanoleuca*	M	Possible	Low
Rufous Fantail	*Rhipidura rufifrons*	M	Possible	Low

Key:
V – Vulnerable
E – Endangered
C – Critically endangered
CEEC – Critically endangered ecological community
M – Migratory or Marine
C – CAMBA
J – JAMBA
K – ROKAMBA

3.11.1 Threatened species

One threatened species listed under the EPBC Act, the Grey-headed Flying-fox, was recorded in the study area during the field survey. An additional four threatened fauna species listed under the EPBC Act have a possible likelihood of occurrence, based on the presence of broadly suitable habitat attributes identified within the study area (refer to Table 3-11).

There is no suitable habitat for any threatened flora species listed under the EPBC Act within non-certified land within the construction footprint.

3.11.2 Threatened ecological communities

As discussed in Section 3.2 and Section 3.3, none of the vegetation within the construction footprint meets the key diagnostic criteria and/or the minimum condition thresholds provided in the listing or conservation advice required for threatened ecological communities listed under the EPBC Act.

3.11.3 Migratory species

No migratory species listed under the EPBC Act were observed within the study area during field surveys. The desktop review identified 21 migratory species predicted to occur within the locality. Of these, nine have the potential to occur in the study area, based on the habitats present (refer Table 3-11 and Appendix A).

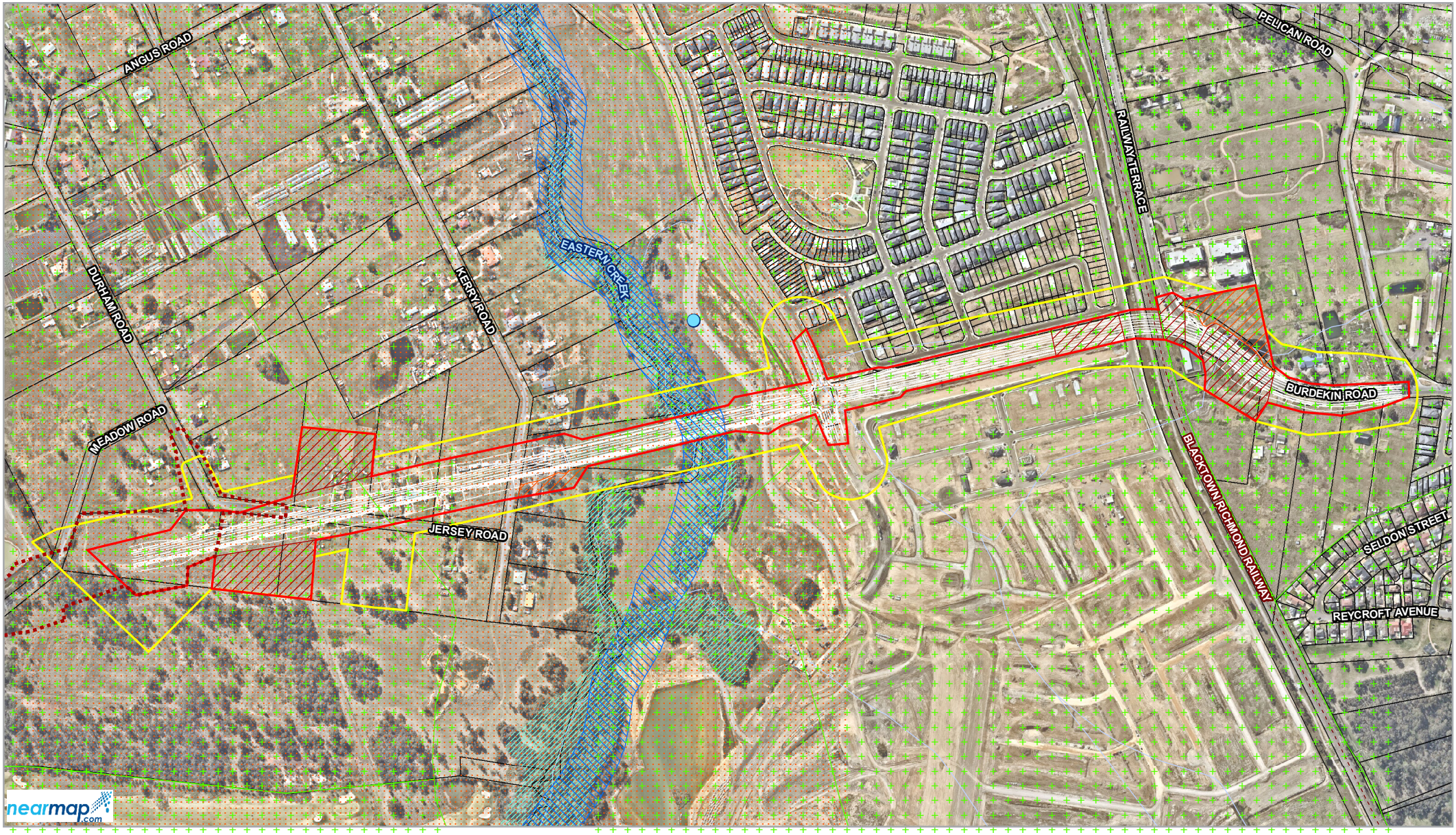
Migratory woodland birds may forage within the study area on occasion, and Latham's Snipe could forage within riparian vegetation along Eastern Creek.

These species may utilise habitats within the study area on an intermittent or transient basis but are unlikely to rely on any habitats within the study area.

Important habitat for these migratory birds is defined in the significance criteria for listed migratory species (DotE 2013) as follows:

- Habitat utilised by a migratory species occasionally or periodically within the region that supports an ecologically significant proportion of the population of the species
- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

The study area is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DotE 2013). This is due to the fact that the habitat in the study area would not support an ecologically significant proportion of the population of these species, is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species' ranges, and is not within an area where these species are declining.



LEGEND

- Stage 2 study area
- Stage 2 construction footprint
- Compound site
- Drainage basin
- Stage 1 REF construction footprint
- The proposal **Subject to detailed design*
- Railway
- Waterways
- Cadastre
- Certified land
- Non certified land
- Existing Native Vegetation (ENV)
- Key fish habitat
- Grey-headed Flying-fox

Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator
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N

GHD

Blacktown City Council
Townson Road Upgrade between Jersey Road and Burdekin Road - Stage 2
Biodiversity Assessment

Matters of National Environmental Significance

Project No. **12511195**
Revision No. **-**
Date **25 Aug 2021**

FIGURE 3.4

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Data source: General Topo - NSW LPI DTDB 2015; Cadastre - NSW LPI DCDB 2019; Key fish habitat, ENV, biocertification, threatened flora/fauna - OEH; Aerial Imagery - Nearmap 2021 (image date 12/09/2019, image extracted 21/09/2019) & Sixmaps 2021 (). Created by: jrprice

3.12 Priority weeds

A number of plant species identified as priority weeds listed under the *Biosecurity Act 2015* for the Greater Sydney region were recorded in the study area, as shown in Table 3-12. These Priority Weeds occur in generally low densities across the construction footprint.

Table 3-12 Priority weeds recorded within the study area and management measures

Scientific name	Common name	Requirements
Olea europaea subsp. *cuspidata*	African Olive	Regional Recommended Measure An exclusion zone is established for all lands in Blue Mountains City Council and Central Coast local government areas. The remainder of the region is classified as the core infestation area. Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers prevent spread from their land where feasible. Land managers reduce impacts from the plant on priority assets.
Opuntia stricta	Prickly Pear	Prohibition on dealings Must not be imported into the State or sold
Lantana camara	Lantana	Prohibition on dealings Must not be imported into the State or sold
Rubus fruticosus species aggregate	Blackberry	Prohibition on dealings Must not be imported into the State or sold
Senecio madagascariensis	Fireweed	Prohibition on dealings Must not be imported into the State or sold
Lycium ferocissimum	African Boxthorn	Prohibition on dealings Must not be imported into the State or sold
Cestrum parqui	Green Cestrum	Regional Recommended Measure Land managers should mitigate the risk of new weeds being introduced to land used for grazing livestock. Land managers should mitigate spread from their land. Plant should not be bought, sold, grown, carried or released into the environment.

4. Impact assessment

The proposal would result in direct impacts on native biota and their habitats within the construction footprint. There is also the potential for indirect impacts on retained areas of native vegetation adjacent to the construction footprint, both during construction and from the resulting operation of the future road.

The proposed Eastern Creek bridge would be a viaduct 300 metres in length and would comprise concrete span deck superstructures with concrete piers. The bridge has a maximum height of around 6.5 metres over Eastern Creek. Given the low height of the bridge, and existing height of the vegetation in this location, a conservative approach to vegetation removal within riparian vegetation associated with Eastern Creek has been undertaken, and full vegetation removal has been assumed.

Specific mitigation measures are recommended to minimise likely impacts on biodiversity values (Section 5.2). These measures are presented according to the hierarchy of avoidance and mitigation of impacts, and the provision of offsets to counter residual impacts of the proposal that cannot be avoided or mitigated (Section 5.2).

4.1 Construction impacts

4.1.1 Removal of native vegetation

The proposal would result in the removal of about 0.63 hectares of native vegetation within an overall construction footprint of about 14.17 ha, as shown on Figure 3-1.

Of these areas, about 0.56 hectares of native vegetation would be removed from non-certified lands, and about 0.07 hectares would be removed from certified lands.

Impacts would include clearing for the permanent infrastructure components of the proposal, including new road areas, road reserve and cut-fill embankments, viaduct bridge piers as well as temporary components such as compound sites, surface water management ponds/infrastructure and all associated earthworks. It is assumed that construction site compounds, temporary sediment management structures and any other ancillary structures would be entirely contained within the construction footprint.

The extent of clearing within the construction footprint is summarised in Table 4-1. The proposal intersects Jersey Road, Aerodrome Driveway and Burdekin Road, however the majority of the proposal is located on agricultural and residential land. These areas support little, if any native vegetation cover and have limited habitat value for native plants. Any vegetation clearing required in these areas would remove a small number of individuals of non-threatened native plants and priority and environmental weeds.

Despite the modified nature of parts of the construction footprint, the proposal would impact on areas of native biodiversity with high conservation value, including clearing of small areas of Cumberland Plain Woodland and River-flat Eucalypt Forest TECs from non-certified areas. While the proposal would impact the riparian corridor associated with Eastern Creek, this would primarily result in impacts to exotic species and highly modified and disturbed native vegetation.

About 0.25 hectares of Cumberland Plain Woodland CEEC (listed under the BC Act) would be removed, from certified and non-certified lands. Up to 0.38 hectares of River-flat Eucalypt Forest EEC and listed under the BC Act would be removed, predominantly from within non-certified lands.

These vegetation types occur as modified patches of vegetation, subject to historical clearing and existing edge effects. Impacts to native vegetation are summarised in Table 4-1.

Table 4-1 Impacts on native vegetation

Plant community type (PCT)	Status		Proposal area[1] (hectares)			Percent cleared in CMA[2]
	BC Act	EPBC Act	Non-certified land	Certified land	Total	
Grey Box - Forest Red Gum grassy woodland on flats - poor condition (PCT ID 849)	CEEC	-	0.21	0.04	0.25	93
Grey Box - Forest Red Gum grassy woodland on flats - high condition (PCT ID 849)	CEEC	-	0	0	0	93
Forest Red Gum - Rough-barked Apple grassy woodland - poor condition (PCT ID 835)	EEC	-	0	0.03	0.03	93
Forest Red Gum - Rough-barked Apple grassy woodland - moderate condition (PCT ID 835)	EEC	-	0.35	0	0.35	93
Total			**0.56**	**0.07**	**0.63**	

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.

2- Based on the VIS classification database.

4.1.2 Impacts to existing native vegetation

The proposal will result in impacts to areas identified as ENV, as shown on Figure 3-1. The proposal will impact on 0.20 hectares of ENV mapped as Forest Red Gum - Rough-barked Apple grassy woodland - moderate condition (PCT ID 835), adjacent to Eastern Creek. This vegetation has been verified and meets the definition of ENV as specified in the Growth Centres SEPP and occurs within non-certified lands in the construction footprint.

4.1.3 Removal of threatened flora species and habitat

As outlined in Section 3.8.1, no threatened flora species were recorded within the Stage 2 construction footprint and none are considered likely to occur (refer to Appendix B). As such, the proposal is unlikely to result in the removal of any threatened flora species or their habitat.

4.1.4 Removal of threatened fauna species habitat

The proposal would remove a small area of foraging habtat for the Grey-headed Flying-fox as well as several species of microbat that have either been recorded within the construction footprint of nearby, or are considered to have the potential to occur. No breeding habitat or roost camps would be impacted.

The proposal would remove up to 0.63 hectares of native vegetation from within the construction footprint, comprising Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849) and Forest Red Gum - Rough-barked Apple grassy woodland (PCT ID 835) in varying conditions. Additional areas of exotic pasture and gardens and landscaped areas would also be impacted. The non-native vegetation types within the construction footprint provide minimal habitat features or resources of importance for native species, given the general lack of fruiting or flowering species present in garden beds (e.g., no suitable foraging habitat for species such as the Grey-headed Flying-fox), and ongoing grazing pressure and management of grassed areas (e.g. slashing/mowing).

Areas of Cumberland Plain Woodland and River-flat Eucalypt Forest in the study area include habitat features or relevance for native fauna speces, including fallen timber, accumulations of leaf litter, and patches of dense shrubs. The proposal would remove known and potential habitat for a range of threatened fauna. The impacts on threatened fauna species are summarised in Table 4-2 and are discussed in more detail in Section 4.4.3.

No stag-trees or hollow-bearing trees would be removed from the construction footprint. Hollow-bearing trees are likely to present in the broader study area in fragmented patches of Cumberland woodland off Jersey Road and also upstream and downstream of the construction footprint at Eastern Creek. The lack of hollow-bearing trees in the broader study area is likely due to historical vegetation clearing. Hollow availability for native species in the wider locality may be limited by occupation of any hollows that are present by the aggressive Noisy Mimer which was observed in the study area.

Given the existing levels of disturbance and impacts from various anthropogenic sources, the study area does not support habitat suitable for many native threatened species. All of the native vegetation that occurs within the study area is modified floristically and structurally, with understorey areas dominated by exotic perennial grasses, and a dominance of exotic species in the midstorey, that favour common generalist fauna species such as Noisy Miners. Notwithstanding this, the study area provides foraging, shelter and nesting habitat for a range of fauna such as common and widespread generalist woodland birds, common reptile species such as small skinks and common frog species, as discussed in Section 3.5.2.

The construction of the proposed viaduct bridge at Eastern Creek could create potential roosting habitat for a range of tree-roosting microbats. Roosting habitat for tree-roosting microbats is currently not present within the construction footprint. There would be a small impact on foraging habitat for the Southern Myotis within Eastern Creek during construction, if water flows are temporarily interrupted.

Eastern Creek does not provide habitat for threatened fish given its highly disturbed condition, turbid nature and location in the landscape. There is likely to be some impact on key fish habitat, with temporary disturbance of fish passage during construction. Impacts on aquatic habitat are discussed further in Section 4.1.5.

Environmental safeguards are proposed in Section 5.2 to minimise the impact on fauna as a result of clearing and loss or disturbance of habitat.

Table 4-2 Impacts on threatened fauna and potential habitat for threatened fauna species

Species	Potential occurrence	Likelihood of impact	Impact within non-certified land
Grey-headed Flying-fox	Present	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No impact to roost camps.
Southern Myotis	Likely	Moderate	Removal of a small amount of dam foraging habitat. Indirect impacts to Eastern Creek.
Cumberland Plain Land Snail	Possible	Low	Removal of 0.21 ha of broadly suitable, poor condition habitat (PCT 849 - poor) from non-certified lands.
Little Bent-winged Bat	Likely	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Australasian Bittern	Possible	Low	Removal of 0.35 ha of potential habitat (PCT 835 – moderate, dam and Eastern Creek) from non-certified lands.
Black Bittern	Possible	Low	Removal of 0.35 ha of potential habitat (PCT 835 – moderate, dam and Eastern Creek) from non-certified lands.

Species	Potential occurrence	Likelihood of impact	Impact within non-certified land
Dusky Woodswallow	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Green and Golden Bell Frog	Possible	Low	Removal of farm dams and impacts to Eastern Creek which represent broadly suitable, poor condition habitat for this species.
Large-eared Pied Bat	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Little Eagle	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No nest sites were recorded within the construction footprint.
Masked Owl	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No breeding habitat would be impacted.
Powerful Owl	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No breeding habitat would be impacted.
Spotted Harrier	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No nest sites were recorded within the construction footprint.
Square-tailed Kite	Possible	Low	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands. No nest sites were recorded within the construction footprint.
Eastern Coastal Free-tailed Bat	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Eastern False Pipistrelle	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Greater Broad-nosed Bat	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Large Bent-winged Bat	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
Yellow-bellied Sheathtail-bat	Possible	Moderate	Removal of 0.56 ha of foraging habitat (comprising all native vegetation types) from non-certified lands.
White-throated Needletail	Possible	Nil	Nil

4.1.5 Aquatic impacts

The construction of the proposed viaduct bridge over Eastern Creek would require the installation of several bridge piers within the floodplain. These bridge piers would be installed outside the low flow channel, but would require excavation within the creek bank and surrounding area. The retention of the low flow channel would continue to provide fish passage. Dry passage for terrestrial fauna during low flow periods would be provided either side of the low flow channel. Scour protection would be included in the design of the bridge to minimise erosion and sedimentation during operation (see Section 5.2).

The proposal would result in the removal of a dam off Burdekin Road from within the construction footprint, within certified land. This dam would be replaced with a drainage basin. The proposed drainage basin is likely to continue to provide foraging resources for species such as the Southern Myotis and several forg species, as well as possible water sources for macropods, birds, and bats. No dams are proposed to be removed within non-certified land. Environmental safeguards are proposed in Section 5.2 to minimise the impact on fauna as a result of clearing and loss or disturbance of habitat for aquatic impacts and include the planting of semi-aquatic vegetation within drainage basins.

4.1.6 Injury and mortality of fauna species

There is potential for injury to, or mortality of, native fauna where native vegetation is to be cleared or disturbed. Tree-dwelling fauna and less mobile, small terrestrial fauna (such as the common frogs and reptiles) that may be sheltering in vegetation within the study area are at most risk. The proposal would also cause displacement of more mobile fauna, through the direct loss of habitat, presence of construction noise and disturbance, and creation of new edges to patches of native vegetation. The magnitude of likely impacts would vary between types of fauna, depending on their size and ecology. Some fauna may be able to seek refuge and persist in alternative habitat outside the construction footprint.

Birds are relatively mobile and so most individuals would be able to avoid vegetation clearing (which is minimal) or construction operations. Most individuals that would be directly affected by construction of the proposal would be displaced initially rather than killed. Continued survival of displaced fauna would depend on the carrying capacities of neighbouring remnants and the existing fauna present and their territories. Many of the small patches in nearby areas are likely to be at carrying capacity already.

Mortality of less mobile individuals, such as nestlings, old or sick birds would also occur. Birds that currently breed in or in the vicinity of the construction footprint, that are likely to include common and widespread species such as Noisy Miners and Australian Magpies, may have breeding success disrupted for one or more seasons. Removal of culverts can result in mortality of roosting microbats if not managed appropriately, however none of the culverts within the construction footprint are suitable for use by microbats, given their small diameter and lack of scuppers or equivalent features that would enable them to roost.

There would be mortality of terrestrial animals less able to avoid the disturbance, including individuals sheltering in leaf litter, woody debris, crevices or under bark. These would include smaller terrestrial mammals, nocturnal species and especially arboreal mammals and microbats which may be sheltering in trees. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows).

Environmental safeguards including pre-clearing surveys, fauna rescue and relocation protocols, are proposed in Section 5.2 to minimise the risk of mortality of fauna as a result of clearing.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity and habitat fragmentation

The proposal would be located in a fragmented, rural-residential landscape, and would involve the extension of Meadow Road to Burdekin Road which is proposed for upgrade. The proposal would create a gap in the Eastern Creek riparian corridor, between Kerry Road and Aerodrome Driveway.

Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings, and construction of linear infrastructure (such as transmission lines and roads). In recent times, large areas have been cleared for residential subdivisions, further fragmenting habitat. These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More mobile species such as birds and bats can readily traverse this landscape. The suite of fauna species recorded in field surveys is dominated by generalist species of open country, reflecting the fragmented nature of vegetation at the construction footprint.

The proposal would clear up to 0.63 hectares of native vegetation, including 0.56 hectares in non-certified lands, comprising modified Cumberland Plain Woodland and riparian vegetation associated with Eastern Creek, which is highly disturbed from historical clearing and current developments. The proposal would also remove a total of 6.72 hectares of exotic vegetation from certified and non-certified lands. The proposal would create a small gap in riparian habitat where vegetation will be removed for the proposed viaduct bridge. While this would slightly increase the degree of fragmentation of stands of habitat within the locality, the proposal is unlikely to completely sever this habitat corridor or fully isolate stands of habitat, given the majority of species that occur within this vegetation are highly mobile and capable of flying between the gaps.

4.2.2 Edge effects on adjacent native vegetation and habitat

Edge effects are described as an ecological impact at two or more interfacing habitat types. Edge effects are inherent or natural in nature but can have negative impacts if their creation alters ecological processes. They also change habitat conditions (such as degree of humidity and exposure to light or wind) created at or near the boundary between areas. In general, edge effects increase in relation to the dissimilarity between adjoining habitats.

Removal of vegetation causes a number of new environmental conditions to develop along the edges of the cleared environments, in particular in environments that originally contain the upper strata levels (canopy and/ or shrub layer) of vegetation. The removal of vegetation generally promotes the invasion of exotic species and/or disturbance tolerant native plants. With the invasion of these new species, it often becomes difficult for the original plant species to recolonise once disturbed.

In general, potential edge effects associated with clearing for development can include the degradation of adjacent habitat through:

- Changes in microclimate (e.g. temperature, wind, light humidity);
- Changes in hydrology (i.e. surface and sub-surface water flows);
- Changes in floristics (i.e. species composition and abundance);
- Creation of new ecotones;
- Alteration to the pattern and frequency of fire;
- Invasion by exotic plant and animal species;
- Increase in sedimentation;
- Increase in tree death (e.g. dieback, impact on root zone); and/or
- Improved access for predators.

The study area is already highly disturbed, and the impacts of edge effects are visible across much of the study area. The proposal is unlikely to substantially increase the influence of edge effects within the study area.

4.2.3 Invasion and spread of weeds

The proposal has the potential to increase the introduction and spread of exotic plants through increased visitation, fragmentation of vegetation and disturbance of soil. Increased weed invasion can lead to decreased diversity of native flora, compromised structural integrity of native vegetation communities and a decrease in habitat quality for native fauna.

Exotic flora species, including a number of priority weeds, are already present throughout the study area. In this context, any increase in weeds as a result of the proposal is therefore likely to have a minor impact on surrounding vegetation and land uses. Nonetheless, weed management measures are proposed in Section 5.2.

4.2.4 Invasion and spread of pests

The proposal is unlikely to result in any increase to, or new invasion or spread of pest fauna within the study area or locality. Numerous introduced fauna species were observed within the study area during the field surveys, including Red Deer, Spotted Doves and Common Mynas. It is likely that other species such as feral cats and foxes are also already well-established in the study area, as they are across much of western Sydney. The proposal will result in impacts to the existing disturbed edges of vegetation and will not open up any new areas of intact vegetation that may facilitate the invasion of pest species.

4.2.5 Invasion and spread of pathogens and disease

Construction activities have the potential to introduce or spread pathogens such as *Phytophthora cinnamomi* (Phytophthora), *Uredo rangelii* (Myrtle Rust) and *Batrachochytrium dendrobatidis* (Chytrid fungus) throughout the study area through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can result in the mortality of entire populations once introduced into an area.

The potential for impacts associated with these pathogens is low, given the disturbed nature of much of the study area, existing visitation levels, and the environmental safeguards that would be implemented during the construction process (see Section 5.2).

4.2.6 Changes to hydrology

The proposal has the potential to result in sedimentation, erosion and pollution within the construction footprint and adjoining areas through soil disturbance and construction activities. Potential sources of soil and water pollution include:

- Soil disturbance during construction activities, including the installation of pre-cast girder piers throughout the floodplain of Eastern Creek
- Inappropriate management of soil and material stockpiles
- Increased sediment transfer and erosion potential in areas cleared of vegetation
- Flood event during construction (particularly during works in Eastern Creek).

Pre-cast girder piers will be located outside of the low flow main creek channel to avoid direct construction impacts on Eastern Creek. Disruption of water flows within the low flow main creek channel of Eastern Creek are not anticipated during construction. Given the placement of piers will be outside of the creek channel, there are unlikely to be any scour effects.

Construction of the bridge structure is likely to result in additional shadowing of the adjacent areas, which may impact on aquatic habitat and adjoining River-flat Eucalypt Forest vegetation. Given how disturbed and modified both the creekline and the vegetation already are, any such impacts are likely to be relatively minor in magnitude.

Sediment laden run-off from the installation of the bridge piers is likely to be generated, and will likely spread around the floodplain in proximity to the piers. This may also take place during 100 year flood events. Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life. Erosion and sedimentation could reduce habitat quality and ecosystem health within River-flat Eucalypt Forest along Eastern Creek. Sediments can smother macroinvertebrate organisms residing in the receiving waterway, alter aquatic habitat by filling interstices of riffle habitat with fine sediment, and reduce water clarity which impacts on the efficiency of submerged aquatic plants to photosynthesise. If severe erosion were to occur, suspended sediment particles could clog or damage gill membranes. All of these altering functions can impact on macroinvertebrates which are a major food source for fish, frogs, wetland birds and some microbats. Notwithstanding, there are already substantial run-off triggers within the local area, which cause substantial sedimentation events post heavy rainfall. The proposal has the potential to result in an increase to these events.

Environmental safeguards to reduce the potential for erosion and sedimentation are described in Section 5.2, and include the use of erosion and sediment control devices.

4.2.7 Noise, light and vibration

The study area currently experiences light, noise and vibration impacts, primarily from heavy traffic flows along Burdekin Road and Meadow Road. Business activities, quarrying, and clearing and building for nearby subdivisions all contribute to existing noise and light levels and vibration in the immediate vicinity of the construction footprint.

The proposal would increase noise and light levels and vibration in the study area during construction, through plant and machinery operation and earth moving activities. Native fauna may temporarily vacate or avoid areas disturbed by construction activities but no substantial impacts on native fauna are anticipated as a result of noise and vibration generated by the proposal. Given the existing noise and vibration levels in the study area, the increase in noise, light and vibration levels as a result of construction is unlikely to substantially impact native biota.

4.2.8 Groundwater dependent ecosystems

The proposal is likely to intercept groundwater around the Eastern Creek viaduct and T1 Western Line bridge, as detailed in GHD (2021a). GHD (2021a) notes that any impacts to groundwater as a result of construction of the proposal would be "*very minor and extremely localised*".

Given the very small area of vegetation that would potentially be impacted by any changes to groundwater, and the location context of the GDEs within a highly modified environment that is already prone to impacts from existing infrastructure and changes to surface and groundwater flows, any impacts on GDEs being retained in adjacent areas is likely to be negligible. As noted in GHD (2021a) "*the risk of occurrence is expected to be low (based on assumed water levels) and any impacts are expected to be minor and temporary*".

4.3 Cumulative impacts

There is extensive development occurring in the Western Sydney region, including, but not limited to transport infrastructure, residential and industrial developments. These development activities include projects of all sizes, from small residential or industrial subdivisions, through to establishment of new motorways, an aerotropolis and new suburbs. Table 4-3 below provides a summary of some of the developments within close proximity to the proposal.

Table 4-3 Current and future projects within close proximity to the proposal

Project	Proponent	Type	Status	Approx. distance from the proposal site	Impact
Marsden Park Public School	NSW Government	Education establishments	Proposed – not yet approved	2.7 km north of proposal	These projects form part of general development in the North West Growth Area. These projects will result in a general increase in traffic, noise, visual and socio-economic impacts and may result in an increase in biodiversity impacts such as removal of native vegetation, habitat features and threatened biota habitat.
Alex Avenue Public School	NSW Government	Education establishments	Current	1.2 km north east of proposal	
ASICS Warehouse Facility	ASICS Oceania Pty Ltd	Industrial development	Proposed – not yet approved	540 m west of proposal	
Lindt Warehouse Facility	Qanstruct (Aust.) Pty Ltd	Industrial development	Proposed – not yet approved	540 m west of proposal	
Swire Warehouse Facility- Mod	Swire Cold Storage Pty Ltd	Industrial development	Proposed – not yet approved	540 m west of proposal	
Marsden Park Warehousing Estate-Modifications	Blacktown Council	Industrial development	Proposed – not yet approved	1.7 km south west of proposal	
Road-Boundary Rd / McCulloch St, Riverstone	Blacktown Council	Transport	Current – due for completion December 2020	4.7 km north east of proposal	
Stormwater detention basin and road construction-Riverstone	Blacktown Council	Transport - road upgrade	Current – due for completion April 2021	6 km north east of proposal	
Commercial development	Kennards	Commercial development	Current	Immediately south of Townson Road/ Richmond Road intersection	These projects have the potential to result in, or have resulted in, impacts to biodiversity values, including removal of native vegetation, habitat features and threatened biota habitat. They may also result in a general increase in traffic, noise, visual and socio-economic impacts
Luxeland	DIHE Holdings Pty Ltd	Residential development	Current	Immediately south of Townson Road	
Alltove Development	Stockland and DHA	Residential development	Current	Immediately north and south of Townson Road (Stage 2)	
‘Compound site’	CSR	Residential development	Unknown	Immediately south of Townson Road	

Given the large number of projects currently underway in Western Sydney, undertaking a comprehensive quantitative analysis of the overall area of impact is challenging. Furthermore, published reports completed for projects in the Growth Centres tend to focus on identifying impacts in non-certified lands, which can be misleading in terms of determining a total cumulative impact on the biodiversity values of the region. All large projects in the locality are resulting in impacts to biodiversity, with the level of impact dependant on the scale of the project, with all impacts being cumulative. This proposal will contribute to the cumulative impacts through native vegetation clearing and loss and disturbance of fauna habitat features and habitat connectivity.

4.4 Assessments of significance

An assessment of the likely significance of impact pursuant to Section 7.3 of the BC Act (5 part test) has been prepared for those threatened biota known or likely to occur within non-certified lands, where the likelihood of any impact on that species is considered to be moderate or high (Appendix C). The outcome of these assessments are summarised in the following sections and in Table 4-4.

Table 4-4 Summary of assessments of significance for impacts on threatened biota in non-certified lands within the study area

BC Act test of significance of impact		
Threatened species, or communities	**Impact**	**Likely significant impact?**
Cumberland Plain Woodland CEEC	Removal of 0.21 ha of native vegetation commensurate with this CEEC from non-certified land	No
River-flat Eucalypt Forest EEC	Removal of 0.35 ha of native vegetation commensurate with this EEC from non-certified land	No
Grey-headed Flying-fox	Removal of 0.56 ha of known foraging habitat from non-certified land	No
Tree-roosting microbats (Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat, Eastern Freetail Bat)	Removal of 0.56 ha of potential foraging habitat from non-certified land	No
Cave/culvert-roosting microbats (Little Bent-winged Bat, Large Bent-winged Bat, Large-eared Pied Bat, Southern Myotis)	Removal of 0.56 ha of potential foraging habitat for the Little Bent-winged Bat, Large Bent-winged Bat and Large-eared Pied Bat from non-certified land. Potential indirect impacts to a small amount of likely foraging habitat within Eastern Creek for Southern Myotis within non-certified lands	No

EPBC Act Assessments of significance		
Threatened species, or communities	**Impact**	**Likely significant impact?**
Grey-headed Flying-fox	Removal of 0.56 ha of known foraging habitat from non-certified land	No

4.4.1 Threatened ecological communities

About 0.21 hectares of Grey Box - Forest Red Gum grassy woodland on flats (PCT ID 849) would be removed from within non-certified land, all of which is in poor condition. All occurrences of PCT 849 within the construction footprint are commensurate with the BC Act-listed critically endangered ecological community (CEEC) Cumberland Plain Woodland in the Sydney Basin Bioregion (Cumberland Plain Woodland), despite being highly modified. This minor reduction in extent would not threaten the viability or persistence of the community in the locality or the region.

The proposal would remove about 0.35 hectares of Forest Red Gum - Rough-barked Apple grassy woodland (PCT ID 835) from non-certified land, all of which is in moderate condition. All occurrences of PCT 835 within the construction footprint are commensurate with the BC Act-listed endangered ecological community (EEC) River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (River-Flat Eucalypt Forest), despite also being highly modified. This minor reduction in extent would not threaten the viability or persistence of the community in the locality or the region.

None of the vegetation within the construction footprint meets the key diagnostic criteria and/or the minimum condition thresholds provided in the listing or conservation advice required for the equivalent threatened ecological communities listed under the EPBC Act.

These vegetation types occur as disturbed patches of vegetation, that have been subject to historical clearing and ongoing edge effects. Tests of significance pursuant to Section 7.3 of the BC Act (see Appendix C) have been prepared to assess the potential impacts on these communities. The proposal is unlikely to have a significant impact on these communities given:

- The small area of each community to be impacted, generally from along the edges of highly modified, disturbed stands of roadside or riparian vegetation
- Clearing involves only a small proportion of the extent of these communities in the locality
- Clearing would result in a reduction of the total patch size of the community in the study area but would not result in the isolation of these communities from other patches
- The small areas of vegetation that would be removed would not be critical for the survival of these communities in the locality
- The proposal would not interfere with the recovery of these communities.

Consequently, a species impact statement or Biodiversity Development Assessment Report (BDAR) would not be required for Cumberland Plain Woodland or River-flat Eucalypt Forest. Environmental safeguards are provided in Section 5.2 to minimise the impacts of the proposal on biodiversity values.

4.4.2 Threatened flora

The proposal would not result in any impacts to threatened flora species, populations or their habitats, and as such, no tests of significance pursuant to Section 7.3 of the BC Act or EPBC Act MNES significance impact criteria have been prepared for threatened flora species or populations.

4.4.3 Threatened fauna

While 20 threatened fauna species have the potential to occur on occasion (refer to section 5.3), the majority of these species are unlikely to be impacted by the proposed works given the limited extent and value of the habitat resources present, and ability of these species to avoid impacts from the proposal. Assessments of significance have been undertaken for those species that were recorded during surveys within the construction footprint or that may utilise habitats on a regular basis. The proposal would not impact significant habitat features such as:

- Hollow-bearing trees (providing potential roosting and denning habitat for a range of birds, reptiles, microbats and arboreal mammals);
- Bridge structures (providing potential roosting habitat for microbats); or
- Large accumulations of leaf litter and woody debris within Cumberland Plain Woodland (providing potential habitat for the Cumberland Plain Land Snail, and reptiles).

Two small culverts may be impacted by the proposal; however, they do not provide suitable roosting habitat for any microbat species.

Up to 0.56 hectares of potential roosting and foraging habitat for threatened microbats would be removed from non-certified lands as a result of the proposal. While no hollow-bearing trees would be removed, some microbats may roost under tree bark and in crevices in trees. Both tree-roosting and culvert/cave-roosting species may forage within the study area on occasion. The study area would likely represent a small proportion of these species' habitat, given their mobile nature. Breeding habitat is unlikely to be present within the study area or construction footprint.

Assessments of significance of impacts on threatened microbats have been prepared in accordance with Section 7.3 of the BC and with consideration of the EPBC Act MNES significance impact criteria. The outcome of these assessments are that the proposal is not likely to have a significant impact on the local population of any species of threatened microbat given:

- The vegetation to be removed comprises a negligible proportion of native vegetation present in surrounding areas and the broader locality;
- No known breeding habitat would be removed or affected; and
- The proposed vegetation removal would not isolate areas of habitat or create barriers to movement for these highly mobile species.

Up to 0.56 hectares of foraging habitat for the Grey-headed Flying-fox would be removed in woodland and forest within the construction footprint in non-certified land. The study area would make up a negligible proportion of its foraging habitat given its wide-ranging nature. No roost camps occur in the study area or immediate vicinity and the study area does not contain breeding habitat for this species.

An assessment of significance of impacts on the Grey-headed Flying-fox has been prepared in accordance with Section 7.3 of the BC and with consideration of the EPBC Act MNES significance impact criteria. The outcome of this assessment is that the proposal is not likely to have a significant impact on the local population of the Grey-headed Flying-fox given:

- The vegetation to be removed comprises a negligible proportion of native vegetation present in surrounding areas and the broader locality;
- No roosting habitat or camp sites would be removed or affected; and
- The proposed vegetation removal would not isolate areas of habitat or create barriers to movement between camp sites or foraging grounds for this species.

A number of other mobile threatened fauna species may occur in the study area on occasion, in most instances on a transient basis. The removal of the small area of River-flat Eucalypt Forest and modified Cumberland Plain Woodland vegetation would have a negligible impact on these species. Any of the more mobile species (e.g. birds) that may occur on occasion would breed elsewhere in the locality, given there is no suitable breeding habitat present within the construction footprint. Foraging resources present within the construction footprint would represent a negligible proportion of the foraging resources of these species available in

the locality. None of these species would rely on the resources present at the site for their continued survival in the locality. Overall, the vegetation within the construction footprint is likely to make a minor contribution to the maintenance of local populations of native species and threatened biota.

Eastern Creek does not contain suitable habitat for threatened aquatic species listed under the FM Act. Therefore, no significant impacts are anticipated on threatened aquatic species within or immediately downstream of the construction footprint.

Environmental safeguards are provided in Section 5.2 to minimise the impacts of the proposal on threatened fauna and fauna habitats.

4.5 Impact summary for non-certified lands

Table 4-5 provides a summary of impacts to native biodiversity in non-certified lands as a result of the proposal. A number of indirect impacts have the potential to occur (see Section 4.2), however provided sufficient mitigation measures are adopted, as per Section 5.2, any impact associated with these matters is likely to be negligible.

Table 4-5 Summary of impacts in non-certified land

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation	Native vegetation	Direct	0.56 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
	Cumberland Plain Woodland CEEC	Direct	0.21 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
	River-flat Eucalypt Forest EEC	Direct	0.35 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
Removal of threatened fauna habitat	Southern Myotis	Direct/ indirect	Indirect impacts on potential foraging habitat along Eastern Creek	Permanent	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
	Tree-roosting microbats (Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat, Eastern Freetail Bat)	Direct	Loss of up to 0.56 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Cave/culvert-roosting microbats (Little Bent-winged Bat, Large Bent-winged Bat, Large-eared Pied Bat, Southern Myotis)	Direct	Loss of up to 0.56 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Cumberland Plain Land Snail	Direct	Loss of 0.21 ha of potential poor quality habitat	Permanent	• Clearing of native vegetation	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
	Grey-headed Flying-fox	Direct	Loss of 0.56 ha of known foraging habitat	Permanent	• Clearing of native vegetation	Known
	Australasian Bittern Black Bittern	Direct	Direct impacts on potential roosting/refuge habitat on Eastern Creek. Indirect impacts on foraging habitat on Eastern Creek	Permanent/ Temporary	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
	Dusky Woodswallow White-throated Needletail	Direct	Loss of 0.56 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Little Eagle Masked Owl Powerful Owl Spotted Harrier Square-tailed Kite	Direct	Loss of 0.56 ha of potential foraging habitat. No impact to breeding habitat.	Permanent	• Clearing of native vegetation	Known
	Green and Golden Bell Frog	Direct	Direct impacts to creekline which represent broadly suitable, poor condition habitat for this species.	Permanent/ Temporary	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
Aquatic impacts	Eastern Creek	Direct	Impacts to creek banks and bed	Temporary	• Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
Injury and mortality of fauna	Tree-dwelling fauna, less-mobile terrestrial fauna	Direct	0.56 ha of native vegetation	Permanent	• Clearing of native vegetation	Known

4.6 Impact summary for certified lands

Table 4-6 provides a summary of impacts to native biodiversity in certified lands as a result of the proposal.

Table 4-6 Summary of impacts in certified land

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation	Native vegetation	Direct	0.07 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
	Cumberland Plain Woodland CEEC	Direct	0.04 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
	River-flat Eucalypt Forest EEC	Direct	0.03 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees	Known
Removal of threatened fauna habitat	Southern Myotis	Direct/ indirect	Direct impacts on potential foraging habitat within the dam off Burdekin Road which will be replaced with a detention basin	Permanent	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
	Tree-roosting microbats (Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat, Eastern Freetail Bat)	Direct	Loss of up to 0.07 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Cave/culvert-roosting microbats (Little Bent-winged Bat, Large Bent-winged Bat, Large-eared Pied Bat, Southern Myotis)	Direct	Loss of up to 0.07 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Cumberland Plain Land Snail	Direct	Loss of 0.04 ha of potential habitat	Permanent	• Clearing of native vegetation	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
	Grey-headed Flying-fox	Direct	Loss of 0.07 of known foraging habitat	Permanent	• Clearing of native vegetation	Known
	Australasian Bittern Black Bittern	Direct	Direct impacts on potential foraging habitat within the dam off Burdekin Road which will be temporarily removed for a detention basin	Permanent/ Temporary	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
	Dusky Woodswallow White-throated Needletail	Direct	Loss of 0.07 ha of potential foraging habitat	Permanent	• Clearing of native vegetation	Known
	Little Eagle Masked Owl Powerful Owl Spotted Harrier Square-tailed Kite	Direct	Loss of 0.07 ha of potential foraging habitat. No impact to breeding habitat.	Permanent	• Clearing of native vegetation	Known
	Green and Golden Bell Frog	Direct	Direct impacts on potential habitat within the dam off Burdekin Road which will be replaced with a detention basin which represent broadly suitable habitat for this species.	Permanent/ Temporary	• Clearing of native vegetation • Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Known
Injury and mortality of fauna	Tree-dwelling fauna, less-mobile terrestrial fauna	Direct	0.07 ha of native vegetation	Permanent	• Clearing of native vegetation	Known

5. Avoid, minimise and mitigate impacts

5.1 Avoidance and minimisation

The proposal is limited in its ability to avoid impacts to areas of high biodiversity value, given it involves upgrades to an existing road. Where possible, ancillary areas such as laydown areas, site compounds and stockpile sites have been located within existing cleared areas, reducing the need for additional unnecessary clearing of native vegetation and flora and fauna habitats. Site compound areas have also been located away from areas of potential wetland and ponded areas. The proposed viaduct bridge over Eastern Creek has been designed so that the piers will not be installed within its low-flow main channel.

5.2 Mitigation measures

The environmental safeguards outlined in Table 5-1 would be implemented to address the potential impacts of the proposal on biodiversity values. A Construction Environmental Management Plan (CEMP) would be prepared, that would identify the specific measures to be implemented during the ‘Pre-construction’ and ‘Construction’ stages of the proposal and would include work methods, contingencies, roles and responsibilities.

Table 5-1 Mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation
General impacts to native biodiversity	Ensure all workers are provided with an environmental induction prior to starting construction activities on site. This will include information on the ecological values of the site and protection measures to be implemented to protect biodiversity during construction.	Prior to construction	Effective
Removal of native vegetation	Native vegetation removal will be minimised through detailed design.	Detailed design	Effective
	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Prior to construction	Effective
	Vegetation removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
	Provision of offsets in line with the requirements of the Biodiversity Certification Order, by carrying out revegetation and/or restoration at a ratio of at least 3:1, for impacts to 0.30 ha of ENV from within non-certified land within the construction footprint.	Prior to construction	Effective
	Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Post construction	Effective
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the construction footprint.	During construction	Proven
	Habitat (for threatened flora and fauna) removal will be minimised through detailed design.	Detailed design	Effective
	Habitat removal will be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
	Habitat will be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the construction footprint.	During construction	Proven
	Pre-clearance surveys will be undertaken by a qualified ecologist and the required methodology will be developed for target species as part of the CEMP. Surveys should include: • A procedure for clearing potential habitat • The presence of an experienced, licenced wildlife carer or ecologist to supervise vegetation clearing and capture and relocate fauna (if required) • The salvage and relocation of habitat features (e.g. leaf litter, hollow logs and branches).	Prior to construction During construction	Effective
	Disturbance and removal of native vegetation and habitat would be unavoidable during the construction phase. To reduce the potential for adverse impacts on ecologically sensitive areas the following measures are recommended: • Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones, as far as possible. • Clearing of mature, hollow-bearing and stag trees should be avoided through refinement during detailed design, where possible. • A suitably qualified ecologist must be engaged prior to any clearing works to physically delineate vegetation to be cleared and/or protected on site and install appropriate signage and high-visibility fencing prior to works commencing. All vegetation outside this fence line will be clearly delineated as an exclusion zone to avoid unnecessary vegetation and habitat removal. Fencing and signage must be maintained for the duration of the construction period. Fencing should be designed to allow fauna to exit the site during clearing activities. • Stockpiles of fill or vegetation should be placed within existing cleared areas (and not within areas of adjoining native vegetation). • Sediment fences should be installed to prevent transfer of sediments into adjacent vegetation. • Implement hygiene protocols to prevent the introduction and spread of weed propagules and soil pathogens. This would include exclusion zones around retained areas of native vegetation.	Detailed design, Prior to construction During construction	Effective

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation
	Bridge design will consider the provision of dry passage under the structure, to allow for improved connectivity for terrestrial species, where possible. Bridge design should also include features such as fauna furniture (eg ledges, bolted poles etc) to allow safe passage of fauna species along the bridge structure and consider 'bat friendly' roost designs.	Detailed design	Effective
	The design of the detention basin will consider the planting of semi-aquatic emergent vegetation, to recreate artificial wetland habitats in the locality.		
Removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the construction footprint.	During construction	Proven
Aquatic impacts	Aquatic habitat will be protected in accordance with *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures* of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013). Detailed design of bridge structures should consider ways to minimise the impacts of shading on adjacent native vegetation and aquatic habitats.	During construction	Effective
Groundwater dependent ecosystems	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Detailed design	Effective
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design.	Detailed design	Effective
Fragmentation of identified habitat corridors	Connectivity measures will be implemented in accordance with the *Wildlife Connectivity Guidelines for Road Projects* (RTA 2011). Native vegetation will be re-established in accordance with *Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011), particularly along the riparian corridor associated with Eastern Creek. Every attempt should be made to retain some riparian vegetation during the construction phase, and revegetation with species characteristic of River-flat Eucalypt Forest should be undertaken following construction.	Detailed design, during construction and post construction	Effective

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
Injury and mortality of fauna	Fauna will be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
	Pre-clearing surveys for the Cumberland Plain Land Snail are recommended within Section 5.2, to be completed within areas of potentially suitable habitat in non-certified land in the construction footprint.	Prior to construction	Effective
Invasion and spread of weeds	Weed species will be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
Invasion and spread of pests	Pest species will be managed within the construction footprint.	During construction	Effective
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective
Noise, light and vibration	Shading and artificial light impacts will be minimised through detailed design.	Detailed design	Effective
Erosion and sedimentation	Erosion and sediment control measures would be established prior to construction in accordance with the principles and guidelines included in *Managing Urban Stormwater: Soils and Construction - Volume 1* (Landcom, 2004) and *Volume 2D of Managing Urban Stormwater: Soils and Construction* (DECC 2008d).	Prior to construction	Proven
	Erosion and sediment control plans would be established prior to the commencement of construction.		
	Controls would be managed and maintained in accordance with the CEMP to ensure their ongoing functionality.		
	Erosion and sediment control controls would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.		
	All stockpiled material should be stored in bunded areas and kept away from waterways to avoid sediment or contaminants entering waterways.		

6. Offset requirements

6.1 Non-statutory offsets

Impacts in non-certified lands have been qualified (refer to Section 4.5), and the TfNSW triggers for offset considered, as per the table below.

TfNSW will provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds summarised in Table 6-1.

None of the triggers are exceeded and as such, there is no requirement for offsets in non-certified lands.

Table 6-1 Offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Requirement for offset?
Activities in accordance with Roads and Maritime Services *Environmental assessment procedure: Routine and Minor Works* (RTA 2011)	No	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	No
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of an CEEC in moderate to good condition	No. 0.21 ha of poor condition Cumberland Plain Woodland listed under the BC Act would be removed from non-certified land. As it is in poor condition, no offset would be required.

Description of activity or impact	Consider offsets or supplementary measures	Requirement for offset?
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	No. River-flat Eucalypt Forest and Cumberland Plain Woodland in the construction footprint do not meet the condition thresholds for the EPBC-Act listed form of these communities. Less than 1 ha of any potential habitat for threatened species listed under the EPBC Act would be required.
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	No. 0.35 ha of River-flat Eucalypt Forest would be removed from non-certified land.
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the DPIE Threatened Species Profile Database (TSPD)	Where clearing > 1 ha or where the species is the subject of an SIS	No. No areas of potential habitat for any threatened flora species would be removed. The proposal would result in the removal of only 0.56 ha of potential foraging habitat for threatened microbats and a number of woodland birds and owls with the potential to occur in the construction footprint, from non-certified land. The proposal would remove 0.56 ha of known foraging habitat for the Grey-headed Flying-fox.
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in DPIE's Threatened Species Profile Database (TSPD)	Where clearing > 5 ha or where the species is the subject of an SIS	No. A total of only 0.56 ha of potential habitat for any threatened ecosystem credit species would be removed.

Description of activity or impact	Consider offsets or supplementary measures	Requirement for offset?
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	No. While Eastern Creek is classified as Type 1 Key Fish Habitat (DPI 2013). The location of bridge piers has been designed to avoid the low-flow channel of Eastern Creek.

6.2 Statutory offsets for existing native vegetation

The clearing of native vegetation and associated habitat for threatened ecological communities, threatened and migratory species within certified areas has already been offset under the North West Growth Centre Biodiversity Certification process (for example by setting aside the Western Sydney Parklands).

Offsets are required under the Biodiversity Certification Order (Minister for the Environment 2007) if any ENV is to be removed from non-certified land. According to relevant biodiversity measure (RBM) 8 of the Biodiversity Certification Order, clearing of ENV in non-certified areas must be offset by either:

a. the protection of an equal or greater area of ENV elsewhere in the Growth Centres, and/or;
b. the revegetation and/or restoration of an area of land elsewhere in the Growth Centres.

According to relevant biodiversity measure 8 of the Biodiversity Certification Order, impacts can be offset by carrying out revegetation and/or restoration at a ratio of at least 3:1.

The proposal will remove about 0.20 hectares of ENV from within non-certified land within the construction footprint. Offsets in line with the Biodiversity Certification Order at the ratio specified within this order (ie, 3:1), would therefore be required.

As the proposal is unlikely to result in a significant impact on any threatened biota, no offsets under the Biodiversity Offsets Scheme are required.

7. Conclusion

TfNSW is proposing to construct a new four-lane divided road along about a 3.6 kilometre Townson Road/Burdekin Road corridor linking Richmond Road, Marsden Park in the west and Burdekin Road, Schofields in the east. This report considers the impacts on biodiversity values of construction of Stage 2 of the project, which is about 2.0 kilometres in length and involves the construction of a new road between the Stage 1 tie-in and Burdekin Road.

The proposal is located within the North West Growth Centre, and largely consists of land certified under the Growth Centres SEPP. Biocertification removes the need to undertake threatened species assessments or prepare SIS for species and communities listed under the BC Act. Activities in biocertified land are taken to be not likely to significantly affect any threatened species, population or ecological community, as these impacts have already been offset, and a determining authority is not required to consider the effect on biodiversity values of the activity in certified areas. This assessment therefore focusses on areas of non-certified land, which for this proposal are generally associated with the riparian zone along Eastern Creek.

Impacts resulting from the proposal are largely unavoidable, giving the location of the existing road and surrounding infrastructure and residential areas. However, additional impacts will be avoided wherever practical through siting stockpile and laydown areas in existing cleared areas or areas that do not support extensive native vegetation in areas of certified land, resulting in a small area of native vegetation to be impacted within non-certified land.

The proposal would remove a total of up to 0.21 hectares of Cumberland Plain Woodland CEEC from within non-certified land, all of which is commensurate with the BC Act community listing. A total of 0.35 hectares of River-flat Eucalypt Forest EEC (as listed under the BC Act) would be removed from non-certified lands. There would be no impact to any vegetation commensurate with threatened ecological communities listed under the EPBC Act.

No threatened flora was identified in the construction footprint during surveys. The proposal would not result in any impacts to threatened flora species, populations or their habitats.

Two threatened fauna species were observed during field surveys:

- Grey-headed Flying-fox – observed foraging within riparian vegetation associated with Eastern Creek. All native vegetation in the construction footprint and wider study area provides suitable foraging habitat for this species, however there is no camp site present.
- Little Bent-winged Bat – recorded as a ‘probable’ occurrence based on Anabat recordings in the study area within non-certified lands in 2019. This species is likely to forage along riparian corridors and amongst other patches of native vegetation but would not breed or roost within the study area or construction footprint.

The proposal would result in the following impacts to threatened fauna species within non-certified land:

- Removal of 0.56 hectares of known foraging habitat for the Grey-headed Flying-fox and Little Bent-winged Bat
- Removal of 0.21 hectares of potential habitat for the Cumberland Plain Land Snail
- Removal of 0.56 hectares of potential foraging habitat for five threatened tree-roosting microbats
- Removal of 0.56 hectares of potential foraging habitat for three threatened culvert-roosting microbats
- Potential indirect impacts to foraging habitat for Southern Myotis
- Removal of 0.56 hectares of potential habitat for a number of woodland birds and owls.

There is no habitat for threatened aquatic fauna listed under the FM Act in the construction footprint or immediately downstream of the proposal, and mitigation measures are proposed to avoid any indirect impacts on aquatic habitats or species. There are unlikely to be any operational impacts on aquatic habitats.

Assessments of the likely significance of impacts of the proposal on ecological communities have been prepared pursuant to Section 7.3 of the BC Act. Impacts of the proposal on Cumberland Plain Woodland and River-flat Eucalypt Forest are unlikely to be significant as only a small area of highly modified vegetation would be removed, that is not critical to the survival of the community.

Assessments of the likely significance of impacts of the proposal on threatened species known to occur within the construction footprint and with the potential to be impacted by the proposal have been prepared pursuant to Section 7.3 of the BC Act. Assessments have been completed for the Grey-headed Flying-fox and several species of microbat. The proposal is unlikely to result in a significant impact on any of these species given the small area of habitat to be impacted and the lack of impacts to any known breeding habitat.

Vegetation to be impacted is not considered to be important habitat for any migratory species listed under the EPBC Act.

As the proposal is unlikely to result in a significant impact on any threatened biota listed under the BC Act, the proposal will not trigger the BOS and assessment and biodiversity offset under the BAM via a BDAR or SIS are not required. Similarly, the proposal will not result in a significant impact on threatened biota or migratory species listed under the EPBC Act and Referral of the proposal to the Australian Minister for the Environment is not considered necessary.

Offsets are required under the Biodiversity Certification Order (Minister for the Environment 2007) for the removal of 0.20 hectares of Existing Native Vegetation (ENV) from non-certified land within the construction footprint.

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Appendix A – Species recorded

Flora species recorded in the study area

Family	Scientific name	Common name	Growth form	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 5 Cover	Plot 5 Abundance	Plot 2-1 Cover	Plot 2-1 Abundance	Plot 2-2 Cover	Plot 2-2 Abundance	Plot 2-3 Cover	Plot 2-3 Abundance	Opportunistic observations
Alliaceae	*Nothoscordum borbonicum*	Onion Weed	EX	*							0.1	20			
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	FG										0.1	1	
Amaranthaceae	*Alternanthera nana*	Hairy Joyweed	FG										0.1	1	
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed	EX	*									0.1	1	
Apiaceae	*Cyclospermum leptophyllum*	Slender Celery	EX	*	0.1	10									
Apocynaceae	*Araujia sericifera*	Moth Vine	HT	*					2	50			0.2	5	
Araceae	*Zantedeschia aethiopica*	Arum Lily	EX	*							0.1	1			
Asphodelaceae	*Asphodelus fistulosus*	Onion Weed	EX	*			5	500							
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	EX	*									0.2	5	
Asteraceae	*Cirsium vulgare*	Spear Thistle	EX	*	0.1	5									
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	EX	*									0.1	2	
Asteraceae	*Hypochaeris radicata*	Catsear	EX	*					0.1	1					
Asteraceae	*Senecio madagascariensis*	Fireweed	HT	*			2	200					1	8	X
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	EX	*	0.1	15									
Brassicaceae	*Capsella bursa-pastoris*	Shepherd's Purse	EX	*									0.2	50	
Cactaceae	*Opuntia stricta*	Common Prickly Pear	EX	*									1	6	X
Casuarinaceae	*Casuarina glauca*	Swamp Oak	TG		30	15			30	43	5	5			
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush	FG		0.1	20					0.1	2	1	10	
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	FG		1	50			5	1000	1	50			
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	HT	*	1	10			60	1000	5	100			
Convolvulaceae	*Dichondra repens*	Kidney Weed	FG		1	100									
Crassulaceae	*Crassula multicava*		EX	*									0.1	5	
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	HT	*	5	30									
Cyperaceae	*Cyperus spp.*		GG		0.1	50									
Euphorbiaceae	*Euphorbia peplus*	Petty Spurge	EX	*					0.1	100					
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant	HT	*					0.2	1					
Fabaceae (Caesalpinioideae)	*Senna pendula* var. *glabrata*		HT	*	0.1	20									
Fabaceae (Faboideae)	*Erythrina crista-galli*	Cockspur Coral Tree	HT	*	1	20			1	3	5	3			
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	OG				0.1	5					0.1	3	
Fabaceae (Faboideae)	*Vicia sativa*	Common vetch	EX	*			0.1	20							
Geraniaceae	*Geranium homeanum*		FG		1	50									
Malvaceae	*Malva parviflora*	Small-flowered Mallow	EX	*					0.1	3	0.1	20	0.1	10	

Family	Scientific name	Common name	Growth form	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 5 Cover	Plot 5 Abundance	Plot 2-1 Cover	Plot 2-1 Abundance	Plot 2-2 Cover	Plot 2-2 Abundance	Plot 2-3 Cover	Plot 2-3 Abundance	Opportunistic observations
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	EX	*	0.5	50									
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	EX	*	5	150			40	500	2	50	2	50	
Myrsinaceae	*Lysimachia arvensis*	Scarlet Pimpernel	EX	*	1	50									
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	TG						2	1					
Myrtaceae	*Eucalyptus moluccana*	Grey Box	TG										15	3	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	TG										0.2	1	
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	SG								5	2			
Oleaceae	*Ligustrum sinense*	Small-leaved Privet	HT	*	10	150			10	200	10	60			
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	HT	*											X
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	EX	*	0.1	50									
Oxalidaceae	*Oxalis perennans*		FG		0.1	100			0.1	50			0.1	40	
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	EX	*			1	200					0.5	50	
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass	GG		1	20									
Poaceae	*Bothriochloa macra*	Red Grass	GG										50	300	
Poaceae	*Briza subaristata*		EX	*			60	1000							
Poaceae	*Bromus catharticus*	Praire Grass	EX	*	0.1	10	0.5	100							
Poaceae	*Bromus diandrus*	Great Brome	HT	*			0.2	20							
Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	HT	*			5	500			40	1000	5	500	
Poaceae	*Chloris truncata*	Windmill Grass	GG										5	50	
Poaceae	*Cynodon dactylon*	Common Couch	GG				20	1000	2	500	5	500	5	50	
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	HT	*	0.5	20							0.2	10	
Poaceae	*Entolasia stricta*	Wiry Panic	GG				0.1	50							
Poaceae	*Eragrostis curvula*	African Lovegrass	HT	*			0.5	10					20	100	
Poaceae	*Lolium perenne*	Perennial Ryegrass	EX	*	0.1	50	1	100							
Poaceae	*Microlaena stipoides*	Weeping Grass	GG		1	100			30	1000	50	1000	10	100	
Poaceae	*Oplismenus aemulus*		GG		0.5	50									
Poaceae	*Oplismenus imbecillis*		GG						1	500					
Poaceae	*Paspalum dilatatum*	Paspalum	HT	*			10	500			10	500	20	100	
Poaceae	*Rytidosperma setaceum*	Small-flowered Wallaby-grass	GG										1	10	
Poaceae	*Setaria parviflora*		EX	*							5	200	20	200	
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	FG						0.1	5					
Polygonaceae	*Persicaria* spp.	Knotweed	FG	*	5	50									
Polygonaceae	*Rumex crispus*	Curled Dock	EX	*			0.1	20	0.1	1	0.1	6			
Portulacaceae	*Talinum paniculatum*		EX	*									0.1	1	
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	HT	*											X
Rubiaceae	*Asperula conferta*	Common Woodruff	FG				0.1	50							

Family	Scientific name	Common name	Growth form	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 5 Cover	Plot 5 Abundance	Plot 2-1 Cover	Plot 2-1 Abundance	Plot 2-2 Cover	Plot 2-2 Abundance	Plot 2-3 Cover	Plot 2-3 Abundance	Opportunistic observations
Sapindaceae	*Cardiospermum grandiflorum*	Balloon Vine	HT	*	0.1	50			20	50	10	50			
Solanaceae	*Cestrum parqui*	Green Cestrum	HT	*					1	12	5	16	0.1	1	X
Solanaceae	*Lycium ferocissimum*	African Boxthorn	HT	*											X
Solanaceae	*Solanum sisymbriifolium*		EX	*									0.2	50	
Verbenaceae	*Lantana camara*	Lantana	HT	*											X
Verbenaceae	*Verbena bonariensis*	Purpletop	EX	*			1	100	0.2	20					

Notes:
Cover: 0.1, 0.2, 0.3…1, 2, 3…10, 15, 20, 25…100…
Abundance: Counts of 1, 2, 3…, estimates of 100, 200, 300…,1000, 2000, 3000…
Opportunistic observations: X= recorded
Growth form: TG=Tree; SG=Shrub; GG=Grass and grass-like; FG=forb; EG=Fern; OG=Other; HT=High Threat Exotic, EX= exotic

BAM vegetation integrity plot data

				Composition (species richness)							Structure (% cover)						Function												
Veg Zone	PCT	Condition	Plot	TG	SG	GG	FG	EG	OG	Total	TG	SG	GG	FG	EG	OG	Large trees	Hollow trees	Litter cover (%)	Fallen logs (m)	Tree DBH 5-10 (cm)	Tree DBH 10-20 (cm)	Tree DBH 20-30 (cm)	Tree DBH 30-50 (cm)	Tree DBH 50-80 (cm)	Tree regen	HTE cover (total)	Zone	Easting	Northing	Bearing
			Benchmark	**5**	**8**	**12**	**14**	**2**	**5**	**46**	**53**	**16**	**58**	**9**	**1**	**4**	**3**		**40**	**40**											
2	849	High	2-3	2	0	5	4	0	1	12	15.2	0.0	71.0	1.3	0.0	0.1	3	0	4.4	0.0	0	0	1	1	1	0	47.7	56	301892	6267558	102
			Benchmark	**4**	**8**	**8**	**8**	**2**	**4**	**34**	**22**	**22**	**70**	**3**	**1**	**1**	**1**		**40**	**12**											
4	835	Moderate	4	1	0	4	6	0	0	11	30.0	0.0	2.6	8.2	0.0	0.0	2	0	48.0	30.0	1	1	1	1	1	1	17.7	56	302451	6267784	0
			2-1	3	0	3	3	0	0	9	42.0	0.0	33.0	5.2	0.0	0.0	3	0	8.2	3.0	0	1	1	1	1	1	96.2	56	302387	6267854	120
			2-2	3	1	2	2	0	0	8	25.0	20.0	55.0	1.1	0.0	0.0	1	0	14.8	0.0	1	1	1	1	1	0	152.1	56	302435	6267801	140
			Benchmark	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**										
6	n/a	Exotic pasture	5	0	0	2	1	0	1	4	0	0	20.1	0.1	0	0.1	0	0	26	0	0	0	0	0	0	0	77.7	56	302483	6267811	230

Note: Growth form: TG=Tree; SG=Shrub; GG=Grass and grass-like; FG=forb; EG=Fern; OG=Other; HT=High Threat Exotic

BBAM vegetation integrity plot data

Veg Zone	PCT	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
2	849	Benchmark	46	8	12	14	2	5	0	> =	1	> =			
		2-3	12	18.5	0	26	0	2	80	0	0	0	301892	6267558	56
4	835	Benchmark	34	8	8	8	2	4	0	> =	1	> =			
		4	11	15	11.5	8	0	10	17.5	0	0.7	30	302451	6267784	56
		2-1	9	37	1.3	36	2	16	94	0	0.7	3	302387	6267854	56
		2-2	8	31	2.2	30	2	4	76	0	0.7	0	302435	6267801	56
6	Exotic pasture	Benchmark	-	-	-	-	-	-	0	> =	1	> =			
		5	4	0	0	30	0	0	63	0	0	0	302483	6267811	56

Fauna species recorded in the study area

Class	Common name	Scientific name	Exotic	BC Act Status	EPBC Act Status	Observation Type
Frogs	Broad-palmed Frog	*Litoria latopalmata*				O
Frogs	Brown-striped Frog	*Limnodynastes peronii*				OW
Frogs	Common Eastern Froglet	*Crinia signifera*				W
Frogs	Eastern Dwarf Tree Frog	*Litoria fallax*				W
Frogs	Peron's Tree Frog	*Litoria peronii*				O
Frogs	Spotted Grass Frog	*Limnodynastes tasmaniensis*				O
Frogs	Verreaux's Frog	*Litoria verreauxii*				W
Birds	Australian Hobby	*Falco longipennis*				O
Birds	Australian Magpie	*Cracticus tibicen*				OW
Birds	Australian Raven	*Corvus coronoides*				OW
Birds	Australian White Ibis	*Threskiornis molucca*				O
Birds	Australian Wood Duck	*Chenonetta jubata*				O
Birds	Cattle Egret	*Ardea ibis*				O
Birds	Common Myna	*Sturnus tristis*	*			OW
Birds	Common Starling	*Sturnus vulgaris*	*			O
Birds	Double-barred Finch	*Taeniopygia bichenovii*				OW
Birds	Eastern Koel	*Eudynamys orientalis*				OW
Birds	Eastern Rosella	*Platycercus eximius*				OW
Birds	Eurasian Coot	*Fulica atra*				O
Birds	Grey Fantail	*Rhipidura albiscapa*				OW
Birds	House Sparrow	*Passer domesticus*	*			OW
Birds	Laughing Kookaburra	*Dacelo novaeguineae*				O
Birds	Little Pied Cormorant	*Microcarbo melanoleucos*				O
Birds	Magpie-lark	*Grallina cyanoleuca*				OW
Birds	Masked Lapwing	*Vanellus miles*				OW
Birds	Noisy Miner	*Manorina melanocephala*				OW
Birds	Rainbow Lorikeet	*Trichoglossus haematodus*				OW
Birds	Red-browed Finch	*Neochmia temporalis*				O
Birds	Red-rumped Parrot	*Psephotus haematonotus*				O
Birds	Rock Dove	*Columba livia*	*			OW

Class	Common name	Scientific name	Exotic	BC Act Status	EPBC Act Status	Observation Type
Birds	Sacred Kingfisher	*Todiramphus sanctus*				O
Birds	Scarlet Honeyeater	*Myzomela sanguinolenta*				O
Birds	Silvereye	*Zosterops lateralis*				OW
Birds	Spotted Pardalote	*Pardalotus punctatus*				OW
Birds	Spotted Turtle-Dove	*Streptopelia chinensis*	*			OW
Birds	Superb Fairy-wren	*Malurus cyaneus*				OW
Birds	Tawny Frogmouth	*Podargus strigoides*				O
Birds	Tawny Grassbird	*Megalurus timoriensis*				O
Birds	Welcome Swallow	*Hirundo neoxena*				O
Birds	White-throated Gerygone	*Gerygone olivacea*				OW
Birds	Willie Wagtail	*Rhipidura leucophrys*				OW
Birds	Yellow Thornbill	*Acanthiza nana*				OW
Birds	Yellow-faced Honeyeater	*Caligavis chrysops*				OW
Mammalia	Common Ringtail Possum	*Pseudocheirus peregrinus*				O
Mammalia	European cattle	*Bos taurus*	*			O
Mammalia	Gould's Wattled Bat	*Chalinolobus gouldii*				U (D)
Mammalia	Grey-headed Flying-fox	*Pteropus poliocephalus*		V	V	O
Mammalia	Little Bentwing-Bat	*Miniopterus australis*		V		U (Pr)
Mammalia	Red Deer	*Cervus elaphus*	*			O
Mammalia	White-striped Freetail-bat	*Austronomus australis*				W
Mammalia		*C. gouldii/ M. ozimops ridei/ M. norfolkensis*				U (SG)
Mammalia		*Nyctophilus geoffroyi/ N. gouldi*				U (D)
Mammalia		*Nyctophilus spp. / Myotis macropus*				U (SG)
Mammalia		*Vespadelus darlingtoni/ V regulus*				U (SG)
Reptilia	Eastern Water Dragon	*Intellagama lesueurii*				O

Notes: O=observed, W= heard, OW= observed and heard, U (D)= 'definite' call recorded via Anabat analysis, U (Pr)= 'probable' call recorded via Anabat analysis, U (SG)= Call identified to species guild via Anabat analysis.
V= listed as a vulnerable species under the BC and/or EPBC Acts

Appendix B – Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Present	The species was observed in the study area during the current survey
Possible	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Unlikely	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Nil	Suitable habitat is absent from the study area.

Flora habitat assessment table

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Acacia bynoeana	Bynoe's Wattle	E	V	24 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Endemic to central eastern NSW, known a limited number of locations, often comprising populations of few plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Unlikely. No sandy soils present in the study area, and no known vegetation associations present.	Nil
Acacia gordonii		E	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Disjunct populations in the lower Blue Mountains and the South Maroota/Glenorie areas, within the Hawkesbury, The Hills and Blue Mountains LGAs. Grows in dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.	Unlikely. Outside of known range, and no rock platforms or sandstone outcrops present in study area.	Nil
Acacia pubescens	Downy Wattle	V	V	29 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Unlikely. No characteristic gravel soils present.	Nil
Allocasuarina glareicola		E	E	15 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Unlikely. No characteristic alluvial gravels present.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Asterolasia elegans		E	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Unlikely. Outside of known range. No sandstone, rocky outcrops or boulders present in study area.	Nil
Callistemon linearifolius	Netted Bottle Brush	V		1 record within 10km (DPIE 2020a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Unlikely. Known from only 5-6 populations in Sydney. Study area is not on the Hornsby Plateau.	Nil
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Unlikely. No local records. No known habitat associations present in study area. No known soil preferences present in study area.	Nil
Cynanchum elegans	White-flowered Wax Plant	E	E	Species or species' habitat likely to occur within 10km (DAWE 2020a)	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Unlikely. No local records, no known vegetation associations present in the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Darwinia biflora		V	V	450 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Known from north and north-western Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai LGAs. Grows on the edges of weathered shale-capped ridges, at the intergrade with Hawkesbury Sandstone. Occurs in woodland, open forest and scrub/heath. Associated overstorey species include Scribbly Gum, Red Bloodwood and/or Scaly Bark.	Unlikely. Study area is outside of known area of occurrence. No shale-capped ridges or integrades with sandstone, or associated overstorey species present in study area.	Nil
Dillwynia tenuifolia		V		491 records within 10km (DPIE 2020a)	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	Unlikely. No associated communities present in the study area. Understorey and midstorey of the entire study area is highly disturbed, and very few native shrubs were evident during any of the field surveys.	Nil
Epacris purpurascens var. *purpurascens*		V		68 records within 10km (DPIE 2020a)	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	Unlikely. No known preferred soil types in the study area. No unidentified Epacrid species were noted during the field surveys.	Nil
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	3 records within 10km (DPIE 2020a)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Nil. Outside species natural range.	Nil
Eucalyptus sp. Cattai		CE	CE	379 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs between Colo Heights and Castle Hill, in NW Sydney, though it historically extended through to central areas of Sydney. Grows in scrub, heath and low woodland on sandy soils, generally on flat ridge tops.	Unlikely. No flat ridge tops in study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Genoplesium baueri	Yellow Gnat-orchid	E	E	Species or species' habitat likely to occur within 10km (DAWE 2020a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Unlikely. No local records. No known habitat associations present in study area.	Nil
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		1949 records within 10km (DPIE 2020a)	Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	Unlikely. Easily identifiable species, not identified in the stage 2 study area or construction footprint, despite numerous targeted surveys. Many individuals identified in the stage 1 study area. No suitable habitat within the Stage 2 construction footprint.	Nil
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	2 records within 10km (DPIE 2020a)	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks. In Sydney it has been recorded from Shale Sandstone Transition Forest, however, other communities occupied include Corym*bia maculata* - *Angophora costata* open forest in the Dooralong area, in Sydney Sandstone Ridgetop Woodland at Wedderburn and in Cooks River / Castlereagh Ironbark Forest at Kemps Creek. Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park.	Unlikely. No Shale Sandstone Transition Forest present on site, nor are there other known vegetation associations present within the study area. Study area is located on the Blacktown and South Creek soil landscapes (OEH, 2019e).	Nil
Haloragis exalata subsp. *exalata*	Wingless Raspwort	V	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in 4 widely scattered localities in eastern NSW, in the central coast, south coast and north-western slopes. Requires protected and shaded damp situations in riparian habitats.	Unlikely. No local records. Riparian zones within the study area are disturbed and lack suitable protection.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Haloragodendron lucasii		E	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Known from 9 sites in a 10km range in the Gordon-Hornsby area. Occurs on Hawkesbury Sandstone in moist sandy loam soil. Prefers sheltered aspects and gentle slopes below cliff lines near creeks in low open woodland or open forest. Distribution correlated with high soil moisture and phosphorus levels.	Nil. No sandstone geology present in the study area. No local records. No sheltered locations below cliff lines present in the study area.	Nil
Hibbertia puberula		E		3 records within 10km (DPIE 2020a)	Distribution extending from Wollemi National Park south to Morton National Park and the south coast near Nowra. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied.	Unlikely. No heath or sandy soils present in the study area. Understorey and midstorey of the entire study area is highly disturbed, and very few native shrubs were evident during any of the field surveys.	Nil
Hibbertia superans		E		516 records within 10km (DPIE 2020a)	Occurs from Castle Hill to South Maroota, and an isolated population near Kempsey. Grows on sandstone ridgetops often near the shale/sandstone boundary, in open woodland and heathland. Prefers open /disturbed areas, such as tracksides.	Unlikely. No sandstone ridgetops or shale/sandstone boundaries in the study area.	Nil
Lasiopetalum joyceae		V	V	1 record within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. Grows on heath on sandstone.	Unlikely. No heath on sandstone within study area.	Nil
Leucopogon fletcheri subsp. *fletcheri*		E		13 records within 10km, last recorded 2008 (DPIE 2020a)	Restricted to northwest Sydney between St Albans and Annangrove, within the Hawkesbury, The Hills and Blue Mountains LGAs. Occurs in dry eucalypt woodland or shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. Flowers August to September.	Unlikely. No ridges or spurs within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflor*a R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		9 records within 10km (DPIE 2020a)	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	Unlikely. Easily detected if present, and not identified in the study area, despite multiple surveys by experienced botanists. While there are some areas of open shale woodland (eg PCT 849) within th wider study area, all occurrences of this community are highly disturbed, and targeted threatened flora surveys were conducted across them. No habitat within the construction footprint.	Nil
Melaleuca deanei	Deane's Paperbark	V	V	1 record within 10km, last recorded 2007 (DPIE 2020a); Species or species' habitat known occur within 10km (DAWE 2020a)	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	Unlikely. No local records. No ridgetops or slopes in the study area, no sandy loam soils, no known vegetation associations present in the study area.	Nil
Micromyrtus minutiflora		E	V	25 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs in Richmond and Penrith areas in western Sydney. Grows in open forest on sandy clay or gravelly soils from Tertiary alluvium. Associated with Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, and other open forest types.	Unlikely. No associated communities present in the study area. Understorey and midstorey of the entire study area is highly disturbed, and very few native shrubs were evident during any of the field surveys.	Nil
Olearia cordata		V	V	Species or species' habitat may occur within 10km (DAWE 2020a)	This species is endemic to NSW and is generally restricted to the south-western Hunter plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau. Most known populations occur within conservation reserves including Wollemi National Park, Yengo National Park and Wisemans Ferry Historic site. Olearia cordata grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.	Nil. No sandstone geology present in the study area. No local records. Study area is outside of known range.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Persicaria elatior	Knotweed	V	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Unlikely. No local records. No known preferred habitat present within study area; no sandy alluvial soil in swampy areas or riparian herblands.	Nil.
Persoonia hirsuta	Hairy Geebung	E	E	23 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Unlikely. No sandstone soils within study area.	Nil
Persoonia nutans	Nodding Geebung	E	E	191 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Unlikely. Understorey and midstorey of the entire study area is highly disturbed, and very few native shrubs were evident during any of the field surveys. No persoonias were identified during field surveys by experienced botanists. No aeolian sediments in study area. Areas on alluvial sediments are highly disturbed and lack an intact understorey or midstorey.	Nil
Pimelea curviflora var. *curviflora*		V	V	34 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Unlikely. No sandstone or shale/sandstone transition soils present in study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Pimelea spicata	Spiked Rice-flower	E	E	118 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Unlikely. No suitable habitat within the construction footprint.	Nil
Pterostylis gibbosa	Illawarra Greenhood	E	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum, Woollybutt and *Melaleuca* decora. Near Nowra, the species grows in an open forest of Spotted Gum, Forest Red Gum and Grey Ironbark. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine.	Unlikely. No local records. No known vegetation associations present within study area.	Nil
Pterostylis saxicola	Sydney Plains Greenhood	E	E	1 record within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Unlikely. No rock shelves above cliff lines present in study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Pultenaea parviflora		E	V	522 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	Unlikely. No associated communities present in the study area. Understorey and midstorey of the entire study area is highly disturbed, and very few native shrubs were evident during any of the field surveys.	Nil
Rhizanthella slateri	Eastern Underground Orchid	V	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available. Flowers September and November.	Unlikely. Understorey of entire study area is highly disturbed, with decades of historical disturbance and vegetation clearing. No local records. Study area is not near any of the known locations.	Nil
Syzygium paniculatum	Magenta Lilly Pilly	E	V	10 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Unlikely. No vegetation associations or preferred soil types present in study area.	Nil
Tetratheca glandulosa		V		15 records within 10km (DPIE 2020a)	Restricted to The Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat (shale-cappings over sandstone). Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils generally shallow, yellow, clayey/sandy loam, commonly with lateritic fragments. Vegetation varies from heath to open forest and is broadly equivalent to Sydney Sandstone Ridgetop Woodland community.	Unlikely. Outside of known LGAs. No shale/sandstone transition habitat in study area, and no known vegetation associations present in study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Thesium australe	Austral Toadflax	V	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Unlikely. No intact stands of Themeda (Kangaroo Grass) present within the study area. All areas of grassland or grassy woodland are dominated by exotic understorey species.	Nil
Zieria involucrata		E	V	10 records within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Zieria involucrata is found within The Hills, Hawkesbury, Hornsby and Blue Mountains local government areas. It occurs primarily on Hawkesbury sandstone but has also been found on Narrabeen Group sandstone and Quaternary alluvium. It has been recorded in sheltered forests on mid-lower slopes and valleys.	Unlikely. Not known from the Blacktown LGA. No sandstone geology present in the study area.	Nil

Notes :
CE= critically endangered, E= endangered, V= vulnerable, EP= endangered population

Fauna habitat assessment table

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
BIRDS							
Anthochaera phrygia	Regent Honeyeater	CE	E	11 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Unlikely. No local records. Lack of known vegetation associations within the study area. No mistletoes present in study area. Very few mature trees, low canopy cover.	Nil
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		50 records within 10km (DPIE 2020a)	Widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. Often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. Although they have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (*Manorina melanocephala*) is a significant threat to this species.	Possible. Large numbers of Noisy Miners in the study area which is likely to deter this species. Vegetation within the construction footprint and wider study area is fragmented and this species prefers large remnants.	Low. Less than 0.56 ha of lower-quality potential foraging habitat in woodland and forest to be removed in non-certified land.
Botaurus poiciloptilus	Australasian Bittern	E	E	1 record within 10km, last recorded 2002 (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly Typha spp.and Eleocharis spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Possible. Broadly suitable habitat for this species is present within and ajdacent to riparian vegetation in non-certified areas.	Low. Less than 0.56 ha of lower-quality potential refuge habitat to be removed from Eastern Creek in non-certified land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Calidris ferruginea	Curlew Sandpiper	E	CE,C,J,K	4 records within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Unlikely. Lack of suitable habitat present within the study area.	Nil
Callocephalon fimbriatum	Gang-gang Cockatoo	V		2 records within 10km (DPIE 2020a)	Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types where it breeds in tree hollows, and in winter it moves to more open types at lower elevations. Nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. Feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Unlikely. Prefers woodland with an intact understorey, which is absent from the study area. Species does not breed on the Cumberland Plain.	Nil
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		10 records within 10km (DPIE 2020a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of *Allocasuarina* species. Prefers woodland and open forests, rarely away from *Allocasuarina*. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	Unlikely. No suitable breeding or foraging habitat present.	Nil
Chthonicola sagittata	Speckled Warbler	V		3 records within 10km (DPIE 2020a)	Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	Unlikely. Vegetation in study area is limited to small, disturbed, and fragmented patches.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Circus assimilis	Spotted Harrier	V		4 records within 10km (DPIE 2020a)	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	Possible. Broadly suitable foraging habitat present within the study area. No raptor nests observed.	Low. Less than 0.56 ha of potential foraging habitat in woodland and forest to be removed in non-certified land. No breeding habitat to be removed.
Daphoenositta chrysoptera	Varied Sittella	V		46 records within 10km (DPIE 2020a)	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Unlikely. Vegetation in study area is limited to small, disturbed, and fragmented patches with thr exception of Eastern Creek that is heavily weed-infested. Most patches lack the structural complexity required by this species. Study area and surrounds dominated by cleared agricultural land as well as residential and industrial developments. Abundance of Noisy Miners in the study area may deter this species.	Nil
Dasyornis brachypterus	Eastern Bristlebird	E	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Nil. No local records. Lack of known vegetation associations within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Falco hypoleucos	Grey Falcon	E	V	Species or species' habitat likely to occur within 10km (DAWE 2020a)	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The species is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. It also occurs near wetlands where surface water attracts prey.	Unlikely. Broadly suitable habitat present throughout the study area, however no local records, and few large old trees within the study area, which are critical during nesting season.	Nil
Falco subniger	Black Falcon	V		4 records within 10km (DPIE 2020a)	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in in land areas.	Unlikely. Broadly suitable habitat present throughout the study area, however no local records, and few large old trees within the study area, which are critical during nesting season.	Nil
Glossopsitta pusilla	Little Lorikeet	V		17 records within 10km (DPIE 2020a)	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially Eucalyptus viminalis, E. blakelyi and E. dealbata. Most breeding records are from the western slopes.	Unlikely. Species prefers larger remnants and areas with structural complexity which is lacking in the study area.	Nil
Grantiella picta	Painted Honeyeater	V	V	Species or species' habitat likely to occur within 10km (DAWE 2020a)	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	Unlikely. No known vegetation associations present. Outside usual range.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	4 records within 10km (DPIE 2020a)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Unlikely. No suitable breeding habitat present. No intact tall forest or woodland present. Degree of disturbance and development in local area is likely to deter this species from occuring.	Nil
Hieraaetus morphnoides	Little Eagle	V		17 records within 10km (DPIE 2020a)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Possible. Broadly suitable foraging habitat present within the study area. No raptor nests observed.	Low. Less than 0.56 ha of potential foraging habitat in woodland and forest to be removed in non-certified land. No breeding habitat to be removed.
Hirundapus caudacutus	White-throated Needletail		V,C,J,K	4 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Possible. May forage high above the study area on occasion. Unlikely to land within the study area.	Nil
Ixobrychus flavicollis	Black Bittern	V		1 record within 10km (DPIE 2020a)	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Possible. Broadly suitable habitat for this species is present within and ajdacent to riparian vegetation in non-certified.	Low. Less than 0.56 ha of lower-quality potential refuge habitat to be removed from Eastern Creek in non-certified land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Lathamus discolor	Swift Parrot	E	CE	36 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Unlikely. Prefered foraging habitat not present. Does not breed in NSW.	Nil
Lophoictinia isura	Square-tailed Kite	V		12 records within 10km (DPIE 2020a)	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km^2.	Possible. Broadly suitable foraging habitat present within the study area. No raptor nests observed.	Low. Less than 0.56 ha of potential foraging habitat in woodland and forest to be removed in non-certified land. No breeding habitat to be removed.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V		4 records within 10km (DPIE 2020a)	Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	Unlikely. Species prefers larger remnants.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Neophema pulchella	Turquoise Parrot	V		1 record within 10km (DPIE 2020a)	Occurs from coast to inland slopes. In coastal area, most common between the Hunter region and Northern Rivers, and further south on the South Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.	Unlikely. The very small woodland patches within study area are highly fragmented and close to properties with free-ranging cats. No intact native grasslands to provide foraging habitat. Could occur along the edge of forest along Eastern Creek on occasion.	Nil
Ninox strenua	Powerful Owl	V		46 records within 10km (DPIE 2020a)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Possible. Broadly suitable foraging habitat present within the study area. Suitable roost habitat may be present within Eastern Creek where dense privet and Casuarina is present. No breeding habitat.	Low. Less than 0.56 ha of potential foraging habitat in woodland and forest to be removed in non-certified land. No breeding habitat to be removed.
Numenius madagascariensis	Eastern Curlew		CE	Species or species' habitat may occur within 10km (DAWE 2020a)	Widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas. It is rarely seen inland. It breeds in Russia and north-eastern China. On passage, they are commonly seen in Japan, Korea and Borneo. Small numbers visit New Zealand. Found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	Nil. No suitable habitat present within the study area.	Nil
Petroica boodang	Scarlet Robin	V		3 records within 10km (DPIE 2020a)	In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	Unlikely. Very sparse fallen timber present within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Petroica phoenicea	Flame Robin	V		2 records within 10km (DPIE 2020a)	Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	Unlikely. Very sparse fallen timber present within the study area.	Nil
Rostratula australis	Australian Painted Snipe	E	E	5 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Unlikely. No wetlands or dams suitable for use by this species within the study area.	Nil
Tyto novaehollandiae	Masked Owl	V		2 records within 10km (DPIE 2020a)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Possible. Broadly suitable foraging habitat present within the study area. No suitable roost or breeding habitat present.	Low. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding habitat would be impacted.
FISH							
Macquaria australasica	Macquarie Perch	V	E	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas.Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Nil. No suitable habitat present within waterways in the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Prototroctes maraena	Australian Grayling		V	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse *et al*. 2008).	Nil. No suitable habitat present within waterways in the study area.	Nil
FROGS							
Heleioporus australiacus	Giant Burrowing Frog	V	V	Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Nil. No suitable sandstone habitat present within the study area.	Nil
Litoria aurea	Green and Golden Bell Frog	E	V	6 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (*Typha* spp.) or spike rushes (*Eleocharis* spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. *Gambusia holbrooki* is a key threat as they feed on Green and Golden Bell Frog eggs and tadpoles.	Possible. Broadly suitable low quality habitat present. There are several dams, waterways and adjacent flooded depressions with *Typha* spp., in the study area, however all support *Gambusia* which would predate on this species. The species is thought to be extinct from the area, with all known records restricted to the Riverstone area to the north.	Low. Negligible area of low quality potential habitat to be removed from non-certified land within Eastern Creek and adjacent ephemerally flooded areas.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Litoria raniformis	Growling Grass Frogx	E	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Currently known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. A few yet unconfirmed records have also been made in the Murray Irrigation Area in recent years. The species is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	Nil. Outside species' range and no local records.	Nil
Pseudophryne australis	Red-crowned Toadlet	V		4 records within 10km (DPIE 2020a)	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Nil. No suitable sandstone habitat present.	Nil
GASTROPODS							
Meridolum corneovirens	Cumberland Plain Land Snail	E		274 records within 10km (DPIE 2020a)	Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton.Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	Possible. May occur within high condition Cumberland Plain Woodland within study area, however low likelihood of occurrence in poor quality Cumberland Plain Woodland in the construction footprint.	Low. Very small area of low quality habitat for this species would be removed from non-certified land within residential gardens.
Pommerhelix duralensis	Dural Land Snail	E	E	17 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	This species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City	Nil. Outside species known range.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
MAMMALS							
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	8 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Possible. Suitable foraging habitat present within the study area. No breeding habitat present.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	7 records within 10km, last recorded 2005 (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	Unlikely. Nearest record is from Featherdale Wildlife Park, and next closest record is a verbal record from an old ADI site that has not been verified. Other records are from areas with larger, less fragmented tracts of vegetation. Study area is likely to be too fragmented and disturbed to support habitat for this species.	Nil
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		38 records within 10km (DPIE 2020a)	Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded) (Churchill 2008, Law *et al*. 2008).	Possible. Species prefers tall wet forest, which is absent from the study area. However, species may forage in study area as part of larger foraging range and adjacent to Easteern Creek. Limited potential breeding habitat present given no obvious tree hollows, which are more likely to support breeding than temporary roost sites such as crevices and tree bark.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V		86 records within 10km (DPIE 2020a)	Found along the east coast from south QLD to southern NSW. Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.	Possible. Broadly suitable foraging habitat present. Limited potential breeding habitat present given no obvious tree hollows which are more likely to support breeding than temporary roost sites such as crevices and tree bark.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.
Miniopterus australis	Little Bent-winged Bat	V		32 records within 10km (DPIE 2020a)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and possibly tree hollows on on occasion (Australian Museum 2020a; OEH 2020d). Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoye and Hall 2008).	Likely. 'Probable' record in 2019 from within riparian vegetation in non-certified land at Eastern Creek. Also recorded at Bells Creek to the west of the current project footprint adjacent to Townson Road. Would not roost or breed in current study area, but may forage on occasion.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding habitat would be impacted.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V		128 records within 10km (DPIE 2020a)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	Likely. Suitable habitat present within the study area, high number of local records.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding habitat ro roosting would be impacted.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Myotis macropus	Southern Myotis	V		74 records within 10km (DPIE 2020a)	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	Likely. Maternity roost recorded in non-certified land along Townson Road to the west of the current project footprint. Would not roost or breed in current study area, but likely to forage along Eastern Creek and farm dams.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land within Eastern Creek. No breeding or roosting habitat would be impacted.
Petauroides volans	Greater Glider		V	Species or species' habitat known to occur within 10km (DAWE 2020a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Nil. No suitable habitat present within study area. No local records. Not known from the Cumberland Plain.	Nil
Petaurus australis	Yellow-bellied Glider	V		6 records within 10km (DPIE 2020a)	Occurs along the east coast to the western slopes of the Great Dividing Range. Inhabits a variety of forest types but prefers tall mature eucalypt forest with high rainfall and rich soils. Relies on large hollow-bearing trees for shelter and nesting, with family groups of 2-6 typically denning together.	Unlikely. Lack of tall mature eucalypt forest present in study area. Highly fragmented landscape dissected by numerous main roads. No suitable habitat present.	Nil
Petaurus norfolcensis	Squirrel Glider	V		1 record within 10km (DPIE 2020a)	Occurs along the drier inland slopes as well as coastal habitats. Inhabits woodland and open forest with a *Eucalyptus*, *Corymbia* or *Angophora* overstorey and a shrubby understorey of Acacia or Banksia. Key habitat components include reliable winter and early-spring flowering Eucalypts, Banksia or other nectar sources, and hollow-bearing trees for roost and nest sites (van der Ree and Suckling 2008, Quin *et al*. 2004), with social groups moving between multiple hollows. Social groups include one or two adult males and females with offspring, and have home ranges of 5-10ha within NSW (van der Ree and Suckling 2008, Kavanagh 2004).	Unlikely. No suitable habitat within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Nil. No suitable habitat within the study area.	Nil
Phascolarctos cinereus	Koala	V	V	8 records within 10km (DPIE 2020a); Species or species' habitat known to occur within 10km (DAWE 2020a)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Unlikely. Vegetation within study area is highly fragmented and lacks suitable habitat for this species.	Nil
Pseudomys novaehollandiae	New Holland Mouse		V	Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Nil. Outside species known range. No suitable habitat within the study area.	Nil
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	621 records within 10km (DPIE 2020a); Roosting known to occur within 10km (DAWE 2020a)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Present. Recorded in Alluvial Woodland vegetation in non-certified land in the study area. Suitable foraging habitat present in all native vegetation within the study area. No roost camps present.	Moderate. Less than 0.56 ha of known foraging habitat to be removed in non-certified land within Eastern Creek and along Kerry Road. No breeding habitat would be impacted.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence in study area	Likelihood of impact
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		24 records within 10km (DPIE 2020a)	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	Possible. Broadly suitable foraging habitat present.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		54 records within 10km (DPIE 2020a)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	Possible. Broadly suitable foraging habitat present.	Moderate. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.
Vespadelus troughtoni	Eastern Cave Bat	V		2 record within 10km (DPIE 2020a)	Occurs in NE NSW south to Kempsey and west to the Warrumbungles. Inhabits rainforest margins, wet and dry sclerophyll forests through to drier forests and woodlands in semi-arid environments. All records are within close proximity to sandstone or volcanic escarpments. Roosts in overhangs and caves, mines, boulder piles, abandoned Fairy Martin nests and occasionally in buildings, and regularly switches between alternate roost colonies. Forages over a small area, but are capable of flying 500 m over clear paddocks (Churchill 2008, Parnaby *et al*. 2008).	Possible. Suitable foraging habitat present within the study area. No breeding habitat present.	Low. Less than 0.56 ha of potential foraging habitat to be removed in non-certified land. No breeding or roosting habitat would be impacted.

Notes:
CE= critically endangered, E= endangered, V= vulnerable
C= Listed as migratory under the China-Australia Migratory Bird Agreement (CAMBA), J= Listed as migratory under the Japan-Australia Migratory Bird Agreement (JAMBA), K= Listed as migratory under the Korea-Australia Migratory Bird Agreement (CAMBA)

Migratory fauna habitat assessment table

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Actitis hypoleucos	Common Sandpiper		C,J,K	Species or species' habitat may occur within 10km (DAWE 2020a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Unlikely. No suitable wetland habitat present in the study area.	Nil
Apus pacificus	Fork-tailed Swift		C,J,K	5 records within 10km (DPIE 2020a)	Recorded in all regions of NSW. Non-breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Possible. Does not breed in Australia. May fly over the study area on occasion. No important habitat present.	Low. Negligible area of potential habitat to be removed from non-certified land.
Calidris acuminata	Sharp-tailed Sandpiper		C,J,K	48 records within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Unlikely. No suitable wetland habitat present in the study area.	Nil
Calidris ferruginea	Curlew Sandpiper		C,J,K	4 records within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Unlikely. No suitable wetland habitat present in the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Calidris melanotos	Pectoral Sandpiper		J,K	10 records within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Unlikely. No suitable wetland habitat present in the study area.	Nil
Calidris ruficollis	Red-necked Stint		C,J,K	11 records within 10km (DPIE 2020a)	Distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. Breeds in Siberia and sporadically in north and west Alaska. In Australasia, mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals.	Unlikely. No suitable wetland habitat present in the study area.	Nil
Cuculus optatus	Oriental Cuckoo		C,J,K	Species or species' habitat known to occur within 10km (DAWE 2020a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Possible. Does not breed in Australia. May occur within the study area on occasion. No important habitat present.	Low. Negligible area of potential habitat to be removed from non-certified land.
Gallinago hardwickii	Latham's Snipe		C,J,K	15 records within 10km (DPIE 2020a); Species or species' habitat may occur within 10km (DAWE 2020a)	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Possible. Does not breed in Australia. May occur within the study area on occasion. No important habitat present.	Low. Negligible area of potential habitat to be removed from non-certified land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Hirundapus caudacutus	White-throated Needletail		C,J,K	Species or species' habitat known to occur within 10km (DAWE 2020a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Possible. Does not breed in Australia. May fly over the study area on occasion. No important habitat present.	Low. Negligible area of potential habitat to be removed from non-certified land.
Monarcha melanopsis	Black-faced Monarch			Species or species' habitat known to occur within 10km (DAWE 2020a)	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	Possible. May occur in the study area on occasion.	Low. Negligible area of potential habitat to be removed from non-certified land.
Monarcha trivirgatus	Spectacled Monarch			Species or species' habitat may occur within 10km (DAWE 2020a)	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. Prefers thick understorey in rainforest, wet gullies and waterside vegetation as well as mangroves.	Unlikely. No suitable thick waterside vegetation within the study area.	Nil
Motacilla flava	Yellow Wagtail		C,J,K	Species or species' habitat likely to occur within 10km (DAWE 2020a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Possible. May occur in the study area on occasion.	Low. Negligible area of potential habitat to be removed from non-certified land.
Myiagra cyanoleuca	Satin Flycatcher			Species or species' habitat known to occur within 10km (DAWE 2020a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Possible. May occur in the study area on occasion.	Low. Negligible area of potential habitat to be removed from non-certified land.

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Numenius madagascariensis	Eastern Curlew		C,J,K	Species or species' habitat may occur within 10km (DAWE 2020a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.	Unlikely. No suitable habitat present within the study area.	Nil
Pandion haliaetus	Osprey			Species or species' habitat likely to occur within 10km (DAWE 2020a)	The Osprey is found around the Australian coast line, except for Victoria and Tasmania. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Ospreys feed on fish over clear, open water and breed from July to September in NSW. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Unlikely. No suitable habitat present within the study area.	Nil
Plegadis falcinellus	Glossy Ibis		C	3 records within 10km (DPIE 2020a)	Occurs throughout eastern and northern Australia, east of the Kimberley and Eyre Peninsula. Largest areas of prime habitat are inland and northern floodplains, with largest numbers in the Top End and Channel Country. Preferred habitats are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Breeds at limited locations, with most records from the Murray Darling Basin (NSW), western Riverina (VIC), south-east (SA), Channel Country (Qld/ SA) and lower Ord/Keep Rivers (WA).	Unlikely. No suitable habitat present within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Pluvialis fulva	Pacific Golden Plover		C,J,K	8 records within 10km (DPIE 2020a)	Breeds in the northern hemisphere. In Australia occurs mainly in coastal areas but also recorded inland. Important sites in NSW include the Hunter and Shoalhaven River estuaries. Usually occur on beaches, mudflats and sandflats in sheltered areas.	Unlikely. No suitable habitat present within the study area.	Nil
Rhipidura rufifrons	Rufous Fantail			Species or species' habitat known to occur within 10km (DAWE 2020a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	Possible. May occur in the study area on occasion.	Low. Negligible area of potential habitat to be removed from non-certified land.
Tringa glareola	Wood Sandpiper		C,J,K	6 records within 10km (DPIE 2020a)	Breeds in N Hemisphere. Occurs in largest numbers in NW Australia, with all sites of national importance within WA. In NSW there are records east of the Divide north from Nowra, and inland from the upper and lower Western regions. Uses well-vegetated, shallow, freshwater wetlands and are typically associated with wetlands supporting emergent aquatic plants or grass and taller fringing vegetation such as dense reeds/rushes, shrubs or trees. Also frequent flooded grasslands and irrigated crops. Rarely in brackish wetlands or saltmarsh. Known from artificial wetlands.	Unlikely. No suitable habitat present within the study area.	Nil
Tringa nebularia	Common Greenshank		C,J,K	1 record within 10km (DPIE 2020a); Species or species' habitat likely to occur within 10km (DAWE 2020a)	Does not breed in Australia, but occurs in all types of wetlands. In NSW has been recorded in most coastal regions and is widespread west of the Great Dividing Range, particularly in the north-west, Macquarie Marshes and areas between the Lachlan and Murray Rivers and Darling River drainage basin. The Hunter River estuary is an internationally important site for the species. In coastal areas typically occurs in sheltered habitats with large mudflats and saltmarsh,mangroves or seagrass.	Unlikely. No suitable habitat present within the study area.	Nil

Scientific name	Common name	BC Act Status	EPBC Act Status	Source	Habitat association	Likelihood of occurrence	Level of impact
Tringa stagnatilis	Marsh Sandpiper		C,J,K	3 records within 10km (DPIE 2020a)	Breeds in N Hemisphere. Occurs in coastal and inland wetlands, including freshwater and estuarine habitats, throughout Australia. All regions of NSW but particularly central and south coasts and western slopes and plains. Sites of national importance in NSW include Parkes wetlands, Macquarie Marshes and Tullakool Evaporation Ponds.	Unlikely. No suitable habitat present within the study area.	Nil

Notes:
C= Listed as migratory under the China-Australia Migratory Bird Agreement (CAMBA), J= Listed as migratory under the Japan-Australia Migratory Bird Agreement (JAMBA), K= Listed as migratory under the Korea-Australia Migratory Bird Agreement (CAMBA)

Appendix C – Section 5A assessment

An assessment of the likely significance of impact resulting from the proposal, pursuant to Section 7.3 of the BC Act (a '5-part test'), has been prepared for those threatened biota known or likely to occur within non-certified lands, where the likelihood of any impact on that species is considered to be moderate or high.

Threatened biota considered in these assessments include:

- Threatened ecological communities
    - Cumberland Plain Woodland in the Sydney Basin Bioregion (referred to as 'Cumberland Plain Woodland'); and
    - River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (referred to as 'River-flat Eucalypt Forest')
- Threatened fauna species
    - Grey-headed Flying-fox;
    - Tree-roosting microbats (Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat); and
    - Cave/culvert-roosting bats (Little Bent-winged Bat, Large Bent-winged Bat and Southern Myotis).

Threatened ecological communities

Cumberland Plain Woodland

Cumberland Plain Woodland is listed as a critically endangered ecological community (CEEC) under the BC Act. No **vegetation** within the construction footprint is commensurate with the CEEC Cumberland Shale Plain Woodlands and Shale Gravel Transition Forest as listed under the EPBC Act (see Section 3.3). Vegetation mapped as PCT 849 within the construction footprint and study area is commensurate with BC Act-listed Cumberland Plain Woodland.

Cumberland Plain Woodland occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Intact examples of this community are characterised by canopy trees such as Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*), with Narrow-leaved Ironbark (*E. crebra*), Spotted Gum (*Corymbia maculata*) and Thin-leaved Stringybark (*E. eugenioides*) occurring less frequently. The shrub layer is dominated by Blackthorn (*Bursaria spinosa*), and it is common to find abundant grasses such as Kangaroo Grass (*Themeda australis*) and Weeping Meadow Grass (*Microlaena stipoides* var. *stipoides*) (OEH 2019b). Within the study area, Cumberland Plain Woodland occurs as small, isolated, highly modified patches with scattered canopy trees over a generally exotic understorey, with no midstorey present.

The proposal would remove 0.21 hectares of poor condition Cumberland Plain Woodland as listed under the BC Act, from within non-certified land. The proposal would not remove any Cumberland Shale Plain Woodlands and Shale Gravel Transition Forest that conforms with the criteria for the community as listed under the EPBC Act. The proposal may also contribute to indirect impacts to this community through the further spread of weeds, sedimentation and introduction of pollutants. Environmental safeguards would be implemented to minimise the potential for these indirect impacts (see Section 5.2).

River-flat Eucalypt Forest

River-flat Eucalypt Forest is listed as an endangered ecological community under the BC Act. Vegetation mapped as PCT 835 within the construction footprint and study area is commensurate with BC Act-listed River-flat Eucalypt Forest.No vegetation within the construction footprint is commensurate with the CEEC River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria as listed under the EPBC Act (see Section 3.3).

River-flat Eucalypt Forest is found on the river flats of the coastal floodplains. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Forest Red Gum (*Eucalyptus tereticornis*), Cabbage Gum (*E. amplifolia)*, Rough-barked Apple (*Angophora floribunda)* and Broad-leaved Apple (*A. subvelutina*) (OEH, 2019b). The community is associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. River-flat Eucalypt Forest generally occurs below 50 metres elevation but may occur on localised river flats up to 250 metres above sea level. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees (OEH, 2019b). Within the construction footprint, River-flat Eucalypt Forest occurs as a narrow, linear strip of modified vegetation along Eastern Creek. It has a canopy dominated by Casuarina glauca, along with very sparse Eucalypt and Angophora species. It lacks an intact natve midstorey and understorey, instead, these strata are dominated by exotic species.

The proposal would remove 0.35 hectares of moderate condition River-flat Eucalypt Forest from within non-certified lands. The proposal would not remove any River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria that conforms to the criteria of the community as listed under the EPBC Act. The proposal may also contribute to indirect impacts to this community through the further spread of weeds, sedimentation and introduction of pollutants. Environmental safeguards would be implemented to minimise the potential for these indirect impacts (see section see Section 5.2).

River-flat Eucalypt Forest	Cumberland Plain Woodland
a) In the case of a threatened species, whether the proposed development or activity 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.	
Not applicable to these TECs.	
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	
The proposal would remove 0.35 ha of River-flat Eucalypt Forest from within non-certified lands, along Eastern Creek. Vegetation to be removed occurs as a narrow vegetated riparian corridor. Vegetation to be removed is highly modified, likely because of past disturbances such as clearing for agriculture, infrastructure and residential development, combined with ongoing pressures such as modified hydrology and surrounding land uses. Most major creeklines in western Sydney have comparable pressures and support similar vegetation. There are comparable stands of vegetation either side of the construction footprint that would not be impacted by the proposal. The removal of a small area of vegetation for construction of the proposal is unlikely to result in adverse impacts on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	The proposal would remove up to 0.21 ha of poor condition Cumberland Plain Woodland from within non-certified land. Vegetation to be removed occurs as canopy trees in isolated patches around residential dwellings off Kerry Road interspersed between garden plantings. Vegetation to be removed represents a highly disturbed occurrence of Cumberland Plain Woodland, and given its modified nature and the landscape context in which it occurs, it is unlikely to contribute to the ongoing persistence of a local occurrence of this community. Better quality patches of Cumberland Plain Woodland occur throughout the locality, including within the Western Sydney Parklands and various reserves within the National Parks estate that are protected. The removal of 0.21 ha of highly modified and isolated vegetation from within residential lots adjacent to an existing road is unlikely to affect the extent of the 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,	
Cumberland Plain Woodland in the study area occurs as small, highly modified, isolated patches off Kerry Road and Burdekin Road. They generally comprise sub-mature and mature canopy trees over an understorey, dominated by exotic horticultural plantings or exotic pasture. There are some bigger patches of better condition Cumberland Plain Woodland off Meadow Road to the west of the construction footprint, which would not be impacted by the proposal. River-flat Eucalypt Forest in the study area occurs in moderate condition and is part of a patchy, linear riparian corridor associated with Eastern Creek. River-flat Eucalypt Forest	

River-flat Eucalypt Forest	Cumberland Plain Woodland
along Eastern Creek comprises predominantly Swamp Oak with the occasional eucalypt species present. It is heavily disturbed, with large, dense stands of Privet present in the midstorey. This vegetation type is also influenced by flood events, which are now concentrated on the area immediately adjacent to the creek itself, as a result of surrounding development and modification of the natural landform, which has effectively removed much of the floodplain that would once have absorbed some of the impacts of flood. Indirect impacts including sedimentation, erosion, chemical spills and introduction of weeds and pathogens have the potential to further modify these communities in the study area. Given the modified nature of the vegetation present, any impacts on these communities would be unlikely to alter the composition of adjoining retained vegetation such that the local occurrence of this community would be placed at risk of extinction. Mitigation measures would be implemented to avoid further spread or introduction of additional weeds to the construction corridor and surrounding lands during construction, as well as to maintain the current condition of vegetation adjacent to the areas of proposed works. The proposal is unlikely to result in significant changes to the composition of these communities outside of the construction corridor. They are already highly disturbed, due to adjoining land uses such as agricultural activities, residential and infrastructure development and edge effects such as weeds, modified hydrology and changes to fire regimes. Each community occurs in a modified state, without intact understorey or midstorey vegetation. This is true of vegetation both within the construction footprint and wider study area. Assuming the recommended mitigation measures are adopted and maintained, the proposal would be unlikely to further alter the composition of either community to the extent that the local occurrence of these communities would be placed at risk of extinction.	
c) 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 proposed development or activity and	
The proposal would remove 0.35 ha of River-flat Eucalypt Forest and 0.21 ha of Cumberland Plain Woodland from within non-certified land. River-flat Eucalypt Forest vegetation to be removed occurs as a narrow strip forming the Eastern Creek riparian corridor. While native Swamp Oak and occasional eucalypts are present in the canopy, vegetation is heavily modified by a dense infestation of Privet in the midstorey. This is most likely due to edge effects, nutrient enrichment and weed dispersal from surrounding residential and agricultural areas. Cumberland Plain Woodland to be removed occurs as fragmented patches of canopy trees within residential lots off Kerry Road, and as a small, isolated patch off Burdekin Road, and is subject to edge effects, rubbish dumping, slashing of the understorey and garden maintenance. Indirect impacts as a result of construction could increase sedimentation and erosion, and further introduce weeds and diseases. Mitigation measures are proposed to minimise the risk of indirect impacts on adjoining stands of native vegetation.	
(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	
Vegetation in the study area is generally fragmented and isolated from extensive patches of vegetation within the locality by existing roads and cleared agricultural land. The exception is vegetation associated with Eastern Creek that forms part of a generally	

River-flat Eucalypt Forest	Cumberland Plain Woodland
continuous vegetated corridor, linking habitats north and south of the construction footprint. The clearing of Cumberland Plain Woodland would comprise the removal of small, already isolated patches of highly modified vegetation from within residential lots, and would not result in any increase to the degree of fragmentation of habitat wihtin the locality. The clearing of River-flat Eucalypt Forest would comprise the removal of vegetation from within a habitat corridor in the locality. The proposal would likely result in a gap of about 50m being created between retained vegetation either side of the construction footprint. This would result in an increase to the degree of fragmentation currently present in the locality. Despite this, the majority of fauna species that utilise the construction footprint, and the habitats present in it, are highly mobile species capable of traversing substantial distances, and any fragmentation resulting from the proposal would not impact their ability to persist in the locality. There would likely be fragmentation of patches of River-flat Eucalypt Forest from each other, however the final bridge design has not been resolved, and there is potential for either retention of some existing vegetaiton or replanting of vegetation characteristic of what is there now, following construction of the bridge over Eastern Creek, which would lessen the impact of any increase in fragmentation as a result of the proposal. The degree of fragmentation that may occur is unlikely to prevent vital ecological processes including seed dispersal, germination and polination from occurring.	
(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,	
As previously discussed, these communities have been subject to historic and ongoing modification and degradation. Cumberland Plain Woodland vegetation within the construction footprint is highly modified, and comprises small fragments already subject to edge effects and ongoing disturbance. These small fragments are highly disturbed and lack an intact midstorey of understorey. They lack characteristic habitat features such as fallen timber, leaf litter and habitat resources of relevance for many native fauna species. They have very low floristic diversity and are unlikely to contribute anything of importance to the local occurrence of the community. The removal of these small patches is unlikely to be important to the long-term survival of Cumberland Plain Woodland in the locality. River-flat Eucalypt Forest is restricted to a narrow linear corridor along Eastern Creek. This vegetation has been subject to substantial modification and weed infestation. This vegetation lacks the floristic or structural diversity typically associated with better condition stands of this vegetation type and is comparable to much of the local extent of this vegetation type. The small area of highly modified vegetation that may be impacted by the proposal is unlikely to be important to the long-term survival of this ecological community in the locality.	
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),	
The proposal will not have an impact on areas of outstanding biodiversity value.	
e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of a key threatening process	
The proposal would directly contribute to the operation of the following KTPs: • Clearing of native vegetation – up to 0.56 ha of native vegetation would be removed from non-certified lands, comprising 0.35 ha of River-flat Eucalypt Forest and 0.21 ha of Cumberland Plain Woodland.	

River-flat Eucalypt Forest	Cumberland Plain Woodland

- Removal of dead wood and dead trees – the proposal will result in the removal of fallen timber from within vegetated areas of the construction footprint, primarily associated with flood debris from within River-flat Eucalypt Forest. Dead wood provides habitat resources for fauna species which are a component of these communities.

The proposal has the potential to introduce or increase the operation of the following KTPs within this community through soil disturbance and increased visitation to the area:

- Invasion of native plant communities by exotic perennial grasses.
- Invasion and establishment of exotic vines and scramblers
- Invasion, establishment and spread of Lantana
- Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust.

River-flat Eucalypt Forest and Cumberland Plain Woodland in the study area are already subject to weed infestation by exotic perennial grasses, exotic vines and scramblers, and Lantana. The proposal is unlikely to influence the introduction or further spread of exotic species, given their existing presence throughout the study area in the understorey of most occurrences of native vegetation. Assuming the recommended mitigation measures are implemented, the proposal is unlikely to result in the introduction or spread of pathogens such as *Phytophthora cinnamomi* or Myrtle Rust.

Mitigation measures to minimise indirect impacts, including prevention of the introduction new exotic species or further spread of existing weeds, and hygiene controls to prevent the introduction of pathogens would be included in the CEMP (see section 5.2).

Conclusion of test of significance

Based on consideration of the above criteria, the proposal is unlikely to have a significant effect on the local occurrence of River-flat Eucalypt Forest or Cumberland Plain Woodland, pursuant to Section 7.3 of the BC Act, given:

- Only small areas of highly modified and disturbed vegetation would be removed or impacted by the proposal (0.35 ha of River-flat Eucalypt Forest and 0.21 ha of Cumberland Plain Woodland);
- Cumberland Plain Woodland vegetation to be removed occurs as small, fragmented patches along already disturbed edges, and River-Flat Eucalypt Forest exists as a patchy riparian corridor along Eastern Creek, interspersed with existing roads, and modified by existing land uses within the local area;
- Vital ecological processes such as pollination would continue to occur within adjacent retained occurrences of these TEC following construction, as the proposal would not result in barriers to movement for pollinators such as insects, birds or bats;
- The proposal would result in only a small increase to the degree of fragmentation, but recommended mitigation measures include implementing revegetation to minimise this impact;
- Vegetation to be impacted is unlikely to be important to the long-term survival of the ecological communities in the locality;
- The proposal will not have any impact on any area of outstanding biodiversity value; and
- The proposal is unlikely to substantially increase the impact of any key threatening process of relevance to these communities.

Threatened fauna species

Grey-headed Flying-fox

The Grey-headed Flying-fox occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (DPIE 2021b).

The Grey-headed Flying-fox was observed foraging within River-flat Eucalypt Forest within the construction footprint during the field surveys. This species is likely to forage in all vegetation in the construction footprint, in response to favourable flowering or fruiting events. Up to 0.56 hectares of potential foraging habitat for the Grey-headed Flying-fox, comprising all native vegetation would be removed in the construction footprint within non-certified lands. The proposal would not remove known roosting habitat for this species or affect any local camps.

Grey-headed Flying-fox
a) In the case of a threatened species, whether the proposed development or activity 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.
Grey-headed Flying-foxes were observed within and adjacent to the construction footprint during field surveys, foraging within vegetation along Eastern Creek. The Grey-headed Flying-fox is a highly mobile species which regularly travels up to 50 km in a night to forage, and has been shown to make migratory movements of almost 1,000 km within a year (Churchill 2008, Webb and Tidemann 1996). It roosts communally in large, established camps which may support several thousand individuals. The construction footprint does not contain roost camps for the Grey-headed Flying Fox, with the closest known camp occurring at Emu Plains, at least 15km to the west of the construction footprint (DAWE 2021c). The construction footprint contains potential foraging habitat for the Grey-headed Flying-fox, including Forest Red Gum (*Eucalyptus tereticornis*), which is a key foraging resource for this species. Forest Red Gum is recognised as a 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) however, it is not a highly productive flowering species and occurs only infrequently within the construction footprint. Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering (0.67). This species flowers in late winter and spring, partly during the 'food bottleneck'. Grey Box (*Eucalyptus moluccana*) is also present in the construction footprint but does not score highly for productivity and reliability of flowering (0.37 and 0.30 respectively) (Eby and Law 2008). The small area of potential foraging habitat to be impacted, comprising foraging species that are not highly productive, represents a minor impact to a small proportion of this highly-mobile species' home range and foraging resources in the locality. Large areas of higher quality foraging habitat exist in the wider locality, including within intact native vegetation in the Wianamatta Regional Park, Castlereagh Nature Reserve, the Western Sydney Parklands and Windsor Downs Nature Reserve, all of which are within 15 km of the construction footprint. The proposal would remove 0.56 ha of foraging habitat for this species and would not impact any camps. There would be no barrier to movement as a result of the proposal. The proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-headed Flying-fox
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to this threatened species.
(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,
Not applicable to this threatened species.
c) 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 proposed development or activity and
Up to 0.56 ha of native vegetation that comprises foraging habitat for the Grey-headed Flying-fox would be removed by the proposal. The vegetation to be removed represents a negligible proportion of native vegetation present in surrounding areas and the broader locality. Vegetation elsewhere in the locality, including within the reserve network, exists as larger patches of better condition vegetation that is likely to be more important to this species. The proposed upgrade would not impact any camps. Recommended mitigation measures are likely to mitigate any potential indirect impacts on areas of retained vegetation adjoining the construction footprint.
(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
Removal of vegetation from the riparian corridor would result in impacts to a habitat corridor in the locality. The proposal would likely result in a gap of about 50m being created between retained vegetation either side of the construction footprint. This would result in an increase to the degree of fragmentation currently present in the locality. Any such impacts would not create a ‘hostile gap’, as defined by DECC (2008) for this species, given the Grey-headed Flying-fox is highly mobile and capable of travelling up to 50 km from their camp to forage (Australian Museum 2020b). The proposal would not isolate any areas of habitat within the study area or at a landscape scale, due to the high mobility of this species and the limited extent of the works. Given the highly mobile nature of this species, the removal of a very small area (0.56 ha) of potential foraging habitat will not result in a substantial increase in fragmentation and no areas of habitat for this species will be isolated from any 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 proposal would remove a small area of foraging habitat for the Grey-headed Flying-fox. Better quality foraging habitat is present in similar vegetation within large areas of intact native vegetation in Wianamatta Regional Park, Castlereagh Nature Reserve, the Western Sydney Parklands and Windsor Downs Nature Reserve, all of which are within 15 km of the construction footprint. This species is known to travel large distances (up to 50 km a night) from its camps to forage (Australian Museum 2020b). The small area of habitat to be removed from the construction footprint would make up a very small proportion of the foraging habitat used by this species in the locality. The proposal would not remove impact on any camps, with the nearest camp located about 15 km from the construction footprint in Emu Plains.

Grey-headed Flying-fox

Consequently, the small area of habitat to be removed is not likely to be important to the long-term survival of this species in the locality.

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

The proposal will not have any impact on any area of outstanding biodiversity value.

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

The proposal would directly contribute to the operation of the following KTP:

- Clearing of native vegetation – 0.56 ha of native vegetation comprising foraging habitat for this species would be removed.

Other KTPs which require consideration, include:

- Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust – the proposal would disturb soil within and adjoining native vegetation and potentially transfer or introduce pathogens via contaminated boots, equipment and machinery during construction.

Mitigation measures to minimise impacts, including establishment of hygeine protocols would be included in the CEMP for the proposal (see Section 5.2).

Conclusion of test of significance

Based on consideration of the above criteria, the proposal is unlikely to have a significant impact on the Grey-headed Flying-fox, pursuant to Section 7.3 of the BC Act, given:

- Only a small area (0.56 ha) of foraging habitat would be removed, which represents a small proportion of available foraging habitat present in surrounding areas and the broader locality;
- The proposal is unlikely to have an adverse effect on the species life cycle, such that a viable local population of the species is placed at risk of extinction;
- The proposed vegetation removal would not isolate areas of habitat or create barriers to movement between camp sites or foraging grounds for this highly mobile, wide-ranging species;
- Habitat to be removed is unlikely to be important to the long-term survival of the species in the locality;
- The proposal is unlikely to have an adverse effect on any declared area of outstanding biodiversity value;
- The proposal is unlikely to substantially increase the impact of any key threatening process of relevance to this species.
- No camp sites would be impacted; and

The EPBC Act MNES significance impact criteria have been considered for the Grey-headed Flying-fox in the light of the above findings and similarly conclude that the proposal is unlikely to have a significant impact on this species.

Tree-roosting microbats (Eastern False Pipistrelle, Eastern Coastal Free-tailed Bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat.)

The Eastern False Pipistrelle, Eastern Coastal Freetail-bat, Greater Broad-nosed Bat, and Yellow-bellied Sheathtail-bat are listed as vulnerable species under the BC Act. These species are known to occur in the locality and require hollow-bearing trees for breeding or roosting. The proposal will involve the removal of 0.56 hectares of potential foraging habitat (comprising all areas of native vegetation) for tree-roosting bats from within non-certified lands. There are no known hollow-bearing trees within the construction footprint in non-certified land, however, vegetation in non-certified lands may still provide unseen roost sites in crevices and under exfoliating bark.

There are no known records of these species from within the study area or construction footprint, however a conservative approach has been taken and it has been assumed that they may occur, given the presence of suitable habitat and/or records from the locality.

Tree-roosting microbats
a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
The Eastern False Pipistrelle, Eastern Coastal Freetail-bat, Greater Broad-nosed Bat, and Yellow-bellied Sheathtail-bat have not been recorded within the construction footprint but are known to occur in the locality (DPIE 2021a). These species may forage within the construction footprint, and may roost within crevices or under exfoliating tree bark on occasion. A total of 0.56 ha of potential foraging and temporary roost habitat for these species would be removed from non-certified land in the construction footprint. The small area of potential habitat to be removed represents a minor proportion of available habitat within the locality. No known hollow-bearing trees are present within the construction footprint in non-certified land, however, vegetation in non-certified lands may still provide unseen roost sites in crevices and under bark. No hollow-bearing trees are present in the broader study area, however, are likely to occur elsewhere along the riparian corridor associated with Eastern Creek, and could provide better quality roosting habitat for these species. Given the small area of foraging habitat to be removed compared to available habitat elsewhere in the locality, and the lack of hollow-bearing trees or stags in the construction footprint, the proposal is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of any of these species is likely to be placed at risk of extinction.
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to these threatened species.
(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,
Not applicable to these threatened species.
c) 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 proposed development or activity and
The proposal would result in the removal of up to 0.56 ha of native vegetation comprising small, isolated patches from residential lots and a small portion of the

Tree-roosting microbats
Eastern Creek riparian corridor. Vegeation to be removed represents potential foraging habitat for these species. No known hollow-bearing trees are present within the construction footprint. However, vegetation to be removed may provide potential roost and/or breeding resources for these species, should they utilise crevices or exfoliating bark. Vegetation within the study area is highly modified and subject to historical and ongoing disturbances, primarily associated with adjacent infrastructure and residential development. These disturbances are likely to deter some species from using the vegetation present. Large areas of higher quality habitat exist elsewhere in the wider locality, including within intact native vegetation in the Wianamatta Regional Park, Castlereagh Nature Reserve, the Western Sydney Parklands and Windsor Downs Nature Reserve, all of which are within 15 km of the construction footprint. Removal of a small area of potential habitat represents a very small reduction to the total extent of available habitat for these species.
(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
Removal of River-flat Eucalypt Forest vegetation from the riparian corridor would result in impacts to a habitat corridor in the locality. The proposal would likely result in a gap of about 50m being created between retained vegetation either side of the construction footprint. This would result in an increase to the degree of fragmentation currently present in the locality. Removal of small, isolated patches of Cumberland Plain Woodland is unlikely to result in any increase in fragmentation, given these patches are already fragmented by existing infrastructure, residential development and land clearing for agriculture. Clearing would increase the gap between retained vegetation, primarily along Eastern Creek, however this would not create a ‘hostile gap’ defined by DECC (2008) for these species, given they are highly mobile and capable of travelling several kilometres to forage each night. The proposal would not isolate any areas of habitat within the study area or at a landscape scale, due to the high mobility of these threatened microbat species and the limited extent of the works. Given the highly mobile nature of these species, the removal of a very small area (0.56 ha) of potential habitat will not result in a substantial increase in fragmentation and no areas of habitat will be isolated from any 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,
No known hollow-bearing trees which provide potential roosting habitat for the Eastern False Pipistrelle, Eastern Coastal Freetail-bat, Greater Broad-nosed Bat, and Yellow-bellied Sheathtail-bat are present within the construction footprint. However, native vegetation to be impacted may provide roost sites in crevices and under bark for these species. Tree-roosting bats are likely to utilise multiple roost trees, typically within a few hundred metres of one another on consecutive nights (Parnaby and Hamilton-Smith, 2004). Hollow-bearing trees elsewhere in the locality are likely to comprise the majority of these species roosting habitat. The proposal would remove up to 0.56 ha of potential habitat for these species from moderately disturbed riparian vegetation and already disturbed and fragmented vegetation patches. The small patches of habitat to be removed are not likely to be important to the long-term survival of these species in the locality.
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
The proposal will not have an impact on any areas of outstanding biodiversity value.

Tree-roosting microbats

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

The proposal would directly contribute to the operation of the following KTPs:

- Clearing of native vegetation – 0.56 ha of native vegetation comprising habitat for these species would be removed.

Other KTPs which require consideration, include:

- Invasion and establishment of exotic vines and scramblers, invasion and establishment of *Lantana camara* – the proposal has the potential to increase the incidence of weeds through ground disturbance and potentially spread of propagules on plant and vehicles during construction. Establishment of exotic vines and scramblers has the potential to affect the condition of habitat for these species;
- Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust – the proposal would disturb soil within and adjoining native vegetation and potentially transfer or introduce pathogens via infected boots, equipment and machinery during excavation.

Mitigation measures to minimise impacts, including minimising vegetation clearing where possible, would be included in the CEMP (see Section 5.2).

Conclusion of test of significance

Based on consideration of the above criteria, the proposal is unlikely to have a significant impact on the local occurrence of the Eastern False Pipistrelle, Eastern Coastal Freetail-bat, Greater Broad-nosed Bat or Yellow-bellied Sheathtail-bat pursuant to Section 7.3 of the BC Act, given:

- No known hollow-bearing trees providing potential roosting habitat are planned for removal as a result of the proposal.
- The proposal is unlikely to have an adverse effect on the life cycle of these species such that a viable local population is placed at risk of extinction;
- A very small (0.56 ha) area of habitat would be impacted;
- No areas of habitat would become isolated as a result of the proposal.
- The habitat to be impacted is unlikely to be important to the long-term survival of these species in the locality;
- The proposal will not have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly);
- The proposal is unlikely to substantially increase the impact of any key threatening process of relevance to these species; and
- There are no known records of these species within the construction footprint.

Cave and culvert-roosting bats (Little Bent-winged Bat, Large Bent-winged Bat and Southern Myotis)

The Little Bent-winged Bat was recorded as 'probably' present within Eastern Creek based on Anabat analysis, and the Large Bent-winged Bat has the potential to occur, given the presence of suitable habitat, and existing records elsewhere in the locality. These species are essentially cave bats, but also utilise man-made habitats such as road culverts, storm-water tunnels and other man-made structures as roost sites outside the breeding season. Breeding takes place in a number of maternity caves that host up 100,000 females (Churchill, 2008). These species forage over a range of habitats, including vegetated and cleared land.

The Southern Myotis is likely to be present within the study area as the species was recorded roosting and breeding in scuppers in a culvert under the bridge over Bells Creek, about 2 kilometres to the west of Eastern Creek. The species is likely to forage over Eastern Creek within non-certified lands.

Culvert-roosting Bats
a) In the case of a threatened species, whether the proposed development or activity 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.
There are no culverts or caves present within the construction footprint in non-certified land. The proposal is unlikely to impact on any roosting habitat for these species. A total of 0.56 ha of potential foraging habitat (comprising all native vegetation) for the Little Bent-winged Bat and Large Bent-winged Bat would be removed from non-certified land in the construction footprint. The small area of potential habitat to be removed represents a minor proportion of available habitat within the locality. Areas of open water along Eastern Creek are likely to provide foraging/hunting habitat for the Southern Myotis. Construction of the bridge over Eastern Creek will likely result in a minor reduction to the amount of foraging or hunting habitat for the Southern Myotis within the locality, however there is ample comparable habitat either side of the construction footprint, as well as elsewhere in the locality. The proposal is unlikely to result in any impacts that effect the life cycle of any of these threatened microbats such that a viable local population is placed at risk of extinction. There would be no impact to any known maternity resources, no barriers to movement, and no substantial loss of habitat.
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
Not applicable to these threatened species.
(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,
Not applicable to these threatened species.
c) 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 proposed development or activity and
There are no culverts or caves within non-certified lands within the construction footprint, and as such, there would be no loss of maternity habitat as a result of the proposal.

Culvert-roosting Bats

A total of 0.56 ha of potential foraging habitat for the Little Bent-winged Bat and the Large Bent-winged Bat would be removed from non-certified land in the construction footprint. The small area of potential habitat to be removed represents a minor proportion of available habitat within the locality.

Temporary interruption of Eastern Creek water flow regime is unlikely to occur during construction but may indirectly impact potential foraging/hunting habitat for the Southern Myotis. Sedimentation and run-off may occur around Eastern Creek during construction and may also indirectly impact potential foraging/hunting habitat for the species if the creek becomes silted the amount of available standing water, however the creek is already subject to periods of high and low flows, in response to rainfall events and drought.

The proposal involves the construction of a viaduct bridge over eastern creek, which may eventually provide roosting habitat for these species, depending on the integration of a 'bat friendly' roost habitat design (which is a recommended mitigation measure).

Taking the above into consideration, the proposal is unlikely to result in any substantial modification or removal of habitat important for this species persistence in the locality.

(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

Native vegetation to be removed typically occurs within riparian vegetation along Eastern Creek, adjacent to Townson Road and within disturbed patches of Cumberland Plain Woodland vegetation adjacent to private properties. Clearing has occurred historically throughout the area. Vegetation clearing would create a gap of about 50 m between retained patches of native vegetation along the Eastern Creek riparian corridor. This wouldincrease the fragmentation of the landscape, however this would not create a 'hostile gap' as defined by DECC (2008) for these highly mobile species. The proposal would not isolate or fragment any areas of habitat within the study area or at a landscape scale, due to the high mobility of these threatened microbat species and the limited extent of the works.

(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 proposal would not result in any impacts to maternity habitat for these species such as culverts or caves. The proposed viaduct bridge over Eastern Creek may eventually provide roosting habitat for culvert-roosting bats if suitable fauna-friendly habitat features are included in its design.

The proposal would remove up to 0.56 ha of potential foraging habitat for the Little Bent-winged Bat and the Large Bent-winged Bat. The small amount of potential habitat to be impacted is unlikely to be important to the long-term survival of the species in the locality. The vegetation along Eastern Creek that is proposed for removal is also not likely to be important to the Southern Myotis, given it comprises a very small proportion of comparable available foraging habitat present within the locality. Similarly, impacts associated with bridge construction over Eastern Creek would result in a minor reduction in the amount of available foraging habitat for this species. This species is known to have a maternity roost on Bells Creek, to the west of the proposal footprint, which is likely to be far more important foraging habitat for this species.

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

The proposal will not have an impact on any areas of outstanding biodiversity value.

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

Culvert-roosting Bats

The proposal would directly contribute to the operation of the following KTPs:

- Clearing of native vegetation – 0.56 ha of native vegetation comprising limited foraging habitat for these species would be removed.

Other KTPs which require consideration, include:

- Invasion and establishment of exotic vines and scramblers, invasion and establishment of *Lantana camara* – the proposal has the potential to increase the incidence of weeds through ground disturbance and potentially spread of propagules on plant and vehicles during construction. Establishment of exotic vines and scrambles has the potential to affect the condition of habitat for these species.
- Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust – the proposal would disturb soil within and adjoining native vegetation and potentially transfer or introduce pathogens via infected boots, equipment and machinery during excavation.

  Mitigation measures to minimise impacts, including minimising vegetation clearing where possible, would be included in the CEMP (see Section 5.2).

Conclusion of test of significance

Based on consideration of the above criteria, the proposal is unlikely to have a significant impact on the local population of Little Bent-winged Bat, Large Bent-winged Bat or Southern Myotis pursuant to Section 7.3 of the BC Act, given:

- No breeding habitat would be removed or disturbed;
- There would be limited impact on foraging habitat for the Little Bent-winged Bat and the Large Bent-winged Bat (0.56 ha of vegetation to be removed);
- There would be limited impact on foraging habitat for the Southern Myotis (potential indirect impact only);
- No areas of habitat would become isolated as a result of the proposal;
- The proposal is unlikely to have an adverse effect on the life cycle of these species such that a viable local population is placed at risk of extinction;
- The habitat to be impacted is unlikely to be important to the long-term survival of these species in the locality;
- The proposal will not have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly); and
- The proposal is unlikely to substantially increase the impact of any key threatening process of relevance to these species.

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	K. Chesnut M. Weerakoon	J. Tipping	On file			
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