



Transport  
for NSW

# Henry Lawson Drive Upgrade Stage 1A

## Biodiversity Development Assessment Report

Transport for NSW | July 2021

BLANK PAGE

**Transport for NSW**

---

# **Henry Lawson Drive Upgrade Stage 1A**

## **Biodiversity Development Assessment Report**

**July 2021**

Prepared by WSP and Transport for NSW



Copyright: The concepts and information contained in this document are the property of Transport for NSW. Use or copying of this document in whole or in part without the written permission of Transport for NSW constitutes an infringement of copyright.

Project no: PS119522

Date: 16/07/2021

Rev	Date	Details
A	5/03/2021	Working Draft
B	20/04/2021	Comments on working draft addressed
C	14/05/2021	Final draft
D	16/07/2021	Final

Author, Reviewer and Approver details				
Prepared by:	Lukas Clews	Date: 16/07/2021	Signature:	
Reviewed by:	Toby Lambert	Date: 16/07/2021	Signature:	
Approved by:	Toby Lambert	Date: 16/07/2021	Signature:	

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or disturbance constraints.

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

No sampling technique can eliminate the possibility that results are not totally representative of conditions encountered. The conclusions are based upon the data and the ecological surveys and are therefore merely indicative of the condition of the study area at the time of preparing the report. Also, it should be recognised that conditions, including the presence of threatened biodiversity, can change with time. No sampling technique can eliminate the possibility that a species is present within the proposal area. Within the limitations imposed by the scope of services, the surveys and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

The report has been prepared for the benefit of the client (and no other party). WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Except as provided below parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.



# Executive summary

---

## Introduction

Transport for NSW (Transport) is proposing to upgrade Henry Lawson Drive between Keys Parade, Milperra, to Tower Road, Bankstown Aerodrome (known as Henry Lawson Drive Upgrade Stage 1A) (the overall proposal). The overall proposal consists of upgrading a 1.3 kilometre length of Henry Lawson Drive and an additional 480 metres along Milperra Road, including intersection upgrades.

The overall proposal forms the first stage of the progressive upgrade to 7.5 kilometres of Henry Lawson Drive between the intersections of Hume Highway, Villawood, and the M5 South Western Motorway, Milperra.

The upgrade would help ease existing traffic issues and increase traffic capacity at key intersections to help meet growing demand, with residential, commercial and industrial development in the surrounding area expected to increase in the coming years. The upgrade would be delivered in three stages.

The overall proposal has been split into two parts as a result of proposed activities interacting with both Divisions 4.1 and 5.1 of the *Environment Planning & Assessment Act 1979* (EP&A Act). The two parts are assessed separately as illustrated in Figure 1.1 and described briefly below.

- REF proposal – incorporates the majority of the overall proposal subject to assessment under Division 5.1 of the *Environment Planning & Assessment Act 1979* (EP&A Act).
- EIS proposal – areas of the overall proposal occurring on land mapped as Coastal Wetlands under the State Environment Planning Policy (Coastal Management) area subject to assessment as designated development under Division 4.1 of the EP&A Act.

This report provides an assessment of biodiversity values associated with the EIS proposal to support an Environmental Impact Statement (EIS) subject to assessment as designated development under Division 4.1 of the EP&A Act.

Other stages of upgrading Henry Lawson Drive would be developed separately in the future and will be subject to future separate assessment processes.

## Methodology

A combination of desk-based research and field assessment was used to develop an appreciation of the existing environment of the study area to inform the impact assessment. The field survey aimed to ground-truth the results of the background research and habitat assessment. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence.

## Vegetation and Flora Surveys

Initial native vegetation surveys were undertaken by WSP (2019) over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional field surveys were undertaken on the 6 & 7 April, 29 & 30 September and 1 October 2020. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitat, especially for threatened species, populations and ecological communities. The field surveys aimed to ground-truth the results of the background research including desktop analysis of vegetation and habitat assessment. The floristic diversity and possible presence of threatened species was assessed using a combination of survey techniques including; plot-based (quadrat/transect) (14 plots were completed), rapid point assessments and parallel line transverses in accordance with the relevant guidelines.

Data on geology, dominant canopy species, native diversity, vegetation structure and condition was collected across the study area to validate and refine existing vegetation

classifications and to determine the associated Plant Community Type (PCT) in accordance with the BioNet Vegetation Classification (Environment Energy and Science, 2021c). Vegetation zones and conditions were identified and mapped following the BAM (Department of Planning Industry and Environment, 2020a). This was based on field verification of the PCT, class and formation as outlined in BioNet Vegetation Classification (Environment Energy and Science, 2021c).

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence in the study area. Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM plot surveys.

## Fauna Surveys

Targeted threatened fauna surveys involved:

- Fauna habitat assessment to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area.
- Nocturnal surveys consisted of spotlighting and call playback, targeting threatened owls, threatened arboreal mammals and threatened amphibians.
- 20 minute diurnal bird searches completed by actively walking through the nominated site (transect) over a period of 20-minutes (this included areas of potential shorebird habitat).
- Remote motion sensing infra-red cameras were positioned in the study area/subject land to target arboreal mammals (e.g. Squirrel Glider).
- Spot Assessment Technique (SAT) was undertaken to identify the presence of Koala usage within the habitats.
- Active invertebrate searches involved diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting Cumberland Plain Land Snail.
- Ultrasonic Anabat bat detection was used to record and identify the echolocation calls of insectivorous bats foraging across the study area.
- Daytime inspections of culverts and bridges were undertaken within the study area and subject land to identify potential bat roosting sites.
- Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted.
- The aquatic habitats within the study area were assessed against the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). The condition of the aquatic habitat was assessed using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman et al., 1997).

## Existing environment

The study area is situated within the Sydney Basin Bioregion, specifically the Cumberland subregion. The study area is across the Ashfield Plains and Georges River Alluvial Plain NSW landscape (Mitchell landscape). The main waterway is the Georges River and associated tributaries. There are no areas of outstanding biodiversity value within the study area or locality (within 10 km of the study area).

## Plant community types

Four NSW Plant Community Types (PCTs) were recorded in the EIS proposal area. These included:

- PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin
- PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner.

The four native vegetation communities were assigned to 4 discrete vegetation zones based on broad vegetation condition class criteria. All native vegetation recorded was limited to EIS proposal area 1 and EIS proposal area 2. In addition, one non-native vegetation type was assigned to a miscellaneous ecosystem class, being Miscellaneous ecosystem – Weeds / exotics – non- native vegetation.

## Wildlife connectivity corridors

The EIS proposal is considered unlikely to result in a large increase to landscape scale fragmentation and to further limit connectivity and movement corridors than what already exists in the study area, as it largely follows existing roadways. The impacts from the EIS proposal would largely widen Henry Lawson Drive and Milperra Road, which would not result in additional habitat fragmentation. The EIS proposal is however likely to result in a reduction in vegetation patch sizes of the regional wildlife patches along the Georges River. The predicted impacts from the EIS proposal is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. The existing functional connectivity for many species would remain in the study area.

## Matters of National Environmental Significance

### Wetlands of International Importance

One wetland of international importance (Ramsar) occurs within 10km of the study area which is the Towra Point Nature Reserve. Additionally, the EIS proposal occurs downstream of a nationally important wetland, Voyager Point wetland. Given the distance of the EIS proposal from Towra Point Nature Reserve and Voyager Point wetland there will not be any direct impact from the EIS proposal and indirect downstream impacts are also predicted to be negligible. The EIS proposal is unlikely to impact any wetlands of international or national importance.

### Threatened Ecological Communities

The EIS proposal area contains vegetation corresponding to two EPBC Act listed TECs as follows:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

### Threatened species

No threatened flora species were recorded within the EIS proposal area. However, a population of *Acacia pubescens* (listed as Vulnerable) was recorded in the adjoining REF proposal area. The targeted flora surveys did not record any other EPBC Act listed threatened flora species from within or directly adjacent to the study area.

Two EPBC Act listed threatened fauna species that are considered at least moderately likely to occur within the EIS proposal area on occasion based on the presence of suitable habitat include:

- Swift Parrot (listed as Critically Endangered)
- Grey-headed Flying-fox (listed as Vulnerable).

### Listed Migratory Species

The one listed Migratory species that has potential to occur in the study area is the Eastern Osprey. However, the habitats in the study area are unlikely to constitute important habitat for any of the listed migratory species. The habitat present in the EIS proposal area is unlikely to support significant proportions of populations of any migratory species nor are the habitats in the EIS proposal area critical to any life stage of identified species. Due to its mobile nature, this species is likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur. Because of this, this species is not considered to be significantly impacted by the EIS proposal.

### Impact Assessments

The key impacts of the EIS proposal include the removal of 0.25 hectares of native vegetation and associated habitat. The table below summaries the Plant Community Types (PCTs) recorded and the area of removal of each PCTs within the EIS proposal.

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region	Impact area in EIS proposal (ha)
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Moderate condition	E	-	74%	0.02
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate condition – Forest Red Gum variant	E	CE	93%	0.02
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Poor condition	E	-	32%	0.01
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Moderate condition	E	E	90%	0.20
<b>Total area of native vegetation impact</b>					<b>0.25</b>

In addition to the removal of native vegetation the other key impact associated with the EIS proposal would be the impact to 0.28 ha of Coastal Wetlands mapped under the Coastal Management SEPP. A summary of these impacts is provided in the table below.

Location	Area of Coastal Wetland impacted (ha)	Area of Wetland 100 m buffer zone (ha)
Study area	1.3	19.26
<b>EIS proposal area (development footprint)</b>	<b>0.28</b>	<b>0.00</b>

A total of three threatened ecological communities (TECs) listed under the BC Act were recorded to occur within the EIS proposal area. These included:

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

Two of these BC Act-listed TECs are also listed under the EPBC Act which include:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

A total of 0.25 ha of BC Act listed TECs and 0.22 ha of EPBC Act TECs would require removal by the EIS proposal.

Field surveys completed identified two threatened flora species as occurring within the study area, being:

- *Acacia pubescens* (Downy Wattle) (BC Act Vulnerable, EPBC Act Vulnerable)
- *Callistemon linearifolius* (Netted Bottle Brush) (BC Act Vulnerable).

Neither of these two threatened flora species will be directly impacted upon by the EIS proposal area.

Field surveys also recorded one threatened fauna species within the study area, being *Myotis macropus* (Southern Myotis) (listed under as Vulnerable under the BC Act).

The construction of drainage infrastructure within EIS proposal areas 1 and 2 would intersect with groundwater and thus may impact upon GDEs, particularly the Coastal Wetlands and Swamp Oak vegetation. With the implementation of environmental groundwater safeguards, it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the EIS proposal area. The EIS proposal area is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

The Georges River has a waterway classification of Class 1: Major key fish habitat with habitat sensitivity Type 2: Moderately sensitive key fish habitat as defined in the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013). No habitat for threatened fish or threatened ecological community listed under the Fisheries Management (FM) Act and/or the EPBC Act occurs within the EIS proposal area.

In the study area, the banks of the Georges River are lined by seedlings, shrubs and trees of River mangroves (*Aegiceras corniculatum*) and Grey mangroves (*Avicennia marina*) (PCT 920). Mangroves are protected under the FM Act. The mangroves would not be impacted by the EIS proposal.

It has been assumed that three hollow-bearing trees will likely be removed as a result of the EIS proposal. All of these HBTs occurred within EIS proposal area 1. The total number of hollow-bearing trees to be impacted will be quantified during detailed design.

## EPBC Act threatened biodiversity impacts

Assessments of impact significance were conducted for all EPBC Act listed threatened species and ecological communities considered likely to be affected by the EIS proposal. These impact assessments determined that the EIS proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats. In respect to Matters of National Environmental Significance (MNES) matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

Key recommendations are as follows:

- limit the removal of native vegetation and threatened ecological communities where practical during detailed design and construction

- prepare and implement a Bat Management Plan during construction
- implement mitigation measures as outlined in Section 10 to limit indirect and direct impacts to biodiversity values during detailed design and construction.

## Cumulative Impacts

The cumulative area of impact on native vegetation that is likely to occur for both the REF proposal area and the EIS proposal area is 1.94 ha and is outlined in the table below.

Proposal area	Area of impact (ha) on native vegetation
REF proposal area	1.69
EIS proposal area	0.25
<b>Cumulative area of impact</b>	<b>1.94</b>

## Biodiversity Offsets

The EIS proposal is classified as a designated development under division 4.1 of the EP&A (Act) as the EIS proposal area is likely to impact upon Coastal Wetlands that are mapped under SEPP (Coastal Management). Designated development projects such as the EIS proposal are required to prepare a BDAR to identify and assess biodiversity impacts under the provisions of the BC Act. The estimate of biodiversity credits calculated using the BAM-C are preliminary as the detailed design has yet to be finalised. Detailed design would develop a Biodiversity Offset Strategy and this would be integrated with the Biodiversity Offset requirements for the REF proposal.

Estimate of biodiversity credit requirements for the EIS proposal are summarised in the table below.

Biodiversity value requiring offsetting in accordance with BAM	Type of credit	Number of credits
PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Ecosystem	0
PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Ecosystem	1
PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Ecosystem	5
1236 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Ecosystem	1
Southern Myotis	Species	8
<b>Total number of ecosystem credits</b>		<b>7</b>
<b>Total number of species credits</b>		<b>8</b>

# Contents

---

<b>Executive summary .....</b>	<b>i</b>
Introduction .....	i
Methodology .....	i
Vegetation and Flora Surveys .....	i
Fauna Surveys.....	ii
Existing environment.....	ii
Matters of National Environmental Significance .....	iii
Impact Assessments .....	iv
EPBC Act threatened biodiversity impacts .....	v
Cumulative Impacts.....	vi
Biodiversity Offsets .....	vi
<b>Glossary of terms .....</b>	<b>xiv</b>
<b>1 Introduction .....</b>	<b>1</b>
1.1 Overall proposal background .....	1
1.2 EIS proposal .....	1
1.3 Purpose of this report.....	5
1.4 Structure of this report.....	5
1.5 Currency of Biodiversity Development Assessment Report.....	6
<b>2 Legislative context.....</b>	<b>7</b>
2.1 Overview.....	7
2.2 Commonwealth .....	7
2.3 State .....	8
<b>3 Methodology.....</b>	<b>12</b>
3.1 Personnel.....	12
3.2 Nomenclature.....	13
3.3 Sources of information used in this assessment.....	13
3.4 Field survey .....	14
3.5 Limitations.....	15
<b>Stage 1 Biodiversity assessment.....</b>	<b>17</b>
<b>4 Landscape context.....</b>	<b>17</b>
4.1 Landscape features .....	17
4.2 Site context .....	18
<b>5 Native vegetation .....</b>	<b>23</b>
5.1 Native vegetation methodology .....	23
5.2 Plant community types.....	30
5.3 Threatened ecological communities .....	59
5.4 Groundwater dependent ecosystems.....	66



## Contents (Continued)

<b>6</b>	<b>Threatened species.....</b>	<b>67</b>
6.1	Threatened species methodology .....	67
6.2	Identifying habitat suitability for ecosystem credit species .....	84
6.3	Identifying habitat suitability for species credit species .....	86
6.4	Aquatic habitat .....	98
6.5	Prescribed impacts .....	104
<b>7</b>	<b>Matters of National Environmental Significance.....</b>	<b>107</b>
7.1	Wetlands of International Importance .....	107
7.2	Threatened communities listed under the EPBC Act.....	107
7.3	Listed threatened species .....	118
7.4	Listed Migratory species .....	118
	<b>Stage 2 Impact assessment (biodiversity values and prescribed impacts).....</b>	<b>121</b>
<b>8</b>	<b>Avoiding minimising impacts on biodiversity values.....</b>	<b>121</b>
8.1	Avoidance and minimisation of impacts on native vegetation and associated habitat.....	121
8.2	Avoidance and minimisation of impacts on prescribed impacts .....	123
<b>9</b>	<b>Assessment of impacts .....</b>	<b>127</b>
9.1	Assessment of direct impacts.....	127
9.2	Assessment of indirect impacts.....	131
9.3	Assessment of prescribed biodiversity impacts .....	135
9.4	Serious and Irreversible Impacts.....	141
9.5	Matters of National Environmental Significance .....	143
9.6	Other impacts.....	147
9.7	Impact summary .....	154
<b>10</b>	<b>Mitigation and management of impacts .....</b>	<b>156</b>
10.1	Terrestrial ecology mitigation measures.....	156
10.2	Aquatic ecology mitigation measures .....	162
<b>11</b>	<b>Biodiversity offsets.....</b>	<b>165</b>
11.1	Ecosystem credits.....	165
11.2	Species credits.....	166
11.3	Aquatic offsets .....	166
11.4	Preliminary offsetting strategy .....	166
<b>12</b>	<b>Conclusion .....</b>	<b>167</b>
<b>13</b>	<b>References.....</b>	<b>170</b>
	<b>Appendix A – Threatened species habitat suitability tables.....</b>	<b>174</b>
	<b>Appendix B – Flora survey data.....</b>	<b>234</b>
	<b>Appendix C – Fauna survey data.....</b>	<b>262</b>
	<b>Appendix D – Aquatic habitat assessments results.....</b>	<b>264</b>
	<b>Appendix E – EPBC Act Assessments of Significance.....</b>	<b>277</b>
	<b>Appendix F – Biodiversity Credit Report.....</b>	<b>287</b>



## List of tables

Table 2.1	SEARs for biodiversity.....	7
Table 3.1	Personnel.....	12
Table 3.2	Weather conditions during the survey period .....	14
Table 4.1	Landscape features.....	17
Table 4.2	Native vegetation cover assessment .....	18
Table 4.3	Patch size for each vegetation zone within and surrounding the EIS proposal area.....	18
Table 5.1	Vegetation broad condition states.....	24
Table 5.2	Comparison of number of plots required and completed per zone area.....	27
Table 5.3	Location and orientation of vegetation integrity plots completed within the study area .....	27
Table 5.4	Plant community types .....	31
Table 5.5	PCT 725 overview of floristic and structural composition.....	35
Table 5.6	Comparison of PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data .....	37
Table 5.7	PCT 781 overview of floristic and structural composition.....	39
Table 5.8	Comparison of PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion plot data against PCT condition benchmark data .....	40
Table 5.9	PCT 835 overview of floristic and structural composition.....	42
Table 5.10	Comparison of PCT 835: Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data.....	44
Table 5.11	PCT 920 overview of floristic and structural composition.....	46
Table 5.12	Comparison of PCT 920: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data .....	47
Table 5.13	PCT 1236 overview of floristic and structural composition.....	49
Table 5.14	Comparison of PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data .....	50
Table 5.15	PCT 1234 overview of floristic and structural composition.....	52
Table 5.16	Comparison of PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data .....	53
Table 5.17	PCT 1800 overview of floristic and structural composition.....	55
Table 5.18	Comparison of PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley plot data against PCT condition benchmark data .....	56
Table 5.19	Summary of TECs listed under the BC Act recorded within the study area.....	59
Table 5.20	Correlation of BC Act-listed Cooks/River Ironbark Forest TEC and associated PCT 725.....	60
Table 5.21	Correlation of BC Act-listed Freshwater Wetland TEC and associated PCT 781 .....	61
Table 5.22	Correlation of BC Act-listed River-flat Eucalypt Forest TEC and associated PCT 835 .....	62
Table 5.23	Correlation of BC Act-listed Swamp Oak Floodplain Forest TEC and associated PCT 1236, PCT 1234 and PCT 1800.....	63
Table 6.1	Database searches undertaken.....	68
Table 6.2	Likelihood of occurrence classification and criteria.....	68

## List of tables (continued)

Table 6.3	Survey timing for candidate threatened flora (species credit species) within the study area .....	70
Table 6.4	Survey effort for threatened fauna species within the study area.....	76
Table 6.5	List of BAM-C generated predicted ecosystem credit species .....	84
Table 6.6	List of BAM-C candidate threatened flora species credit species.....	87
Table 6.7	Summary results of targeted seasonal surveys completed for candidate threatened flora species credit species.....	88
Table 6.8	List of BAM-C candidate threatened fauna species credit species.....	91
Table 6.9	Justification for exclusion of any predicted threatened fauna species credit species.....	92
Table 6.10	Summary results of targeted seasonal surveys completed for candidate threatened fauna species credit species.....	93
Table 6.11	Summary of RCE results.....	99
Table 6.12	Prescribed impacts identified within the study area.....	105
Table 7.1	A summary of TECs listed under the EPBC Act recorded within the study area.....	108
Table 7.2	Comparison of Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest in the NSW and South East Queensland ecological community key diagnostics against candidate PCTs.....	109
Table 7.3	Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of the NSW and South East Queensland ecological community minimum condition thresholds (Department of the Environment and Energy, 2018) .....	111
Table 7.4	Comparison of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC key diagnostic characteristics against PCT 725 within the study area.....	112
Table 7.5	Comparison of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC condition thresholds against PCT 725 within the study area .....	114
Table 7.6	Comparison of River-flat eucalypt forest on coastal floodplains of the southern NSW and eastern Victoria TEC key diagnostics against PCT 835 within the study area .....	115
Table 7.7	River-flat eucalypt forest on coastal floodplains of the southern NSW and eastern Victoria community minimum condition thresholds (Department of the Environment and Energy, 2018).....	117
Table 7.8	Migratory species with a moderate or higher likelihood of occurring within the study area .....	119
Table 8.1	Efforts to avoid and minimise impacts on native vegetation and habitat during the overall proposal design with reference to the EIS proposal. ....	121
Table 8.2	Efforts to avoid and minimise impacts on prescribed biodiversity during proposal design with reference to the EIS proposal.....	123
Table 9.1	Direct impacts to native vegetation .....	127
Table 9.2	Direct impacts to BC Act-listed TECs.....	128
Table 9.3	Key threatening processes associated with the removal of native vegetation .....	128
Table 9.4	Direct impacts on predicted ecosystem species.....	129
Table 9.5	Direct impacts on threatened species credit species.....	131
Table 9.6	Key threatening processes associated with removal of key fauna habitat features .....	131
Table 9.7	Summary of prescribed biodiversity impacts listed under the BC Regulation .....	135
Table 9.8	Potential impacts on species and ecological communities associated with human-made structures within the EIS proposal area.....	137
Table 9.9	Summary of potential impacts to hydrology associated with biodiversity habitat .....	139

## List of tables (continued)

Table 9.10	Potential impacts of vehicle strikes on threatened species or on animals that form part of a TEC.....	141
Table 9.11	Threatened fauna SAI entities with potential to occur within the study area.....	142
Table 9.12	A summary of predicted impacts to TECs listed under the EPBC Act.....	143
Table 9.13	A summary of predicted impacts to threatened fauna species listed under the EPBC Act .....	144
Table 9.14	Summary findings of the EPBC Act significance assessments .....	146
Table 9.15	Extent of mapped Coastal Wetlands and Proximity Coastal Wetlands in the study area and extent potentially impacted by the EIS proposal .....	149
Table 9.16	Past, present and future projects within the vicinity of the EIS proposal.....	152
Table 9.17	Cumulative Impact to Freshwater Wetlands.....	153
Table 10.1	Mitigation measures .....	157
Table 10.2	Aquatic mitigation measures.....	162
Table 11.1	Ecosystem credits required to offset EIS proposal impacts .....	165
Table 11.2	Species credits required to offset EIS proposal impacts.....	166
Table 12.1	Summary of PCTs and impacts .....	167
Table 12.2	Summary of impacts.....	167
Table 12.3	Summary of Biodiversity credit requirements .....	168

## List of figures

Figure 1.1	Proposal overview .....	3
Figure 1.2	EIS proposal area .....	4
Figure 4.1	Landscape context – IBRA bioregion subregion, LGAs and Mitchell Landscapes.....	19
Figure 4.2	Landscape context – Native vegetation assessment.....	20
Figure 4.3	Landscape context – Rivers, streams, wetlands and estuaries.....	21
Figure 4.4	Landscape context – Areas of geographical significance and soil hazard features .....	22
Figure 5.1	Native vegetation surveys .....	25
Figure 5.2	Survey effort.....	29
Figure 5.3	EIS proposal area Plant community types.....	32
Figure 5.4	Study Area Plant Community Types .....	33
Figure 5.5	Threatened ecological communities.....	65
Figure 6.1	Aquatic survey locations.....	83
Figure 6.2	Threatened species and Hollow-bearing Trees .....	95
Figure 6.3	Threatened flora species polygons .....	96
Figure 6.4	Southern Myotis Species Polygons.....	97
Figure 7.1	Matters of National Environmental Significance .....	120
Figure 9.1	Impact summary.....	155

## List of photographs

Photo 5.1	PCT 725 Moderate condition .....	35
Photo 5.2	PCT 725 Moderate condition .....	35
Photo 5.3	PCT 725 Poor condition (regrowth).....	35
Photo 5.4	PCT 725 Poor condition (regrowth).....	35
Photo 5.5	PCT 781 – moderate condition .....	38
Photo 5.6	PCT 835 Moderate condition – Forest Red Gum variant .....	42
Photo 5.7	PCT 835 Moderate condition – Forest Red Gum variant .....	42
Photo 5.8	PCT 835 Moderate condition – Blue Box variant.....	42
Photo 5.9	PCT 835 Moderate condition – Blue Box variant.....	42
Photo 5.10	PCT 920 Moderate condition .....	45
Photo 5.11	PCT 920 Moderate condition .....	45
Photo 5.12	PCT 920 Moderate condition along the Georges River .....	46
Photo 5.13	PCT 1236 Moderate condition .....	48
Photo 5.14	PCT 1236 Moderate condition .....	48
Photo 5.15	PCT 1236 Moderate condition – periodically flooded low-lying areas .....	49
Photo 5.16	PCT 1234 Moderate condition .....	51
Photo 5.17	PCT 1234 Moderate condition .....	51
Photo 5.18	PCT 1800 Poor condition .....	54
Photo 5.19	PCT 1800 Poor condition .....	54
Photo 5.20	Misc. ecosystem – Urban exotic/native landscape plantings .....	57
Photo 5.21	Misc. ecosystem – Urban exotic/native landscape plantings .....	57
Photo 5.22	Misc. ecosystem – Non-native vegetation.....	58
Photo 5.23	Misc. ecosystem – Non-native vegetation.....	58
Photo 5.24	Georges River.....	58
Photo 5.25	Water body – tributary of Georges River.....	58
Photo 6.1	<i>Acacia pubescens</i> .....	90
Photo 6.2	<i>Callistemon linearifolius</i> within Ashford Reserve .....	91
Photo 6.3	Aquatic Site 1 - Georges River looking north from the Newbridge Road bridge showing riparian zone .....	99
Photo 6.4	Aquatic Site 1 - Georges River looking west from the cycle path adjacent to the Newbridge Road Bridge .....	99
Photo 6.5	Aquatic Site 1 - Georges River looking north west from the Newbridge Road bridge .....	100
Photo 6.6	Aquatic Site 2 - Georges River looking south west from the cycle path back to the Newbridge Road bridge showing riparian zone .....	100
Photo 6.7	Aquatic Site 3 - The unnamed stream that exits Georges River Golf Course showing the culvert and riparian zone on the western side of Henry Lawson Drive .....	100
Photo 6.8	Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive .....	100
Photo 6.9	Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing culvert .....	100
Photo 6.10	Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing water clarity .....	100
Photo 6.11	Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing riparian zone .....	101

## List of photographs (continued)

Photo 6.12	Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing water clarity .....	101
Photo 6.13	Aquatic Site 12 - The unnamed stream upstream of the Auld Avenue bridge showing riparian zone .....	101
Photo 6.14	Aquatic Site 5 - The unnamed stream and culvert on the northern side of Milperra Road .....	101
Photo 6.15	Aquatic Site 5 - Inside the culvert under Milperra Road showing the unnamed first order stream which drains south to the Milperra Drain .....	101
Photo 6.16	Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road which drains south to the Milperra Drain showing water clarity.....	101
Photo 6.17	Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road showing riparian zone .....	102
Photo 6.18	Aquatic Site 8 - The unnamed first order stream on the southern side of Milperra Road showing riparian zone .....	102
Photo 6.19	Aquatic Site 8 - The unnamed stream on the southern side of Milperra Road showing mapped Coastal Wetland .....	102
Photo 6.20	Aquatic Site 6 - The unnamed stream in the east of the study area on the northern side of Milperra Road showing the culvert.....	102
Photo 6.21	Aquatic Site 6 - The unnamed first order stream in the east of the study area on the northern side of Milperra Road .....	102
Photo 6.22	Aquatic Site 6 - The unnamed first order stream in the east of the study area showing inside the culvert .....	102
Photo 6.23	Aquatic Site 7 - The unnamed first order stream in the east of the study area on the southern side of Milperra Road.....	103
Photo 6.24	Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the riparian zone .....	103
Photo 6.25	Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the pipe exit .....	103
Photo 6.26	Aquatic Site 10 - A stormwater drain on the eastern side of Henry Lawson Drive showing macrophytes.....	103

# Glossary of terms

---

## Definitions

Accredited person or assessor	A person accredited under section 6.10 of the <i>Biodiversity Conservation Act 2016</i> to prepare reports in accordance with Biodiversity Assessment Method.
Assessment area	Includes the subject land and the area of land within the 1500 m buffer zone surrounding the subject land (or 500 m buffer zone for linear proposals) that is determined as per Subsection 3.1.2 (Department of Planning Industry and Environment, 2020a).
BAM-C or calculator	Biodiversity Assessment Method Calculator (BAM-C) – a tool that applies the BAM to calculate the number and type of credits required to offset the impacts of development on biodiversity or credits generated at a biodiversity stewardship site (Department of Planning Industry and Environment, 2020a).
Biodiversity credit report	The report produced by the Biodiversity Assessment Method Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site (Department of Planning Industry and Environment, 2020a).
Biodiversity credits	Ecosystem credits or species credits
Biodiversity offsets	The gain in biodiversity values achieved from the implementation of management actions on areas of land, to compensate for losses to biodiversity values from the impacts of development (Department of Planning Industry and Environment, 2020a).
Biodiversity Offsets and Agreement Management System	The system used to administer the Biodiversity Offsets Scheme. BOAMS is used to access the version of the Calculator that can be used to perform and submit Biodiversity Assessment Method assessments, submit Biodiversity Assessment Method related applications, generate a credit obligation, calculate a credit price or apply to sell or retire credits.
Biodiversity values map	Is established according to clause 7.3 of the Biodiversity Conservation Regulation 2017. Development within an area identified on the map requires assessment using the Biodiversity Assessment Method.
BioNet Atlas	The DPIE database of flora and fauna records (formerly known as the New South Wales Wildlife Atlas). The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails listed under the <i>Biodiversity Conservation Act 2016</i> ) and some fish (Department of Planning Industry and Environment, 2020a).
BioNet Vegetation Classification	Refers to the vegetation community-level classification for use in vegetation mapping programs and regulatory biodiversity impact assessment frameworks in New South Wales. The BioNet Vegetation Classification is published by the Department and available at <a href="http://www.environment.nsw.gov.au/research/Visclassification.htm">www.environment.nsw.gov.au/research/Visclassification.htm</a> .
Candidate species	A species has been identified within the assessment area or is considered to have a moderate to high likelihood of occurrence and may be impacted by the EIS proposal.
Cumulative impact	The extent to which the development or activity contributes to the cumulative impacts of existing and planned developments or activities on threatened species, ecological communities, habitats, Areas of Outstanding Biodiversity Value and key threatening processes.
Direct impact	Direct impacts on biodiversity values include those related to clearing native vegetation and threatened species habitat, and impacts on biodiversity values prescribed by the Biodiversity Conservation Regulation 2017 (Department of Planning Industry and Environment, 2020a).

Ecosystem credit	A measurement of the value of Threatened Ecological Communities and threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type, and Plant Community Types generally. Ecosystem credits measure the loss in biodiversity values at a development, activity, clearing or biodiversity certification site and the gain in biodiversity values at a biodiversity stewardship site (Department of Planning Industry and Environment, 2020a).
EIS Proposal	Areas of the overall proposal occurring on land mapped as Coastal Wetlands subject to assessment as designated development under Division 4.1 of the <i>Environmental, Planning and Assessment Act 1979</i> .
EIS proposal area(s)	<p>The EIS proposal is comprised of three proposal areas which include:</p> <ul style="list-style-type: none"> <li>• EIS proposal area 1 – Henry Lawson Drive opposite Tower Road</li> <li>• EIS proposal area 2 – Milperra Road opposite Bankstown Airport</li> <li>• EIS proposal area 3 – Henry Lawson Drive opposite Auld Avenue.</li> </ul> <p>These areas include all areas of land that is directly impacted on by the overall proposal that is being assessed under Division 4.1 of the <i>Environmental, Planning and Assessment Act 1979</i>, including access roads, and areas used to store construction materials. It includes the construction and operational areas of the EIS proposal and therefore land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land.</p>
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.
Indirect impact	Impacts that occur when the proposal affects native vegetation and threatened species habitat beyond the development footprint or within retained areas (e.g. transporting weeds or pathogens, dumping rubbish). This includes impacts from activities related to the construction or operational phase of the proposal and prescribed impacts (Department of Planning Industry and Environment, 2020a).
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH 2017).
Matters of National Environmental Significance	A Matter of National Environmental Significance (MNES) protected by a provision of Part 3 of the EPBC Act.
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (Department of Planning Industry and Environment, 2020a).
Mitigation	Action to reduce the severity of an impact (Department of Planning Industry and Environment, 2020a).
Mitigation measure	Any measure that facilitates the safe movement of wildlife, prevents wildlife mortality and/or reduces the severity of an impact.
Native vegetation	<ol style="list-style-type: none"> <li>trees (including any sapling or shrub or any scrub),</li> <li>understorey plants,</li> <li>groundcover (being any type of herbaceous vegetation),</li> <li>plants occurring in a wetland.</li> </ol> <p>A plant is native to New South Wales if it was established in New South Wales before European settlement (<i>Biodiversity Conservation Act 2016</i>).</p>
Overall proposal	The overall proposal of the Stage 1A upgrade inclusive of all activities impacting areas within the overall proposal boundary.
PlantNet NSW	An online database of the flora of New South Wales which contains currently accepted taxonomy for plants found in the State, both native and exotic.
Population	A group of organisms, all of the same species, occupying a particular area.

Proposal area	The overall proposal area includes all areas of land that is directly impacted on by the proposal that is being assessed under Division 4.1 of the <i>Environmental, Planning and Assessment Act 1979</i> , including access roads, and areas used to store construction materials. It includes the construction and operational areas of the overall proposal.
REF Proposal	The majority of the overall proposal subject to assessment under Division 5.1 of the <i>Environmental, Planning and Assessment Act 1979</i> .
REF proposal area(s)	The REF proposal area includes all areas of land that is directly impacted on by the overall proposal that is being assessed under Division 5.1 of the <i>Environmental, Planning and Assessment Act 1979</i> . The REF proposal area excludes all land mapped as SEPP (Coastal Management) where activities are proposed and deemed as a designated development. The impact areas include access roads, and areas used to store construction materials.
Species credit species	Threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits (Department of Planning Industry and Environment, 2020a).
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Study area	The proposal area and any other areas surveyed and assessed for biodiversity values which may be subject to indirect impacts (20m from design footprint).
Subject land	Is land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the assessment area which surrounds the subject land (i.e. the area of land in the 1500 m buffer zone around the subject land or 500m buffer zone for linear proposals) (Department of Planning Industry and Environment, 2020a).
Threatened Biodiversity Data Collection	A publicly assessable online database (registration required) which contains information for listed threatened species, populations and ecological communities. Part of the BioNet database, published by Environment, Energy and Science and accessible from the BioNet website at <a href="http://www.bionet.nsw.gov.au">www.bionet.nsw.gov.au</a> .
Vegetation Integrity Score	The condition of native vegetation assessed for each vegetation zone against the benchmark for the Plant Community Type. A score is generated for each vegetation zone using the Biodiversity Assessment Method Calculator.
Vegetation Zone	A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same Plant Community Type and broad condition state.

## Abbreviations

AOBV	Area of Outstanding Biodiversity Value
BAM	Biodiversity Assessment Method
BC Act	<i>Biodiversity Conservation Act 2016</i> (NSW)
BC Regulation	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offset Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CSSI	Critical State Significant Infrastructure
DAWE	Department of Agriculture, Water and the Environment
DIWA	Directory of Important Wetlands in Australia
DPI	Department of Primary Industries



DPIE	Department of Planning, Infrastructure and Environment
EEC	Endangered Ecological Community
EES	NSW Environment Energy and Science Group within the Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
Environment Agency Head	Environment Agency Head, Environment, Energy and Science Group, Department of Planning, Industry and Environment
EP&A Act	<i>Environment Planning and Assessment Act 1979</i> (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
Fisheries NSW Policy and Guidelines	Fisheries NSW Policy and guidelines for fish habitat conservation and management (Update 2013)
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographical Regionalisation of Australia
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
PMST	EPBC Act Protected Matters Search Tool
REF	Review of Environmental Factors
SAIL	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SDD	State Significant Development
SSI	State Significant Infrastructure
TBDC	Threatened Biodiversity Data Collection
TECs	Threatened Ecological Communities (VECs, EECs and CEECs)
Transport	Transport for NSW
VEC	Vulnerable Ecological Community
VI	Vegetation Integrity
VIS	Vegetation information system

# 1 Introduction

---

## 1.1 Overall proposal background

Transport for NSW (Transport) is proposing to upgrade Henry Lawson Drive between Keys Parade, Milperra, to Tower Road, Bankstown Aerodrome (known as Henry Lawson Drive Stage 1A) (the overall proposal). The overall proposal consists of upgrading a 1.3 kilometre length of Henry Lawson Drive and an additional 480 metres along Milperra Road, including intersection upgrades (Figure 1.1).

The overall proposal forms the first stage of the progressive upgrades to 7.5 kilometers of Henry Lawson Drive between the intersections of the Hume Highway, Villawood, and the M5 South Western Motorway, Milperra.

The upgrade would help ease existing traffic issues and increase traffic capacity at key intersections to help meet growing demand, with residential, commercial and industrial development in the surrounding area expected to increase in the coming years. The upgrade would be delivered in three stages.

Subject to approval, construction of the Stage 1A proposal may commence in early 2023 and would take about two years to complete. Other stages of upgrading Henry Lawson Drive would be developed separately in the future.

The overall proposal has been split into two parts as a result of proposed activities interacting with both Divisions 4.1 and 5.1 of the *Environment Planning & Assessment Act 1979* (EP&A Act). The two parts are assessed separately as illustrated in Figure 1.1 and described briefly below.

- REF proposal – incorporates the majority of the overall proposal subject to assessment under Division 5.1 of the Environment Planning & Assessment Act 1979 (EP&A Act)
- EIS proposal - areas of the overall proposal occurring on land mapped as Coastal Wetlands under the State Environment Planning Policy (Coastal Management) area subject to assessment as designated development under Division 4.1 of the EP&A Act.

Key features of the overall proposal are described in the Biodiversity Assessment Report and Review of Environmental Factors prepared for the REF proposal.

This report has been prepared to assess the biodiversity impacts of the EIS proposal. It will support an Environmental Impact Statement (EIS) being prepared under Division 4.1 of the EP&A Act.

## 1.2 EIS proposal

### 1.2.1 EIS proposal overview

The EIS proposal area is located along the existing Henry Lawson Road and Milperra Road Intersection at Milperra in the City of Canterbury Bankstown local government area (LGA) in New South Wales (NSW) (study area, see Figure 1.2).

For the purposes of this report the following terminology has been used:

- Overall proposal: overall proposal of the Henry Lawson Drive Stage 1A upgrade inclusive of all activities impacting areas within the overall proposal boundary.
- EIS proposal: areas of the overall proposal occurring on land mapped as Coastal Wetlands under the SEPP (Coastal Management) subject to assessment as designated development under Division 4.1 of the EP&A Act and subject of this report.
- REF proposal: majority of the overall proposal subject to assessment under Division 5.1 of the EP&A Act.
- EIS proposal area: the area of land that would be directly impacted on by the EIS proposal (i.e. the construction footprint), including construction ancillary infrastructure such as access tracks and site and storage compounds. It includes the construction and operational areas of the EIS proposal and therefore land to which the Biodiversity

Assessment Method (BAM) is applied in Stage 1A to assess the biodiversity values of the land (i.e. the subject land).

- Study area: the EIS proposal area (i.e. the development footprint) and adjacent areas of vegetation and associated habitat surveyed as part of this investigation which may be subject to direct or indirect impacts as a result of the EIS proposal.
- Locality: is defined as an approximate 10 km radius around the EIS proposal area.
- The study area is located in the Sydney Basin bioregion (Cumberland subregion) (Department of the Environment and Energy, 2016).

An overview depicting the facets of the EIS proposal is provided in Figure 1.2.

### **1.2.2 EIS proposal areas**

There are three areas within the EIS proposal area that are discussed throughout this Biodiversity Development Assessment Report (BDAR). These three areas are described below and illustrated in Figure 1.2.

#### **EIS proposal area 1 – Henry Lawson Drive opposite Tower Road**

The key features of EIS proposal area 1 are:

- Widening of Henry Lawson Drive northbound lanes.
- Installing of fill embankments along the edge of the new carriageway to meet existing ground levels.
- Extending existing stormwater culvert and installing outlet scour protection measures.
- Installing additional stormwater drainage infrastructure and water quality treatments.
- Installing a vegetated channel along the toe of the new fill embankment.
- Adjusting the existing shared path to suit the new re-alignment and to connect it back to the existing path.
- Installing road furniture, including road safety barriers.

#### **EIS proposal area 2 – Milperra Road opposite Bankstown Airport**

The key features of EIS proposal area 2 are:

- Installing a new bus stop relocated from its existing position on Milperra Road.
- Installing a section of a new footpath to the bus stop (connecting to the remainder of the new path to Henry Lawson Drive – REF proposal).
- Installing fill embankments along the edge of the new carriageway to meet existing ground levels.
- Extending existing stormwater culvert and installing outlet scour protection measures.
- Installing additional stormwater drainage infrastructure connecting to the outlet of the extended culvert.
- Installing road furniture, including road safety barriers.

#### **EIS proposal area 3 – Henry Lawson Drive opposite Auld Avenue**

The key features of EIS proposal area 3 are:

- Removing of existing ancillary structures.
- Installing temporary fencing, flagging of exclusion boundaries & temporary erosion and sediment controls for use as an ancillary facility and construction area.
- Installing fill embankments along the edge of the new carriageway to meet existing ground levels.
- Stabilising the ground surface following the completion of construction to minimise erosion.



Figure 1.1  
Proposal overview

Legend

- Watercourse
- Study area
- EIS proposal area
- REF proposal area
- Potential compound sites



Coordinate system: GDA 1994 MGA Zone 56  
 Scale ratio correct when printed at A3  
 1:6000 Date: 07-May-21  
 Data sources: NGA, WSP, BOM, Geoscience Australia  
 Software: HERE, Garmin, OpenStreetMap contributors, and the GIS user community

This document is the property of WSP. It is to be used only for the purposes for which it was prepared. It is not to be used for any other purpose without the written consent of WSP. WSP does not accept any liability for any loss or damage arising from the use of this document. The information contained herein is for general information only and should not be used as a basis for any specific decision. The information contained herein is for general information only and should not be used as a basis for any specific decision. The information contained herein is for general information only and should not be used as a basis for any specific decision.





 EIS proposal area



1:6 C00 Date: 16-Apr-21

1:6 C00 Date: 16-Apr-21

Free source - N/A Map, TMS, Geospatial data in Esri, HERE, Garmin, Open-StreetMap contributors, and the GIS user community



### 1.3 Purpose of this report

This BDAR has been prepared in accordance with the Biodiversity Assessment Methodology (BAM) (Department of Planning Industry and Environment, 2020a) and supplementary BAM Operational Manuals – Stage 1 and Stage 2 (Department of Planning Industry and Environment, 2020b, Department of Planning Industry and Environment, 2020c) to specifically consider matters in relation to biodiversity. The purpose of this report is to describe biodiversity values present and to assess the potential impacts of the construction and operation of the EIS proposal on biodiversity values. This BDAR supports the overarching EIS prepared to address the potential impacts on the environment associated with the EIS proposal.

The report has the following objectives:

- Provide a brief overview of the EIS proposal and identify the EIS proposals key legislative requirements.
- Provide a 'Stage 1 Biodiversity assessment' and 'Stage 2 Impact assessment (biodiversity values and prescribed impacts)' of biodiversity values within the EIS proposal area in accordance with BAM.
- Summarise steps taken to 'avoid, minimise and mitigate' impacts on biodiversity associated with the EIS proposal.
- Identify and describe threatened species and communities pursuant to the *Fisheries Management Act 1994* (FM Act) and *Biodiversity Conservation Act 2016* (BC Act).
- Identify and describe Matters of National Significance (MNES) which occur within the Modification study area and assess the EIS proposal's impacts on MNES entities by completing significant impact assessments pursuant to '*Matters of National Environmental Significance Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*' (Department of the Environment, 2013a).
- Provide a detailed assessment of the potential impacts (direct and indirect) to coastal wetlands protected under the SEPP (Coastal Management) and aquatic species/habitat listed under the *Fisheries Management Act 1994* (FM Act) and any offset requirements resulting from this assessment.
- Identify appropriate biodiversity offsets to compensate for residual impacts on protected matters arising from the EIS proposal in accordance with the NSW Biodiversity Offset Scheme (BOS).

### 1.4 Structure of this report

The structure and content of this report is as follows:

- Chapter 1 – Introduction: Outlines the background and need for the EIS proposal, and the purpose of this report.
- Chapter 2 – Legislative context: Provides an overview of the key legislative requirements and policy guidelines relating to the EIS proposal.
- Chapter 3 – Methodology: Provides an overview of methodologies implemented as part of this biodiversity assessment.

#### Stage 1 – Biodiversity assessment

- Chapter 4 – Landscape context: Provides information on a range of landscape features in accordance with Chapter 3 of the BAM that occur in the EIS proposal area and broader locality.
- Chapter 5 – Native vegetation: Provides information on native vegetation in accordance with Chapter 4 of the BAM and matters relating to the BC Act listed Threatened Ecological Communities (TECs).
- Chapter 6 – Threatened species: Provides information on BC Act listed threatened species and habitats in accordance with Chapter 5 and Chapter 6 of the BAM.
- Chapter 7 – Matters on National Environmental Significance: Describes biodiversity matters relating to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

## Stage 2 – Impact assessment

- Chapter 8 – Avoid and minimise impacts: Provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the EIS proposal in accordance with Chapter 7 of the BAM.
- Chapter 9 – Assessment of impacts: Describes the potential construction and operational impacts associated with the EIS proposal. This chapter also includes potential cumulative impacts with respect to other known developments within the vicinity of the EIS proposal in accordance with Chapter 8 and Chapter 9 of the BAM.
- Chapter 10 – Mitigation and management of impacts: Outlines the proposed mitigation measures for the EIS proposal on biodiversity matters in accordance with Chapter 8 of the BAM.
- Chapter 11 – Biodiversity offsetting: Provides an overview of residual impacts requiring offsets, the Biodiversity Assessment Methodology Calculator (BAM-C) and biodiversity credit report output in accordance with Chapter 10 of the BAM.
- Chapter 12 – Conclusion: Provides a conclusion of the potential impacts of the EIS proposal on biodiversity.
- Chapter 13 – References: Identifies the key reports and documents used to generate this report.

Appendices to this report includes:

- Appendix A – Threatened species habitat suitability tables
- Appendix B – Flora survey data
- Appendix C – Fauna survey data
- Appendix D – Aquatic habitat assessment results
- Appendix E – EPBC Act Assessments of Significance
- Appendix F – Biodiversity Credit Report.

## 1.5 Currency of Biodiversity Development Assessment Report

I, Toby Lambert (BAM Accredited Assessor (BAAS17046)), certify that this BDAR has been prepared on the basis of the requirements of (and information provided under) the current biodiversity assessment method dated 22 October 2020 available from <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method>.

## 2 Legislative context

### 2.1 Overview

EISs are prepared to assess the impacts of development projects assessed under Division 5.2 of the EP&A Act (State Significant Infrastructure (SSI) or Critical State Significant Infrastructure (CSSI), Division 4.1 of the EP&A Act (designated development) or Division 4.7 of the EP&A Act (State Significant Development (SSD)).

As sections of the overall proposal intersect with areas mapped as Coastal Wetlands, an EIS has been prepared to assess the proposal under Division 4.1 of the EP&A Act. This BDAR forms part of the EIS being prepared for the Henry Lawson Drive Stage 1A upgrade EIS proposal under Division 4.1 of the EP&A Act as a designated development.

EIS's are subject to a range of legislative and policy requirements as set out in the Secretary's Environment Assessment Requirements (SEARs). For this EIS, SEARs have been issued by the Department of Planning, Industry and Environment, which describe assessment requirements. Table 2.1 sets how the biodiversity requirements in the SEARS have been addressed in this BDAR.

Biodiversity assessments requirements established by the BC Act, require a BDAR to be prepared using a person accredited under the BC Act. These requirements are reflected in the SEARs.

**Table 2.1 SEARs for biodiversity**

Requirement	Section addressed
A detailed assessment of the ecological values and potential impacts of biodiversity values to determine if the proposed development is ' <i>likely to significantly affect threatened species</i> ' for the purposes of Section 7.2 of the <i>Biodiversity Conservation Act 2016</i> (BC Act). If the proposed development is significantly likely to affect threatened species the application for development consent is to be accompanied by a Biodiversity Development Assessment Report (BDAR) prepared in accordance with Part 6 of the BC Act, and	Entirety of this report
A detailed assessment of the potential impacts (direct and indirect) to coastal wetlands and aquatic species/habitat listed under the <i>Fisheries Management Act 1994</i> and any offset requirements resulting from this assessment.	Chapter 9 of this report
Downstream impacts of contaminated soil on aquatic ecology	Chapters 9 and 10 of this report

This BDAR forms part of the EIS being prepared for the EIS proposal and assesses the biodiversity impacts of the EIS proposal to meet the requirements of State and Commonwealth legislation.

### 2.2 Commonwealth

#### 2.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

Under the EPBC Act, any action that has, would have, or is likely to have a significant impact on a Matter of National Environmental Significance (MNES) or on Commonwealth land, triggers the Act and may require assessment and approval from the Commonwealth Minister for the Environment.



The nine MNES protected under the EPBC Act are:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of international importance (listed under the Ramsar Convention)
- Commonwealth marine areas
- World heritage properties
- National heritage places
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource, in relation to coal seam gas development and large coal mining development.

Based on the potential minor impacts of the EIS proposal to EPBC Act listed threatened species and water resources, a referral under the EPBC Act is not required to be submitted to the Department of Agriculture, Water and the Environment (DAWE) to determine whether it comprises a controlled action.

## **2.3 State**

### **2.3.1 *Environment Planning and Assessment Act 1979***

The EP&A Act provides the statutory controls that establish a framework governing what development is permitted or prohibited, and the processes for how assessment and gaining approval for development is undertaken in NSW. It is supported by the NSW Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) which provides additional detail and gives effect to the legislation.

Of relevance to the EIS proposal is Division 4.1 of the EP&A Act, which deals with designated development.

### **2.3.2 *State Environmental Planning Policy (Coastal Management) 2018***

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) gives effect to the objectives of the NSW *Coastal Management Act 2016* from a land use planning perspective.

If Coastal Wetlands listed under the Coastal Management SEPP are to be impacted by a proposal, then it will require consent from the local council under Part 4 of the EP&A Act. Such development is declared designated development pursuant to clause 10(2) of the Coastal Management SEPP and Crown development application with an EIS would be required.

In this circumstance, the biodiversity impact assessment would require the preparation of a BDAR in accordance with the BAM. Therefore, offset obligations would be determined and required to be fulfilled in accordance with BAM, the BC Regulation and the BOS.

As the EIS proposal will impact on Coastal Wetlands listed under the Coastal Management SEPP it is declared a designated development and as such requires the preparation of an EIS. As such, the biodiversity impact assessment requires the preparation of a BDAR in accordance with the BAM, BC Regulation and BOS.

### **2.3.3 *State Environmental Planning Policy (Koala Habitat Protection) 2020***

The State Environmental Planning Policy (Koala Habitat Protection) 2020 (Koala Habitat Protection SEPP) commenced on the 30 November 2020. The Koala Habitat Protection SEPP requires that before consent for development on land in the Local Government Areas listed on Schedule 1 of the SEPP and over one hectare in area, a consent authority must be satisfied as to whether the land is 'potential' or 'core' habitat for Koalas. Under the SEPP, where core habitat is found to occur, a site-specific Koala Plan of Management must be prepared, unless a local Koala Management Plan already exists.

The EIS proposal occurs within the City of Canterbury Bankstown LGA which is not listed under Schedule 1 of the Koala Habitat Protection SEPP. As such, the Koala Habitat Protection SEPP does not apply to the EIS proposal.

### **2.3.4 Biodiversity Conservation Act 2016**

The BC Act, together with the Biodiversity Conservation Regulation 2017 (BC Regulation), outlines the framework for assessment and approval of biodiversity impacts associated with developments that require consent under the EP&A Act. It introduces a BOS, a framework to avoid, minimise and offset impacts on biodiversity from development and clearing.

The proponent for a development to which the Division 5.2 of the EP&A Act applies is required to prepare a BDAR in support of an application for approval to undertake that development (see section 7.9 of the BC Act). The BDAR uses the BAM established under these biodiversity reforms to provide a methodology for determining the number and type of biodiversity credits required to offset biodiversity impacts.

Designated development projects such as the EIS proposal are required to prepare a BDAR to identify and assess biodiversity impacts under the provisions of the BC Act and offset those impacts by retiring biodiversity credits, determined using the BAM, through the BOS.

This BDAR has been specifically prepared to address the BAM and associated guidance documents to enable development approval under Part 5 of the EP&A Act.

### **2.3.5 Biosecurity Act 2015**

The NSW *Biosecurity Act 2015* (Biosecurity Act) 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.

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 minimise, so far as is reasonably practicable.

### **2.3.6 Fisheries Management Act 1994**

The FM Act was introduced to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The Act provides for the listing of threatened species, populations and ecological communities, listing of 'Key Threatening Processes', and the requirements to assess potential impacts on aquatic resources.

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, the Department of Primary Industries (DPI) has produced the '*Policy and guidelines for fish habitat conservation and management*' (Department of Primary Industries, 2013). This policy applies to the following developments, works or activities, each of which can impact on key fish habitat:

- dredging or reclamation
- impeding fish passage
- damaging marine vegetation
- de-snagging.

Part 7 of the FM Act relates to the protection of fish and aquatic habitats with the objective of conserving the biodiversity of fish and aquatic vegetation. It provides for the management of certain works located on land that is permanently or intermittently submerged by water. Pursuant to sections 201, 205 and 219 of the FM Act, works and activities such as those listed above, may be undertaken under the authority of a permit.

### 2.3.7 Local Land Services Act 2013

The NSW *Local Land Services Act 2013* (LLS Act) was introduced to provide direction around programs and services associated with agricultural production, biosecurity, natural resource management and emergency management. It aims to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistent with the principles of ecologically sustainable development. One of the ways that it intends to achieve this is through the regulation of clearing of native vegetation.

Part 5A of the LLS Act sets out the ways in which the regulating of activities (in connection with land management) would occur and the areas of the State to which it would apply. Section 60A applies Part 5A to any area of the State, other than some nominated areas which, relevantly, include urban areas of the State to which the State Environmental Planning Policy (Vegetation in Non-Rural Areas) SEPP 2017 applies. Additionally, section 60O of the LLS Act deals with clearing that is authorised under other legislation.

City of Canterbury Bankstown LGA is identified as an urban area to which the Vegetation in Non-Rural Areas SEPP applies, thereby excluding them from the provisions of the LLS Act. Furthermore, under the provisions of section 60O of the LLS Act the clearing of native vegetation is authorised if the clearing was authorised by a development consent under Part 4 of the EP&A Act.

The provisions of the LLS Act do not apply to the EIS proposal. Land management of native vegetation does not apply to the lands on which the EIS proposal is located.

### 2.3.8 Regional Environmental Plans and Local Environment Plans

#### **Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (1999 EPI 52)**

The Greater Metropolitan Regional Environmental Plan No 2 – Georges River Catchment (1999 EPI 52) applies to specific LGAs that occur within the Georges River catchment. The aims of the plan are to:

- Maintain and improve water quality and river flows of the Georges River and its tributaries.
- Protect and enhance the environmental quality of the Catchment for the benefit of all users.
- Ensure consistency and local environment plans and also in the delivery of the principles of ecologically sustainable development in the assessment of development within the catchment where there is potential to impact adversely on groundwater and on the water quality and river flows within the Georges River.
- To establish a consistent and co-ordinated approach to environmental planning and assessment for land along the Georges River and its tributaries and to promote integrated catchment management policies and programs in the planning and management of the catchment.
- To provide a mechanism that assists in achieving the water quality objectives and river flow objectives agreed under the Water Reform Package.

The EIS proposal area is located within the City of Canterbury Bankstown LGA which is identified in Part 1 of the plan as a LGA in which the plan applies. As the EIS proposal would involve the removal of wetlands, alter stormwater run-off and disturb the Georges River foreshore, Part 2 of the plan applies. Part 2 requires that removal of wetlands must take into account potential impacts of surrounding land uses and to incorporate measures to mitigate adverse effects. Wetlands must also be protected when clearing by adequate mitigation measures such as a construction of a levee, draining or landscaping.

Part 3 of the plan requires that any public authority undertaking works that may significantly affect the water quality and flows of Georges River its tributaries and the environment within the catchment must undertake the controls set out in the LEP of the local council.

The EIS proposal may result in a reduction in water quality and increase surface run-off entering the Georges River catchment because of an increase in impervious surfaces. Furthermore, excavations of subsurface soil may result in the mobilisation of potential contaminants. All of the EIS proposal areas are located in proximity to potential sources of

these contaminants. Further discussion and mitigation measures are outlined in Section 9.2.5 and Section 10.

## **Bankstown Development Control Plan (2015)**

### ***Part B 11 Tree Management Order***

The objectives of the tree management order is to retain trees in the urban environment as they provide ecological, environmental, social, health, heritage and amenity values. Trees maintain and enhance biodiversity and natural ecosystems and processes.

The concept design for the EIS proposal would involve the removal of native and exotic trees as part of the impacts of the road upgrade. These trees provide habitat for a number of threatened fauna species including three hollow-bearing trees which occur in EIS proposal area 1.

Where practicable trees would be retained as part of the EIS proposal. Removal of all trees would use best practice methods outlined in the Biodiversity Guidelines: protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011).

Native trees that are representative of the vegetation removed would be replanted in areas that were previously cleared for temporary ancillary sites where practicable. 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 (Roads and Traffic Authority, 2011) and Landscaping Plans prepared as part of the proposal's urban design. This biodiversity assessment has informed the development of the concept design Landscaping Plans. Further information can be found in the proposal's Urban Design Report by Tract (2021).

### ***Part B12 Flood Risk Management***

This part of the Bankstown Development Control Plan (DCP) aims to reduce the risk of human life and damage to property caused by flooding. Areas of the City of Canterbury Bankstown LGA have been mapped according to their risk of flooding.

The EIS proposal areas are mapped as at high risk of flooding and below the 100-year flood level defined in this DCP. The EIS proposal areas are subject to flooding due to the close proximity to the Georges River.

The stormwater design for operational phase would aim to maintain, wherever possible, the existing flood regime and levels as identified by Lyall & Associates (2018). Upgrading of transverse drainage along Henry Lawson Drive, upgrade of existing stormwater drainage system and raising of Henry Lawson Drive in strategic locations is recommended (Lyall & Associates, 2018).

## 3 Methodology

This section provides a detailed description of the general methodologies used in the preparation of this BDAR. Methodologies used included a combination of desk-based searches of relevant databases and historical records, as well as field inspections of the study area to identify and assess biodiversity values in accordance with Stage 1 and Stage 2 of the BAM.

Specific methodologies used for the assessment of native vegetation and threatened species are detailed in Section 5.1 and Section 6.1 of this report respectively.

All work was carried out under the appropriate licences, including scientific licences as required under Part 2 of the BC Act (License Number: SL100630) and an Animal Research Authority issued by the DPI (Agriculture).

### 3.1 Personnel

This BDAR has been prepared by a team of qualified and experienced ecologists and accredited BAM assessors (see Table 3.1).

**Table 3.1 Personnel**

Name	Role	Qualifications
Alex Cockerill	Ecology National Team Executive – Project director	Bachelor of Science (Hons), BAM Accredited Assessor (BAAS17020)
Toby Lambert	Principal Ecologist – Project manager, technical review and BAM-C calculations	Bachelor of Environmental Science, BAM Accredited Assessor (BAAS17046)
Mark Stables	Principal Ecologist – Field survey and report preparation	Bachelor of Science (Hons), BAM Accredited Assessor (BAAS18097)
Lukas Clews	Principal Ecologist – Field surveys and report preparation	Master of Scientific Studies, Graduate Certificate in Applied Science, Diploma Conservation and Land Management, Bachelor of Science, BAM Accredited Assessor (BAAS17060)
Debbie Landenberger	Principal Ecologist – Report preparation	Bachelor of Science (Hons), BAM Accredited Assessor (BASS18187)
Josie Stokes	Principal Ecologist – Report preparation	Bachelor of Science
Tanya Bangel	Senior Ecologist – Field survey, report preparation and BAM-C calculations	Bachelor of Environmental Management and Science (Hons), Diploma of Conservation and Land Management, BAM Accredited Assessor (BAAS18076)
Allan Richardson	Senior Ecologist – Field survey and report preparation	Bachelor of Environmental Science (Hons) and has completed the BAM training
Troy Jennings	Ecologist – Field survey	Bachelor of Biodiversity and Conservation, Masters of Wildlife Management, BAM Accredited Assessor (BAAS18172)
Julia Emerson	Ecologist – Field survey	Bachelor of Science, Certificate III Conservation and Land Management, BAM Accredited Assessor (BAAS18034)
Clementine Watson	Ecologist – Field survey	Bachelor of Environmental Science, BAM Accredited Assessor (BAAS18164)
Devon Raiff	Graduate Ecologist – Field survey	Bachelor of Science, Certificate III Land Management and Conservation

Name	Role	Qualifications
Emily Mitchell	Mapping and data management – GIS operator	Masters of Information Technology, Bachelor of Development Studies, Certificate IV Spatial Information Services
Huw Chittleborough	Mapping and data management – GIS operator	Bachelor of Applied Geographical Information Systems (Hons)
Nickie Kelleway	Mapping and data management – GIS operator	Diploma of Agriculture, Precision Agriculture, Bachelor of Spatial Science and Technology (GIS)

### 3.2 Nomenclature

Names of vegetation communities used in this report are based on the PCT used in the NSW BioNet Vegetation Classification Database (Environment Energy and Science, 2021c). These names are cross-referenced with those used for threatened ecological communities listed under the BC Act and/or the EPBC Act.

Names of plants used in this document follow PlantNet (Royal Botanic Gardens, 2021). Scientific names are used in this report for species of plant. The names of introduced species are denoted with an asterisk (\*).

For threatened species of plants, the names used in the BioNet Atlas of NSW Wildlife (Environment Energy and Science, 2021b) are also provided where these differ from the names used in the PlantNet database.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the DAWE (2021a). Common names are used in the report for species of animal. Both common and scientific names are provided in appendices.

For threatened species of animals, the names used in the BioNet Atlas of NSW Wildlife and DPI Spatial Data Portal (2021) are provided.

### 3.3 Sources of information used in this assessment

The following information sources were used to inform the preparation of this report:

- Aerial photographic imagery.
- NSW Mitchell Landscapes (Department of Planning Industry and Environment, 2021b).
- Interim Biogeographic Regionalisation of Australia (IBRA version 7.0) (Department of the Environment and Energy, 2016).
- Atlas of Groundwater Dependent Ecosystems (GDE) (Bureau of Meteorology, 2021).
- Directory of Important Wetlands of Australia (Department of Agriculture Water and the Energy, 2021b).
- Register of Declared Areas of Outstanding Biodiversity Value (AOBV) – Critical habitat declarations in NSW (Department of Planning Industry and Environment, 2021a).
- Register of Critical Habitat (Department of Agriculture Water and the Energy, 2021d).
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage, 2016).
- NSW BioNet Threatened Biodiversity Data Collection (Environment Energy and Science, 2021d).
- BioNet Atlas of NSW Wildlife (Environment Energy and Science, 2021b).
- BioNet Vegetation Classification Database (Environment Energy and Science, 2021c).
- EPBC Act Protected Matters Search Tool (Department of Agriculture Water and the Energy, 2021c).
- Species Profiles and Threats Database (Department of Agriculture Water and the Energy, 2021e).
- NSW Flora Online (PlantNet) (Royal Botanic Gardens, 2021).
- Atlas of Living Australia – interactive map search (Atlas of Living Australia, 2021).



- Other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

Other relevant documents and data that were reviewed as part of this study are referenced throughout this report where appropriate.

### 3.4 Field survey

The field survey aimed to ground-truth the results of the background research and habitat assessment within the study area. As such, all threatened species, populations and communities that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence. A description of all field surveys completed to inform this report is provided below.

#### 3.4.1 Survey timing and weather conditions

##### Original field surveys

Initial native vegetation surveys were undertaken by WSP (2019) over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional field surveys were undertaken on the 6 & 7 April 2020. All proposed field surveys were rescheduled for and organised for April in consultation with Transport due to health and safety concerns surrounding Covid-19, and uncertainty about whether complete lockdowns would occur and for how long. If the initial additional field surveys had not been fast-tracked there was the potential threat that surveys could not be completed as required due to Covid-19 issues.

##### Additional field surveys

Additional flora and fauna field surveys sought to verify existing mapping (WSP, 2019) and survey additional areas within the study area/subject land as well as supplement previous surveys. These surveys were completed on 6 & 7 April 2020 and 29 September – 1 October 2020. The focus of these surveys were to fulfil any requirements of the BAM within the subject land (including additional BAM Vegetation Integrity plots) as well as ground-truth the results of the background research, habitat suitability assessments, presence of threatened species and breeding habitat features for candidate threatened fauna.

##### Weather conditions

Weather conditions can affect activity (and therefore detectability) of some species. If adverse weather conditions occur during field surveys the validity of survey techniques are affected and can impact the probability of detecting a species if it was present within the study area. During the field survey program weather conditions were generally mild with low to moderate winds and temperatures recorded. Low amounts of rainfall were received during the survey program. These conditions were somewhat favourable and are outlined in Table 3.2.

**Table 3.2 Weather conditions during the survey period**

Date	Minimum temperature (°C)	Maximum temperature (°C)	Wind direction (Km/hr)	Rain (mm)
21/05/2018	6.1	22.5	W / 25	0
22/05/2018	6.0	24.1	W / 37	0
23/05/2018	10.4	22.6	NE / 22	0
24/05/2018	6.9	20.7	SE / 33	0
25/05/2018	13.5	20.9	ESE / 28	0
31/05/2018	5.9	19.0	SSW / 46	1.2
01/06/2018	8.4	18.3	SSE / 54	0
21/06/2018	10.6	18.0	E / 17	0.6
04/12/2018	16.5	24.7	SE / 46	0

Date	Minimum temperature (°C)	Maximum temperature (°C)	Wind direction (Km/hr)	Rain (mm)
05/12/2018	16.3	22.0	SE / 24	1.0
12/12/2018	16.7	25.8	ENE / 30	0
13/12/2018	19.5	29.1	W / 72	2.4
06/04/2020	10.6	24.3	SE / 37	0
07/04/2020	15.3	21.7	SE / 30	0
29/09/2020	9.7	20.2	NNE / 33	0
30/09/2020	8.9	21.9	NNE / 31	0
01/10/2020	13.4	25.5	SE / 41	1.4

(1) Source: Bankstown AWS (station 066137) (Bureau of Meteorology, 2021)

### 3.5 Limitations

No access was granted for EIS proposal area 3, a private residential property, a BAM plot was conducted to the south adjoining EIS proposal area 3. The mapping was extrapolated from aeriels and vegetation observed in the adjoining block.

No sampling technique can eliminate the possibility that a species is present on a site. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present on site during surveys. The conclusions in this report are based upon previous studies, data acquired for the site and the environmental field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of threatened species, can change with time.

Where surveys were conducted outside the optimal time for detecting a species, or field surveys were of limited scope, a precautionary approach was taken and it was assumed that the species was present if suitable habitat was observed.

The data used in the assessment is based on results of the field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of survey, including the presence or otherwise of species. For species where the timing of surveys was not appropriate for detection, a precautionary approach was taken and surveys focussed on detection of areas of potential habitat for these species.

#### 3.5.1 Other limitations

Other limitations relating to the conclusions contained in this report are detailed in the following sections.

##### Reliance on externally supplied information

In preparing this study, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations. Except as otherwise stated in the study, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this study (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

##### Study for benefit of client

This document has been prepared for the exclusive benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with in this study, or for any loss or damage suffered by any



other person or organisation arising from matters dealt with or conclusions expressed in this study (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this study).

Other parties should not rely upon the study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

### **Changing circumstances**

To the best of WSP's knowledge, the EIS proposal presented and the facts and matters described in this study reasonably represent the client's intentions at the time of preparation of the study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the proposal and of its possible environmental impact.

WSP will not be liable to update or revise this assessment to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the document.

# Stage 1 Biodiversity assessment

## 4 Landscape context

This chapter addresses the landscape context in accordance with Section 3.1 and Section 3.2 of the BAM and provides information on a range of landscape features that occur in the EIS proposal study area and surrounding areas.

The landscape features outlined below are used to inform the habitat suitability of the EIS proposal area for threatened species and the potential movement of species across the landscape.

### 4.1 Landscape features

An overview of landscape features associated with the EIS proposal area are presented in Table 4.1 and depicted in Figure 4.1, Figure 4.2, Figure 4.3 and Figure 4.4.

**Table 4.1 Landscape features**

Landscape feature	Subject land
IBRA bioregions and subregions	Sydney Basin Bioregion / Cumberland subregion
NSW landscape regions (Mitchell landscapes)	Georges River Alluvial Plain
Local Government Area (LGA)	City of Canterbury Bankstown
Native vegetation extent in the buffer area	Within the buffer area, as defined in the BAM, native vegetation cover has been identified as 18%.
Cleared areas	Cleared areas are associated with residential housing in the suburbs of Georges Hill, Bankstown Airpoty and Milperra. Large cleared areas also occur on Bankstown Airport lands and golf courses that are adjacent to Henry Lawson Drive.
Rivers and streams	Two main watercourses occur surrounding the EIS proposal area including Georges River, Prospect Creek and their unnamed tributaries.
Wetlands	Several Coastal Management SEPP listed Coastal Wetlands and associated proximity buffers occur within the study area. Approximately 0.28 ha of Coastal Wetlands listed under the Coastal Management SEPP occur within the EIS proposal area.
Connectivity features	Native vegetation within the study area provides connectivity to large patches of remnant native vegetation within Landsdowne Reserve and patches fringing Georges River and Prospect Creek.
Areas of Geological Significance and Soil Hazard Features	There are no areas identified to have geological significance. Potential high risk acid sulphate soils, associated with low lying alluvial flats along the Georges River have been identified within the study area.
Areas of outstanding biodiversity value	None recorded.

## 4.2 Site context

### 4.2.1 Native vegetation cover

Native vegetation cover of the EIS proposal area and a 1,500 m buffer area surrounding the EIS proposal area was determined in accordance with Subsection 3.2 of the BAM. A summary of this assessment is provided Table 4.2 and Figure 4.2.

**Table 4.2 Native vegetation cover assessment**

Assessment area	Total assessment area (ha)	Area of native vegetation cover (ha)	Native vegetation percentage cover (%)
EIS proposal area	0.28	0.25	89%
Buffer area	1,430.05	259.61	18%
<b>Total</b>	<b>1,430.33</b>	<b>259.86</b>	<b>18%</b>

### 4.2.2 Patch size

Patch size is defined under the BAM as an area of native vegetation that:

- occurs on the subject land; and
- includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m of non-woody ecosystems).

Patch size may extend onto adjoining land that is not part of the subject land. Patch size is assigned to each vegetation zone within the development footprint as a class, being either <5 ha, 5-24 ha, 25-100 ha or ≥100 ha.

A summary of the patch size of each vegetation zone located within the EIS proposal area and used in the BAM-C is provided in Table 4.3 below.

**Table 4.3 Patch size for each vegetation zone within and surrounding the EIS proposal area**

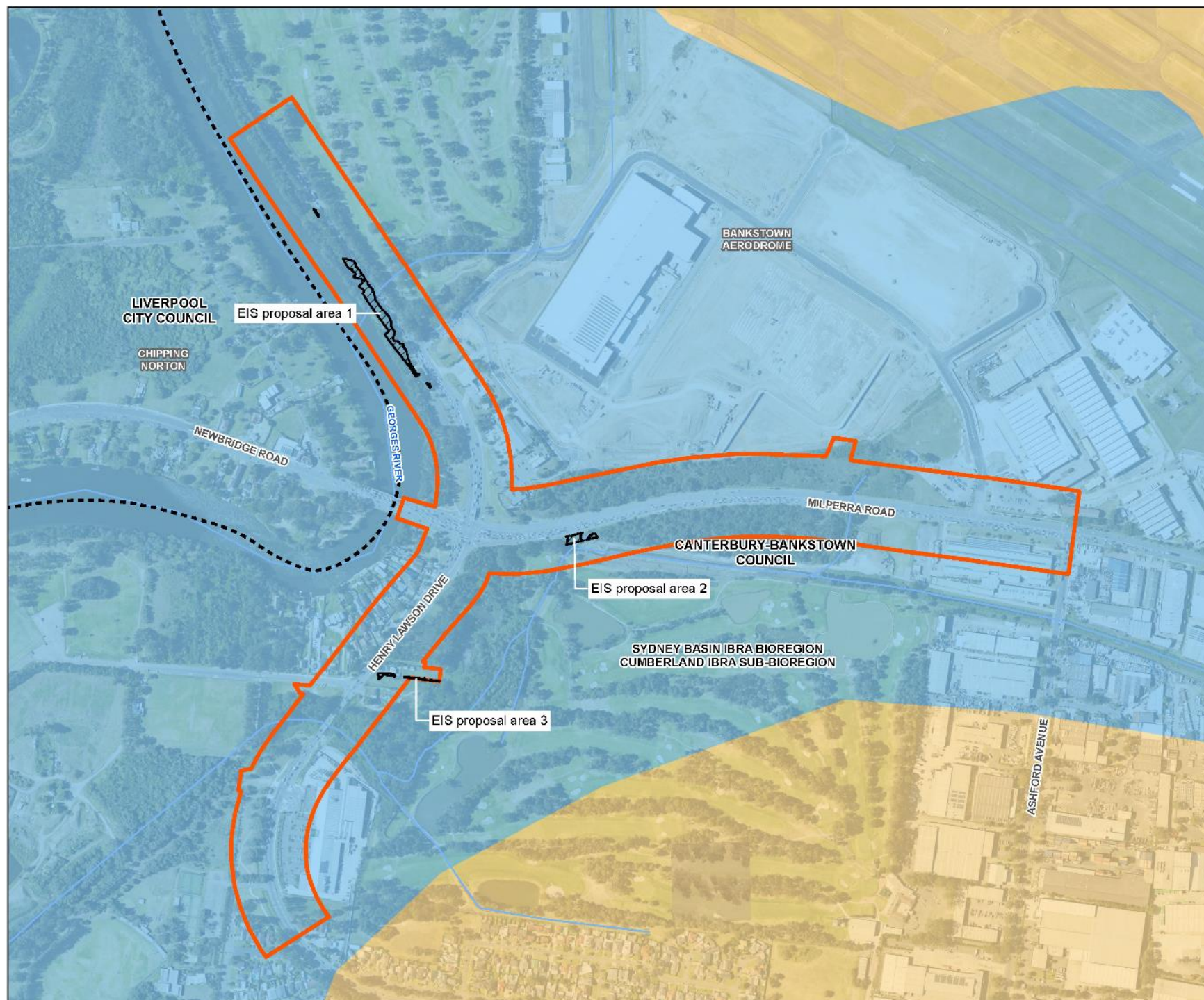
PCT	Vegetation zone	Area within EIS proposal area (ha)	Patch size (ha)
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	VZ2 – Moderate condition	0.02	25 – 100
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	VZ3 – Moderate condition – Forest Red Gum variant	0.02	25 – 100
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	VZ11 – Poor condition	0.01	25 – 100
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	VZ12 – Moderate condition	0.20	25 – 100



**Figure 4.1**  
Landscape context – IBRA  
bioregion, subregion, LGAs and  
Mitchell Landscapes

### Legend

- Watercourse
- Local Government Area
- Study area
- EIS proposal area
- Mitchell Landscape**
  - Ashfield Plains
  - Georges River Alluvial Plain



Coord. rate system: CDA 1994 MGA Zone 56

Scale ratio: correct when printed at A3

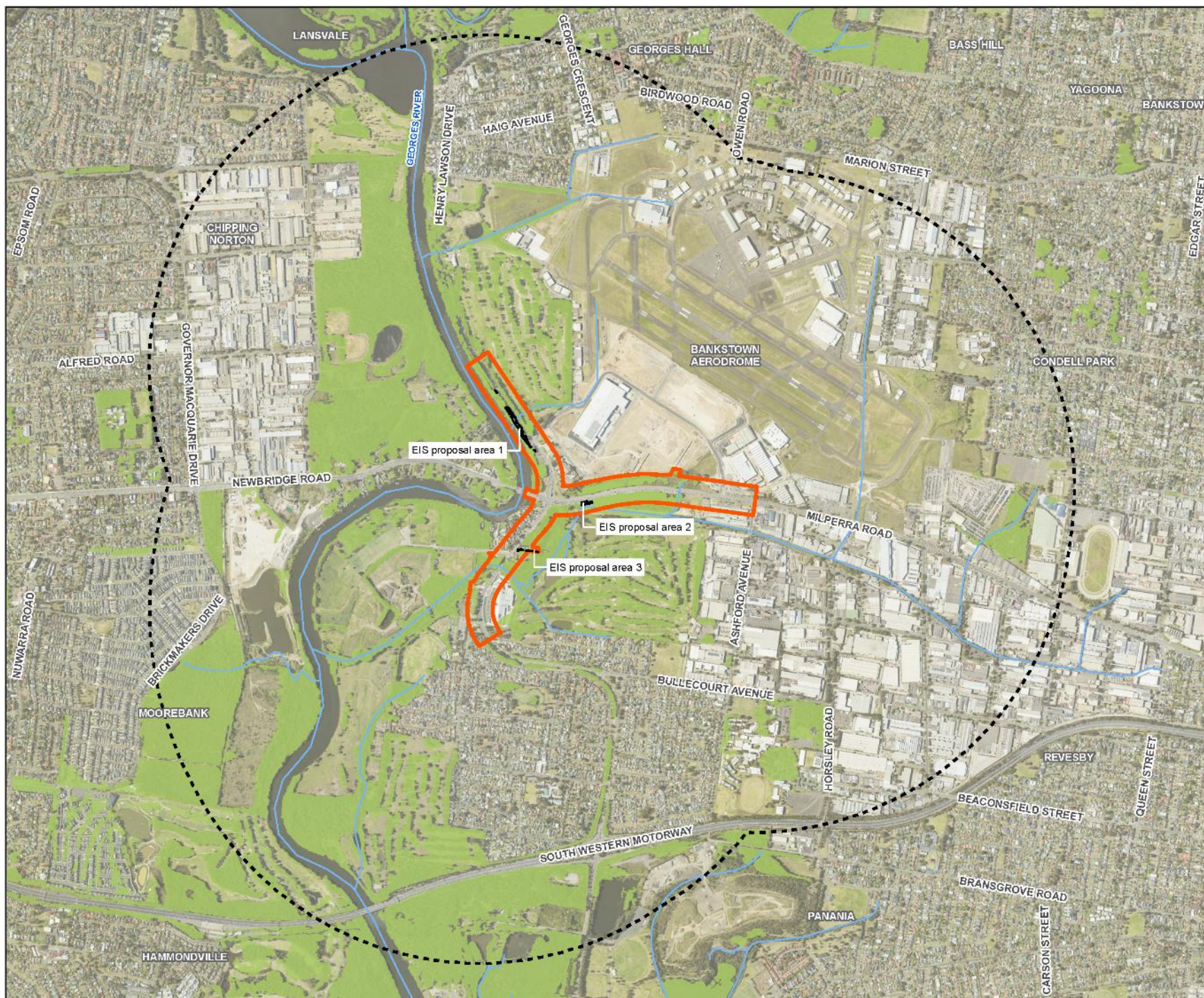
1:6 000 Date: 19-Apr-21

Data sources: ESRI/ArcGIS, NSW Government, and the GIS user community

This map is a representation of the landscape context for the Henry Lawson Drive Stage 1A project. It is not a site plan or a detailed map of the project area. The map is intended to provide a general overview of the landscape context for the project. The map is not intended to be used for any other purpose. The map is not intended to be used for any other purpose.



Figure 4.2  
Landscape context –  
Native vegetation assessment



**Legend**

- Assessment
- Study area
- EIS proposal
- Native



0 0.5 1 km

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:17,500 Date: 16-Apr-21

Data sources: NGA Map, WGS, Google Earth, Esri, HERE, Garmin, OpenStreetMap contributors, and the GIS user community

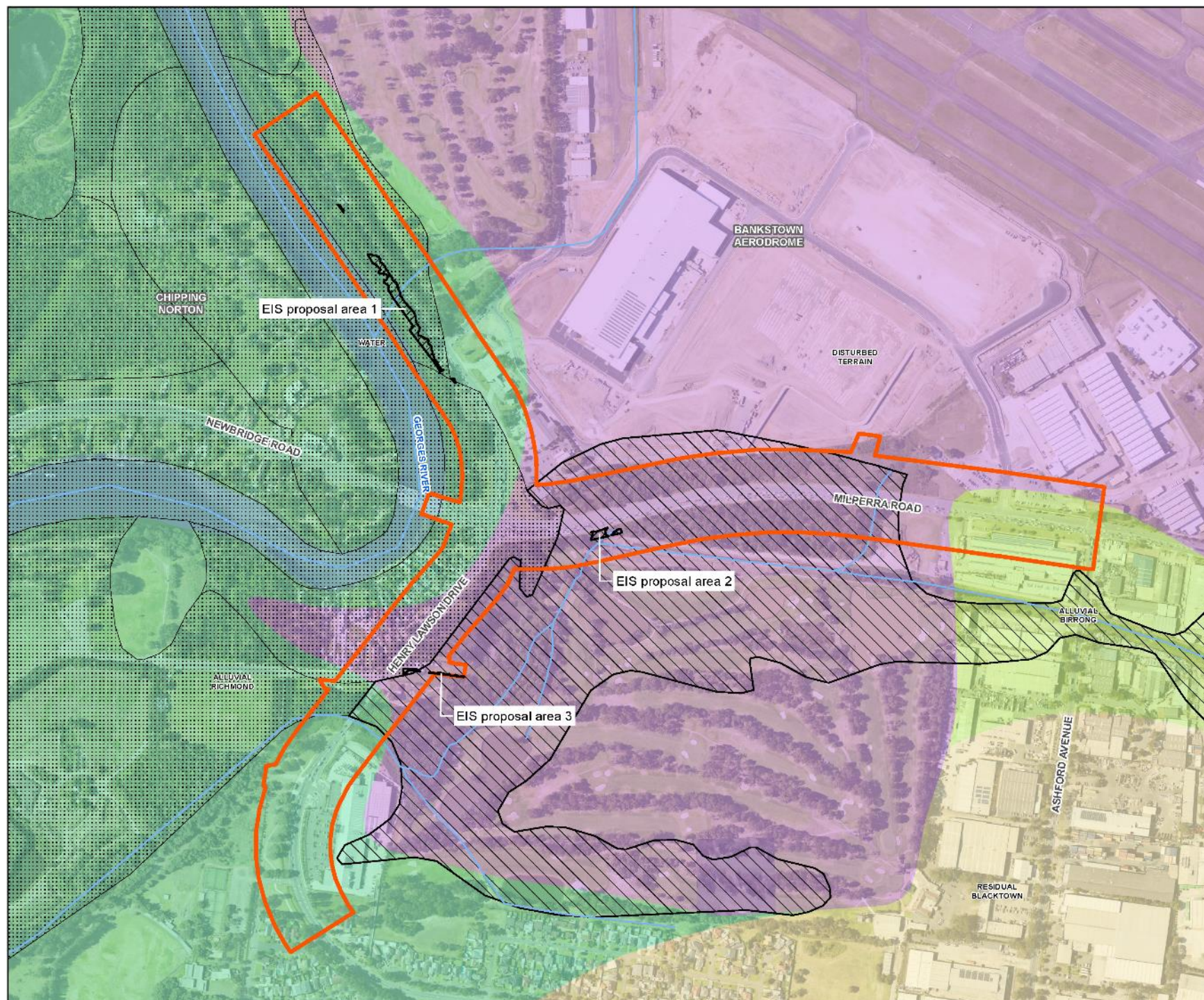
This map is a representation of the landscape context for the proposed project. It is not a site plan or a detailed engineering drawing. The map is intended to provide a general overview of the project location and the surrounding landscape context. The map is not to be used for any other purpose without the prior written consent of WSP. WSP does not accept any liability for any errors or omissions in this map.







**Figure 4.4**  
Landscape context –  
Areas of geological significance  
and soil hazard features



### Legend

- Watercourse  
 Study area  
 EIS proposal area  
**Acid Sulfate Risk**  
 High Probability  
 Low Probability

Soil Landscape - Penrith & Sydney (1:100,000)

- Alluvial Birrong
- Alluvial Richmond
- Residual Blacktown
- Disturbed terrain
- Water



Coordinate system: GDA 1994 MGA Zone 56



Scale ratio correct when printed at A3

1:0000 Date: 15-Apr-21

Other sources: - NGA 1984p, TGSW, Geoscience Australia  
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

© 1997 Cambridge University Press. Printed in the United Kingdom. This journal is registered with the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. Organizations in the USA who are also registered with the C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of US copyright law) subject to payment to C.C.C. of the per copy fee of \$05.00. This consent does not extend to multiple copying for promotional or commercial purposes. ISI Tear Sheet Service, 3501 Market Street, Philadelphia, PA 19104, USA, is authorized to supply single copies of separate articles for private use only. Organizations authorized by the Copyright Licensing Agency may also copy material subject to the usual conditions. For all other use, permission should be sought from Cambridge or the American Branch of Cambridge University Press.



## 5 Native vegetation

---

This chapter address native vegetation in accordance with Chapter 4 of the BAM and associated matters relating to the BC Act.

### 5.1 Native vegetation methodology

Vegetation surveys were undertaken over an eight-day period on the 21 to 25 & 31 May, 1 & 21 of June 2018. Additional surveys to support the BDAR were also completed on 6 & 7 April 2020 and 29 September – 1 October 2020. These surveys sought primarily to assess the extent and condition of vegetation and fauna habitat, especially for threatened species, populations and ecological communities.

The vegetation surveys were used to identify variations in vegetation condition that were not apparent in existing vegetation mapping and refine vegetation community boundaries. This allowed vegetation assemblages to be assigned to PCTs and associated vegetation zones based on broad vegetation condition classes.

#### 5.1.1 Stratification and verification of existing vegetation mapping

Preliminary mapping of vegetation community boundaries was undertaken through analysis of existing vegetation mapping and aerial photograph interpretation.

Analysis of the aerial photographs was used to identify areas of disturbance (e.g. buildings, vehicle tracks, dams and power lines), vegetation structure and likely native versus exotic species composition throughout the site. This provided an initial definition of vegetation communities into simple structural and disturbance classifications for verification during field surveys.

Vegetation within the study area and locality has been mapped at the regional scale in:

- Native vegetation of the Southeast NSW: Revised Classification and Map for the Coast and Eastern Tablelands (Tozer et al., 2010).
- The Native Vegetation of the Sydney Metropolitan Area (Office of Environment and Heritage, 2016).

Data on geology, dominant canopy species, native diversity, vegetation structure and condition was collected across the study area to validate and refine this existing vegetation classification to determine their associated Plant Community Type (PCT) in accordance with the BioNet Vegetation Classification (Environment Energy and Science, 2021c).

#### 5.1.2 Mapping of vegetation zones

Field validation (ground-truthing) of the existing vegetation classifications undertaken by regional vegetation mapping and previous ecological surveys of the site was completed to confirm the vegetation structure, dominant canopy species, native diversity, condition and presence of threatened ecological communities. This was based on vegetation integrity plot data collected as described below.

Vegetation zones and conditions were identified and mapped following the BAM (Department of Planning Industry and Environment, 2020a). This was based on field verification of the PCT, class and formation as outlined in BioNet Vegetation Classification (Environment Energy and Science, 2021c). Criteria used to assign vegetation zones based on broad vegetation condition class classification are outlined in Table 5.1.



**Table 5.1**      **Vegetation broad condition states**

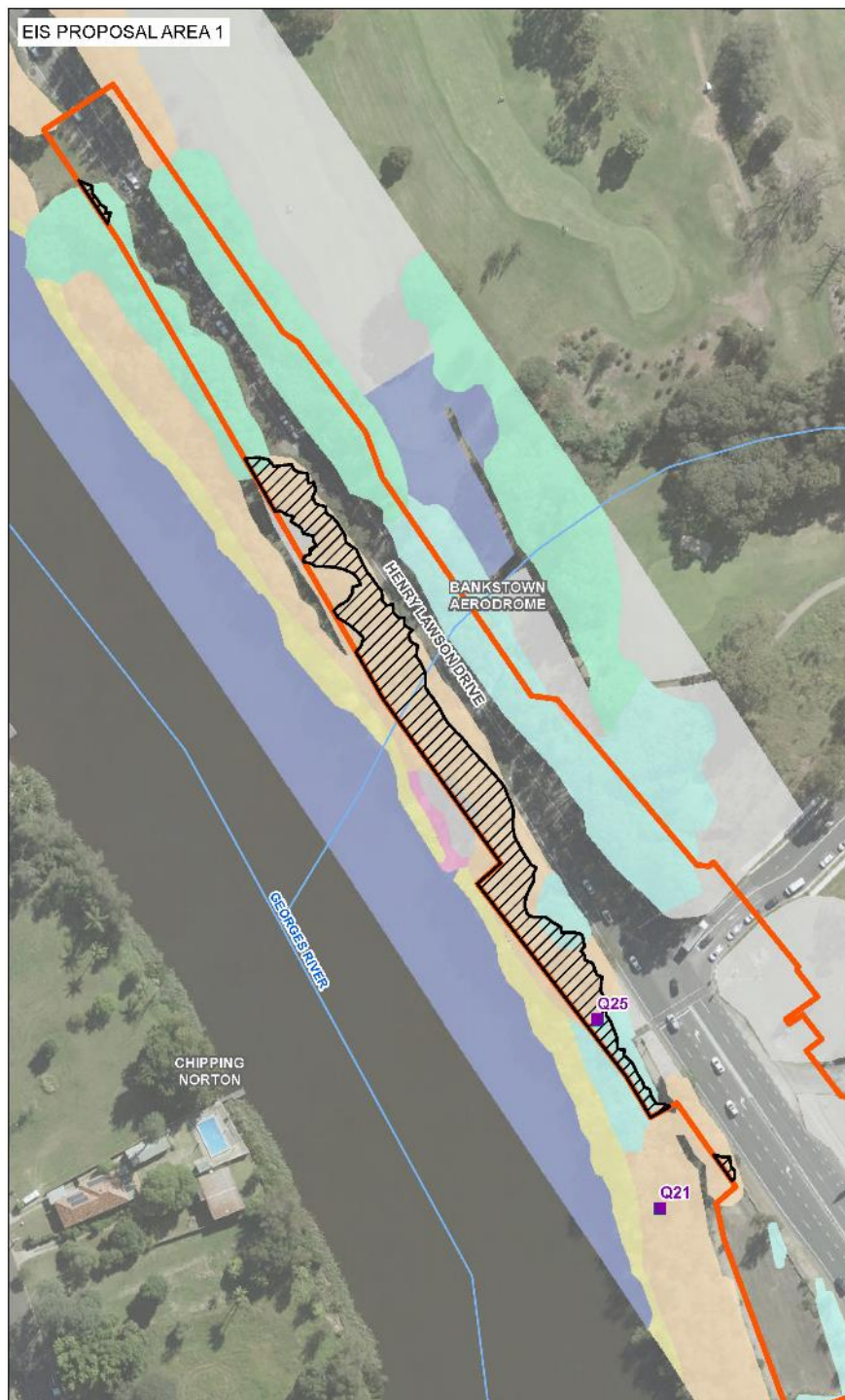
Condition classes	Description criteria
High	Vegetation still retains the species complement and structural characteristics. The vegetation displays resilience to weed invasion due to intact groundcover, shrub and canopy layers. Native species diversity is relatively high. Weeds may exist in this vegetation type but exhibit <10% foliage cover. High condition vegetation is considered to exhibit a vegetation integrity score of >70.
Moderate	Vegetation has retained a native canopy but the understorey and groundcover layers are generally co-dominated by exotic species. The mid and low strata may have been structurally modified because of previous disturbance and subsequent weed incursions. Moderate condition vegetation is considered to exhibit a vegetation integrity score of between 40 and 70.
Poor	Vegetation has retained a native canopy or the canopy cover is showing signs of regeneration. The understorey and groundcover layers are generally dominated or co-dominated by exotic species. Native species diversity is generally relatively low and the mid and low strata have been structurally modified due to weed incursions or clearing. Poor condition vegetation is considered to exhibit a vegetation integrity score of <40 and does not meet low condition thresholds as described below.
Low	Vegetation is in low condition where: <ul style="list-style-type: none"> <li>• A vegetation zone has a vegetation integrity score &lt;15 where the PCT is representative of an endangered or critically endangered ecological community</li> <li>• A vegetation zone has a vegetation integrity score &lt;17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community</li> <li>• A vegetation zone has a vegetation integrity score &lt;20 where the PCT is not representative of a TEC or associated threatened species habitat.</li> </ul>

### 5.1.3 Vegetation integrity plots

Vegetation integrity plots (VI plots) were completed in accordance with BAM. A schematic diagram illustrating the layout of each vegetation integrity plot is provided below.



Figure 5.1 shows the location of the VI plots within and close to the EIS proposal area.



#### Field Verified Vegetation

- |   |  |
|---|--|
| VZ1a: PCT725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion - Poor condition (regrowth) | VZ12: PCT1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner - Moderate condition   |
| VZ1: PCT725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion - Moderate condition         | VZ5: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Moderate condition  |
| VZ2: PCT781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner - Moderate condition   | VZ9: PCT920 - Mangrove Forest in Estuaries of the Sydney Basin and South East Corner - Moderate condition  |
| VZ4: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin - Moderate condition (Blue Box variant)       | VZ7: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Poor condition (canopy only)                                      |
| VZ3: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin - Moderate condition (Forest Red Gum variant) | VZ6: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Moderate condition (regrowth)                                     |
| VZ11: PCT1236 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion - Poor condition                | VZ8: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Poor condition (regenerating native understorey - planted canopy) |
| VZ13: PCT1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley - Poor condition  | VZ15: Miscellaneous ecosystem - Woods / exotics - non-native vegetation  |
| VZ14: Miscellaneous ecosystem - Urban exotic / native landscape plantings   | VZ16: Miscellaneous ecosystem - Waterbodies  |

**wsp**

**HENRY LAWSON DRIVE**

**Figure 5.1**  
Native vegetation

#### Legend

- Quadrats
- Watercourse
- Study area
- ▨ EIS proposal area



Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

Date: 15 Jul 21

Data sources: - HEREMap, HERE, Google Australia  
Esri, HERE, DeLorme, OpenStreetMap, and the GIS user community

WSP hereby warrants that this map is a true and accurate representation of the information provided to it by the client and that it has been prepared in accordance with the standards of the profession. WSP does not warrant that the information provided to it by the client is true and accurate. WSP is not responsible for any errors or omissions in this map or for any consequences arising from the use of this map. WSP is not responsible for any damage or loss of any kind arising from the use of this map. WSP is not responsible for any third party claims or actions against it or its staff or agents in connection with this map.

The following site attributes were recorded at each vegetation integrity plot location:

- **Location:** (easting – northing grid type MGA 94, Zone 56).
- **Vegetation structure and dominant species and vegetation condition:** Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- **Native and exotic species richness (within a 400-metre squared quadrat):** This consisted of recording all species by systematically walking through each 20 metre x 20 metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- **Number of trees with hollows (1000 metre squared quadrat):** This was the frequency of hollows within living and dead trees within each 50 metre x 20 metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least five centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least one metre above the ground and the (e) the centre of the tree was located within the sampled quadrat.
- **Number of large trees and stem size diversity (1000 metre squared quadrat):** tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (greater than five centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks.
- **Total length of fallen logs (1000 metre squared quadrat):** This was the cumulative total of logs within each 50 metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre.
- **Litter cover:** This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect.
- **Evaluation of regeneration:** This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height less than or equal to five centimetres).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the study area and establishing the required number of plots at some of these waypoints.

Areas of non-native vegetation were also identified and mapped. Data was collected in these areas through rapid point assessments to show the composition and abundance of non-native vegetation within the study area.

A comparison of the number of BAM VI plots that were completed and the required BAM plots per vegetation zones are outlined in Table 5.2.



**Table 5.2 Comparison of number of plots required and completed per zone area**

Plant community type	Vegetation zone	Area in study area (ha)	Minimum Number of VI Plots required (BAM 2020)	Survey effort
VZ1 PCT 725 – Broad-leaved Ironbark – <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – moderate condition	Moderate	2.33	2	Q1, Q3
VZ1a PCT 725 – Broad-leaved Ironbark – <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – poor condition	Poor condition (regrowth)	0.60	1	Q4
VZ2 PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition	Moderate condition	0.21	1	Q23
VZ3 PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition	Moderate condition - Forest Red Gum variant	2.32	2	Q12, Q18, Q24
VZ4 PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition	Moderate condition - Blue Box variant	0.64	1	Q7
VZ9 PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Moderate condition	Moderate condition	0.29	1	Q25
VZ11 PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition	Poor condition	0.84	1	Q2
VZ12 PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	Moderate condition	1.32	1	Q21
VZ13 PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter Valley – Poor condition	Poor condition	0.90	1	Q20, Q26
VZ14 Miscellaneous ecosystem – Urban exotic / native landscape plantings	-	0.30	0	-
VZ15 Miscellaneous ecosystem – Weeds / exotics – non-native vegetation	-	8.96	0	Q19
Miscellaneous ecosystems - Waterbodies	-	1.27	0	-

BAM plot locations and orientations are provided in Table 5.3 and illustrated in Figure 5.2.

**Table 5.3 Location and orientation of vegetation integrity plots completed within the study area**

Plot ID	Vegetation type and zone	Easting	Northing	Orientation
Q1_20	VZ1 - PCT 725: Broad-leaved Ironbark - <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	313855	6243825	260

Plot ID	Vegetation type and zone	Easting	Northing	Orientation
Q2_20	VZ11 – PCT 1236: Swamp Paperbark – Swam Pak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Croner Bioregion – Poor condition	313573	6243803	270
Q3_20	VZ1 - PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	313716	6243827	280
Q4_20	VZ1a - PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition (regrowth)	313645	6243901	280
Q7	VZ4 – PCT 835: Forest Red Gum Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)	312766	6245100	168
Q12_20	VZ3 - PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313346	6243765	90
Q18_20	VZ3 - PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313306	6243717	320
Q19_20	VZ15 Miscellaneous ecosystem - Weeds / exotics – non-native vegetation	313174	6243566	70
Q20_20	VZ13 - PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition	313095	6243534	250
Q21_20	VZ12 - PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	313235	6244032	20
Q23_20	VZ2 - PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition	313565	6243824	0
Q24_20	VZ3 - PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	313291	6243933	315
Q25_20	VZ9 - PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner – Good condition	313217	6244086	310
Q26_20	VZ13 - PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition	313011	6244397	139












Zone 56, GDA 94



**Figure 5.2**  
Survey effort



### Legend

-  Study area
  -  EIS proposal area
- Native vegetation and threatened species survey effort**
-  Aquatic habitat assessment
  -  Bird survey point
  -  Call playback point
  -  Green and Golden Bell Frog Survey
  -  Habitat Assessment
  -  Microbat survey/Anabat
  -  Remote cameras
  -  SAT survey
  -  Snail search point
  -  Quadrats



Coordinate system: GDA 1994 MGA Zone 58

Scale ratio correct when printed at A3  
1:6,000 Date: 12/05/21

©2005 by American Society for Microbiology. All rights reserved. This article is published in the *Journal of Bacteriology*, Vol. 187, No. 1, pp. 1-11, 2005. The copyright for this article is held by the American Society for Microbiology. All rights reserved. No part of this article may be reproduced without permission in writing from the American Society for Microbiology. For all other use, permission should be sought from the American Society for Microbiology, 11 Dupont Circle, N.W., Washington, D.C. 20036.



## 5.2 Plant community types

A total of seven NSW Plant Community Types (PCTs) were recorded in the study area. These are:

- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion.
- PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner.
- PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin.
- PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner.
- PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion.
- PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner.
- PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

In addition, three non-native vegetation types were assigned to a miscellaneous ecosystem class, being:

- Miscellaneous ecosystem – Urban exotic / native landscape plantings
- Miscellaneous ecosystem – Weeds / exotics – non-native vegetation
- Miscellaneous ecosystem – Waterbodies.

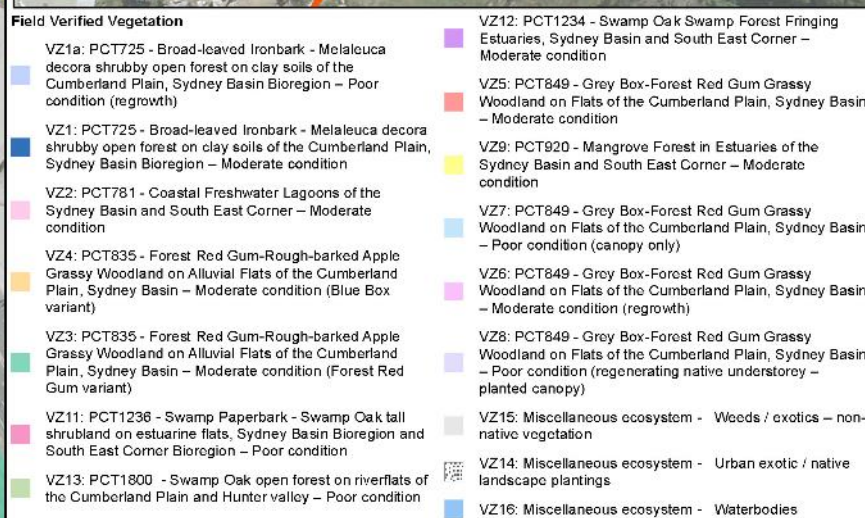
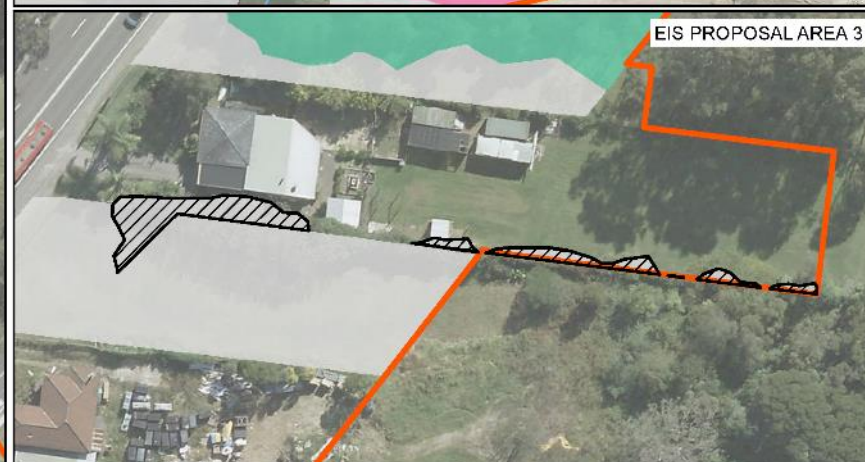
These native and non-vegetation communities (listed above) were assigned to 12 discrete vegetation zones based on broad vegetation condition class criteria as outlined in Table 5.1. A summary of PCTs and associated vegetation zones are presented in Table 5.4 with the extent and distribution shown in the EIS proposal area in Figure 5.3, and in the study area in Figure 5.4.

Detailed description and selection justification for each PCT and vegetation zone is provided below.

**Table 5.4 Plant community types**

Plant community type (PCT)	Vegetation zone (VZ)	VI score	Patch size (ha)	Threatened ecological community?	Area (ha) study area	Area (ha) impacted (EIS proposal)
PCT 725: Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	VZ1 – Moderate condition	56.9	N/A	Cooks River/ Castlereagh Ironbark Forest in the Sydney Basin Bioregion	2.33	-
	VZ1a – Poor condition (regrowth)	32.3	N/A		0.60	-
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	VZ2 – Moderate condition	8.8	25 – 100	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.21	0.02
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	VZ3 – Moderate condition - Forest Red Gum variant	48.4	25 – 100	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	2.32	0.02
	VZ4 – Moderate condition - Blue Box variant	43.5	N/A		0.64	-
PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner	VZ9 – Moderate condition	61.4	N/A	Not listed	0.29	-
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	VZ11 – Poor condition	34.3	25 – 100	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.84	0.01
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	VZ12 – Moderate condition	49.4	25 – 100	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	1.32	0.20
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	VZ13 – Poor condition	14.3	n/a		0.90	-
Sub-total native vegetation within study area and EIS proposal area					9.45	0.25
Miscellaneous ecosystem	VZ14 – Urban exotic / native landscape plantings	N/A	N/A	N/A	0.30	-
Miscellaneous ecosystem	VZ15 – Weeds / exotics – non-native vegetation	N/A	N/A	N/A	8.94	0.02
Miscellaneous ecosystem	VZ16 – Waterbodies	N/A	N/A	N/A	1.27	-
Sub-total non-native vegetation within study area					10.51	0.02
Total					19.96	0.27

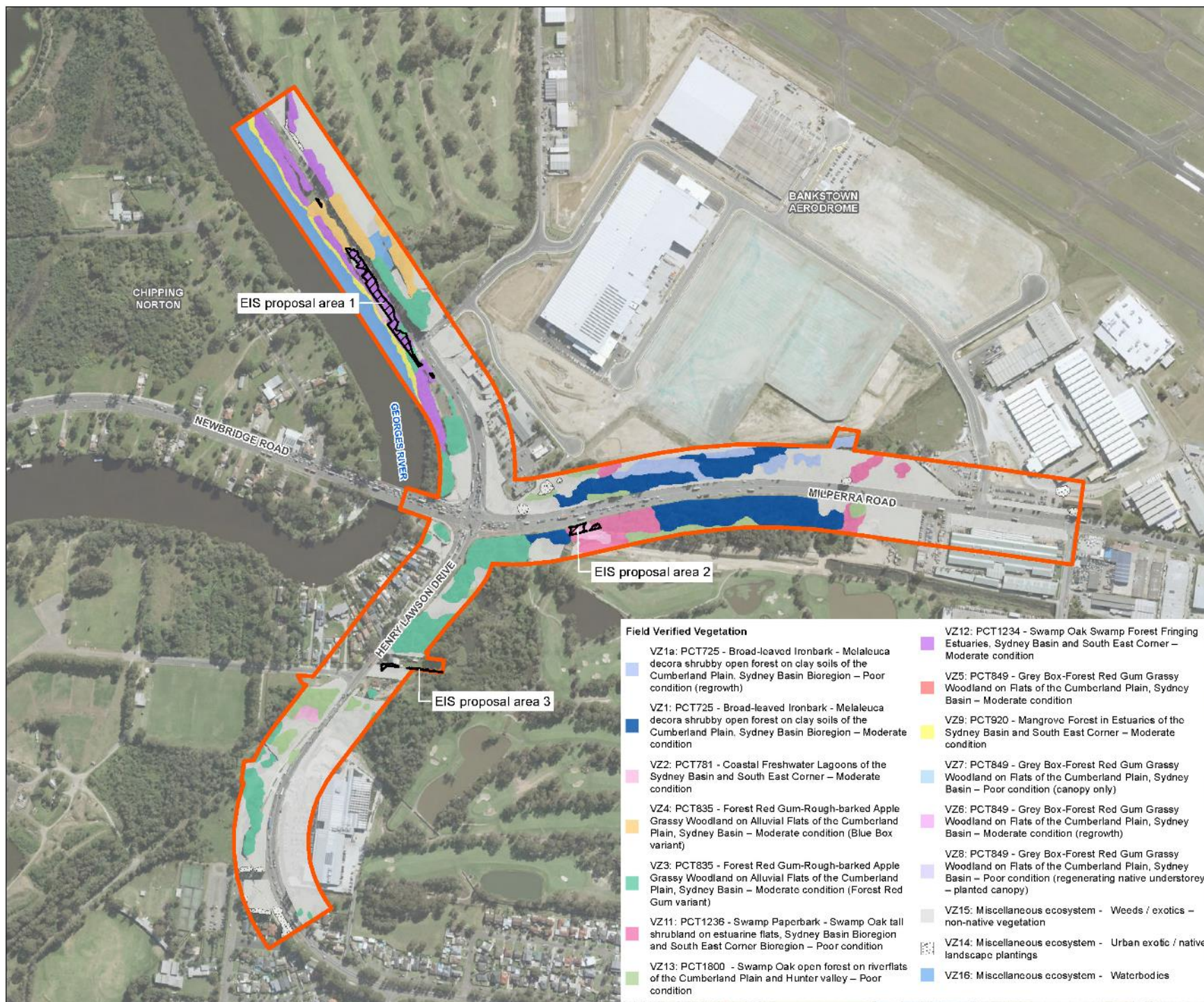






### Legend

- Study area
- EIS proposal area



### Field Verified Vegetation

VZ1a: PCT725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion - Poor condition (regrowth)

VZ1: PCT725 - Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion - Moderate condition

VZ2: PCT781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner - Moderate condition

VZ4: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin - Moderate condition (Blue Box variant)

VZ3: PCT835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin - Moderate condition (Forest Red Gum variant)

VZ11: PCT1236 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion - Poor condition

VZ13: PCT1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley - Poor condition

VZ12: PCT1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner - Moderate condition

VZ5: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Moderate condition

VZ9: PCT920 - Mangrove Forest in Estuaries of the Sydney Basin and South East Corner - Moderate condition

VZ7: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Poor condition (canopy only)

VZ6: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Moderate condition (regrowth)

VZ8: PCT849 - Grey Box-Forest Red Gum Grassy Woodland on Flats of the Cumberland Plain, Sydney Basin - Poor condition (regenerating native understorey - planted canopy)

VZ15: Miscellaneous ecosystem - Weeds / exotics - non-native vegetation

VZ14: Miscellaneous ecosystem - Urban exotic / native landscape plantings

VZ16: Miscellaneous ecosystem - Waterbodies



Coordinate system: GDA 1994 MGA Zone 58



Scale ratio correct when printed at A3

1:6,000

Date: 15-Jul-21

Data sources: - NEARMAP, THEM, Geoscience Australia  
Est HERE, OpenStreetMap contributors, and the GIS user community

WSP is not responsible for any errors or omissions in this document. The user of this document is advised to verify the accuracy of the information contained herein. WSP is not responsible for any errors or omissions in this document. The user of this document is advised to verify the accuracy of the information contained herein.



## **PCT 725: Broad – leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion**

The occurrence of this vegetation type within the study area is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.1, Photo 5.2, Photo 5.3 and Photo 5.4. An overview of floristic and structural composition is presented in Table 5.5 and Table 5.6. A general description provided below.

**Vegetation formation:** KF\_CH5A Dry Sclerophyll Forest (Shrub/grass sub-formation)

**Vegetation class:** Cumberland Dry Sclerophyll Forests

**Other mapping sources:** PCT 725 - DSF01 - Castlereagh Ironbark Forest (Office of Environment and Heritage 2016)

**Estimate of percent cleared:** 95%

**Conservation status:**

- BC Act: Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion – Endangered
- EPBC Act: Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion – Critically Endangered.

**Landscape position:** Low-lying clay plains associated with Tertiary alluvium. This vegetation type was recorded from Airport and Ashford Reserves within Stage 1A of the study area.

**PCT justification:** In assigning this vegetation type, the following three candidate PCTs were considered based on floristic similarities and given the communities are known to intergrade:

- PCT 724 Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 725 – Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1067 – Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion.





Plot data collected from this vegetation type was analysed against a floristic positive diagnostic test following the guideline outlined for each PCT reference community (Office of Environment and Heritage, 2016, Tozer et al., 2010). Based on the overall strength of PCT 725 analysis, the landscape position of low-lying clay plains associated with Tertiary alluvium and the dominance of *Eucalyptus fibrosa* (Broad-leaved Ironbark), *Eucalyptus longifolia* (Woollybutt) and *Melaleuca decora* (White Feather Honey myrtle), PCT 725 was considered the most closely aligned PCT to this vegetation type.

**Vegetation zones:** Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

- Moderate condition: The vegetation was recorded in relatively intact condition although has exhibited previous disturbances and exhibits ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses. Photographic representation is presented in Photo 5.1 and Photo 5.2.
- Poor condition: This condition class is in a regeneration state due to historic clearing and disturbance (Photo 5.3 and Photo 5.4).

**Vegetation integrity survey plots:** Q1\_20 and Q3\_20 (moderate condition), and Q4\_20 (poor condition). See Appendix B for full floristic and structural data.

A comparison of PCT 725 - Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion plot data recorded against PCT condition benchmark data is provided in Table 5.6.

	
<b>Photo 5.1</b> <b>PCT 725 Moderate condition</b>	<b>Photo 5.2</b> <b>PCT 725 Moderate condition</b>
	
<b>Photo 5.3</b> <b>PCT 725 Poor condition (regrowth)</b>	<b>Photo 5.4</b> <b>PCT 725 Poor condition (regrowth)</b>

**Table 5.5**      **PCT 725 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	16.1	<i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark), <i>Eucalyptus longifolia</i> (Woollybutt), <i>Melaleuca decora</i> (White Feather Honeymyrtle), <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (Parramatta Red Gum), <i>Angophora floribunda</i> (Rough-barked Apple), <i>Casuarina glauca</i> (Swamp Oak), <i>Eucalyptus sideroxylon</i> (Mugga Ironbark)
Shrubs	35.3	<i>Melaleuca decora</i> (White Feather Honeymyrtle), <i>Melaleuca nodosa</i> (Ball Honey Myrtle), <i>Bursaria spinosa</i> subsp. <i>spinosa</i> (Native Blackthorn), <i>Leucopogon juniperinus</i> (Prickly Beard-heath), <i>Acacia falcata</i> (Hickory Wattle) <i>Hakea sericea</i> (Needlebush), <i>Kunzea ambigua</i> (Tick Bush)
Grass and grass like	18.6	<i>Entolasia stricta</i> (Wiry Panic), <i>Dichelachne micrantha</i> (Shorthair Plumegrass), <i>Lomandra longifolia</i> (Spiked Mat-rush), <i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass), <i>Aristida vagans</i> (Threeawn Speargrass), <i>Eragrostis brownii</i> (Brown's Lovegrass),
Forb	8.5	<i>Dianella revoluta</i> var. <i>revolute</i> (Blue Flax-lily), <i>Dianella longifolia</i> (Blueberry Lily), <i>Dichondra repens</i> (Kidney Weed)
Fern	0.9	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> (Rock Fern)
Other	3.1	<i>Billardiera scandens</i> (Hairy Apple Berry), <i>Cassytha glabella</i> f. <i>glabella</i> , <i>Clematis glycinoides</i> var. <i>glycinoides</i> (Headache Vine), <i>Glycine tabacina</i> , <i>Hardenbergia violacea</i> (False Sarsaparilla)

Growth form	Average % foliage cover	Dominant species (native and exotic)
Exotic	20.2	<i>Passiflora subpeltata</i> * (White Passionfruit), <i>Briza subaristata</i> *, <i>Coreopsis lanceolata</i> * (Coreopsis)
High threat weed	16.6	<i>Araujia sericifera</i> * (Moth Vine), <i>Asparagus asparagoides</i> * (Bridal Creeper), <i>Eragrostis curvula</i> * (African Lovegrass), <i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> * (Bitou Bush), <i>Ligustrum sinense</i> * (Small-leaved Privet), <i>Ochna serrulata</i> * (Mickey Mouse Plant)

**Table 5.6 Comparison of PCT 725: Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>5</b>	<b>11</b>	<b>13</b>	<b>12</b>	<b>1</b>	<b>4</b>	<b>42</b>	<b>34</b>	<b>47</b>	<b>6</b>	<b>1</b>	<b>2</b>	<b>68</b>	<b>60</b>	<b>3(50)</b>
Q1	6	12	8	6	1	5	16.8	42.6	19.4	4.3	1	4.7	16.5	58	0
Q3	4	6	9	8	1	5	27.8	40.9	22.4	20.1	0.5	3.8	8.5	79	0
Q4	3	12	12	5	2	1	3.8	22.4	14	1.2	1.2	0.8	4	37	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion Keith Formation KF\_CH5A Dry Sclerophyll Forests (Shrubby/grass sub-formation) Keith Class: Cumberland Dry Sclerophyll Forests), source (Environment Energy and Science, 2021c).



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

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.5. An overview of floristic and structural composition is presented in Table 5.7 and Table 5.8. A general description provided below.

**Vegetation formation:** KF\_CH8 Freshwater Wetlands

**Vegetation class:** Coastal Freshwater Wetlands

**Estimate of percent cleared:** 74%

**Conservation status:**

- BC Act: Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – Endangered.
- EPBC Act: Not listed.

**Landscape position:** Associated with creek tributaries and areas of standing water on alluvial flats.

**PCT Justification:** This vegetation type was recorded as treeless and contained a high proportion of wetland reeds and sedges associated with pools of standing freshwater.

**Vegetation zones:** This vegetation type occurred in a single broad condition state being:

- Moderate - within the study area, PCT 781 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

**Vegetation integrity survey plots:** Q23\_20. See Appendix B for full floristic and structural data.



**Photo 5.5**      **PCT 781 – moderate condition**

**Table 5.7 PCT 781 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	1	<i>Grevillea robusta</i> (Silky Oak)
Shrubs	1	<i>Melaleuca ericifolia</i> (Swamp Paperbark)
Grass and grass like	30	<i>Phragmites australis</i> (Common Reed)
Forb	0	-
Fern	0	-
Other	0.8	<i>Cassytha glabella</i> f. <i>glabella</i>
Exotic	61.8	<i>Passiflora subpeltata</i> (White passion-flower), <i>Rubus fruticosus</i> (Blackberry)
High treat weed	42.4	<i>Acetosa sagittata</i> (Turkey Rhubarb), <i>Anredera cordifolia</i> (Madera Vine), <i>Cestrum parqui</i> (Green cestrum)

**Table 5.8 Comparison of PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>102</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>60</b>	<b>25</b>	<b>2</b>
Q23	1	1	1	0	0	1	1	1	30	0	0	0.8	0	0	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 781: Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF\_CH8 Freshwater Wetland Keith Class: Coastal Freshwater Wetland), source (Environment Energy and Science, 2021c).

## PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.6, Photo 5.7, Photo 5.8 and Photo 5.9. An overview of floristic and structural composition is presented in Table 5.9 and Table 5.10. A general description is provided below.

**Vegetation formation:** KF\_CH9 Forested Wetlands

**Vegetation class:** Coastal Floodplain Wetland

**Estimate of percent cleared:** 93%

**Conservation status:**

- BC Act: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.
- EPBC Act: River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner bioregions – Critically Endangered.

**Landscape position:** occurs on with poorly drained alluvial flats of the Georges River and associated tributaries.

**PCT Justification:** landscape position on alluvial flats and dominant canopy species, *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum), *Eucalyptus tereticornis* (Forest Red Gum), *Angophora floribunda* (Rough-barked Apple) are consistent with the PCT description of PCT 835.

**Vegetation zones:** Within the study area, PCT 835 was recorded in a single condition class that was allocated to two discrete vegetation zones based on dominance of canopy species. Two distinct vegetation zones were assigned within this vegetation type based on broad condition state. These are:

- Forest Red Gum variant: The canopy of this vegetation zone was dominated by *Eucalyptus amplifolia* subsp. *amplifolia* (Cabbage Gum) and *Eucalyptus tereticornis* (Forest Red Gum). Slight variation was floristic structure and composition was observed with some patches having a managed understorey. All patches were observed to exhibit moderate weed incursions.
- Blue Box variant: The vegetation zone was recorded on low-lying areas fringing the Georges River and graded into PCT 1234. The vegetation zone was dominated by *Eucalyptus baueriana* (Blue Box) with most patches occurring adjacent to Henry Lawson Drive between the intersection of Milperra Road and Rabaul Road.

**Condition:** Moderate – the vegetation was recorded in relatively intact condition although has exhibited previous disturbances and exhibits ongoing edge effects from Milperra Road, Bankstown Airport and surrounding commercial, industrial and recreational land uses.

**Vegetation integrity survey plots:** Q12\_20, Q18\_20 and Q24\_20 (Forest Red Gum variant), and Q7 (Blue Box variant). Q7 is located immediately outside the study area due to the small patch size of the vegetation zone within the study area. See Appendix B for full floristic and structural data.

A comparison of PCT 835 – Forest Red Gum – Rough – barked Apple Grassy Woodland on Alluvial Flats of The Cumberland Plain, Sydney Basin plot data recorded against PCT condition benchmark data is provided in Table 5.10.

	
<b>Photo 5.6</b> <b>PCT 835 Moderate condition – Forest Red Gum variant</b>	<b>Photo 5.7</b> <b>PCT 835 Moderate condition – Forest Red Gum variant</b>
	
<b>Photo 5.8</b> <b>PCT 835 Moderate condition – Blue Box variant</b>	<b>Photo 5.9</b> <b>PCT 835 Moderate condition – Blue Box variant</b>

**Table 5.9      PCT 835 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	39.7	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i> (Cabbage Gum), <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>Angophora floribunda</i> (Rough-barked Apple), <i>Eucalyptus fibrosa</i> (Red Ironbark), <i>Acacia decurrens</i> (Green Wattle), <i>Corymbia maculata</i> (Spotted gum)
Shrubs	13.1	<i>Melaleuca styphelioides</i> (Prickly-leaved Paperbark), <i>Melaleuca decora</i> (White Feather Myrtle), <i>Melaleuca linariifolia</i> (Snow-in Summer),
Grass and grass like	1.8	<i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass), <i>Cynodon dactylon</i> (Couch), <i>Carex appressa</i> (Tall sedge)
Forb	5.2	<i>Einadia hastata</i> (Berry Saltbush), <i>Tetragonia tetragoides</i> (New Zealand Spinach)
Fern	0	-
Other	0.9	<i>Cayratia clematidea</i> (Native Grape), <i>Glycine clandestine</i> (Twining glycine)
Exotic	58.8	<i>Bidens pilosa</i> * (Cobblers Peg), <i>Conyza sumatrensis</i> * (Fleabane), <i>Euphorbia peplus</i> * (Milkweed), <i>Sida rhombifolia</i> * (Paddy's Lucerne)

Growth form	Average % foliage cover	Dominant species (native and exotic)
High Threat Weed	51.3	<i>Cardiospermum grandiflorum</i> * (Ballon Vine), <i>Ehrharta erecta</i> * (Panic Veldtgrass) <i>Tradescantia fluminensis</i> * (Trad), <i>Panicum maximum</i> var. <i>maximum</i> (Guinea grass), <i>Eragrostis curvulua</i> (African love Grass)



**Table 5.10 Comparison of PCT 835: Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>4</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>2</b>	<b>4</b>	<b>22</b>	<b>22</b>	<b>70</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>12</b>	<b>40</b>	<b>1</b>
Q7	4	2	3	2	0	1	51.4	21	3.9	10.6	0	3	0	62	7
Q12	4	4	1	3	0	1	19.4	29.4	0.2	1.2	0	1	0	57	2
Q18	4	1	2	4	0	1	40	0.7	2.3	8.8	0	0.4	10	74	7
Q24	8	4	1	0	0	0	48	1.1	0.6	0	0	0	0	60	5

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 835: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion Keith Formation: KF\_CH9 Forested Wetland Keith Class: Coastal Floodplain Wetland), source (Environment Energy and Science, 2021c).

## PCT 920: Mangrove Forest in Estuaries of the Sydney Basin and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.10, Photo 5.11 and Photo 5.12. An overview of floristic and structural composition is presented in Table 5.11 and Table 5.12. A general description is provided below.

**Vegetation formation:** KF\_CH10 Saline Wetlands

**Vegetation class:** Mangrove Swamps

**Estimate of percent cleared:** 86%

**Conservation status:** PCT 920 does not form part of any TEC listed under either the BC Act or the EPBC Act. Mangroves, which form part of this PCT, are however protected under the FM Act.

**Landscape position:** Recorded from tidal mudflats fringing the Georges River.

**PCT Justification:** In selecting the most representative PCT for this vegetation type, the following candidate PCTs were considered:

- PCT 916 – Mangrove – Grey Mangrove low closed forest of the NSW Coastal Bioregion.
- PCT 918 – Mangrove – River Mangrove low closed forest of the NSW Coastal Bioregion.
- PCT 920 – Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion.

Based on the dominance of both *Aegiceras corniculatum* (River Mangrove), *Avicennia marina* subsp. *australasica* (Grey Mangrove) and the landscape position fringing a tidal portion of the Georges River PCT 920 was considered the closest representative PCT.

**Vegetation zones:** Within the study area, PCT 920 was recorded in a single condition class being:

- Moderate - within the study area, PCT 920 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

**Vegetation integrity survey plots:** Q25\_20. See Appendix B for full floristic and structural data. A comparison of PCT 920: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 5.12.



Photo 5.10 PCT 920 Moderate condition



Photo 5.11 PCT 920 Moderate condition



**Photo 5.12 PCT 920 Moderate condition along the Georges River**

**Table 5.11 PCT 920 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	62	<i>Avicennia marina</i> subsp. <i>australasica</i> (Grey Mangrove), <i>Casuarina glauca</i> (Swamp sheoak)
Shrubs	45	<i>Aegiceras corniculatum</i> (River mangrove)
Grass and grass like	0	-
Forb	0.8	<i>Tetragonia tetragoinioides</i> (New Zealand Spinach)
Fern	0	-
Other	0	-
Exotic	0.3	<i>Atriplex prostrata</i> * (Spear – leaved Orache)
High threat weed	0	-

**Table 5.12 Comparison of PCT 920: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>38</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>0</b>
Q25	2	1	0	1	0	0	62	45	0	0.8	0	0	11	1.6	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type: PCT 920 - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF\_CH10 Saline Wetlands Keith Class: Mangrove Swamps), source (Environment Energy and Science, 2021c).

## PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.13, Photo 5.14 and Photo 5.15. An overview of floristic and structural composition is presented in Table 5.13 and Table 5.14. A general description is provided below.

**Vegetation formation:** KF\_CH9 Forested Wetlands

**Vegetation class:** Coastal Floodplain Wetland

**Estimate of percent cleared:** 32%

**Conservation status:**

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.
- EPBC Act: Not listed.

**Landscape position:** located on periodically flooded low-lying areas and drainage tributaries of the Georges River. This vegetation zone was wholly located within Stage 1a of the study area and generally occurred in areas of restricted drainage within Airport and Ashford Reserves.

**PCT Justification:** this vegetation type is dominated by *Melaleuca ericifolia* (Swamp Paperbark) and *Melaleuca linariifolia* (Snow-in Summer) along with sedges and reeds. The floristic composition and landscape position is consistent with PCT 1236. This community intergrades with PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

**Vegetation zones:** Within the study area, PCT 1236 was recorded in a single condition class being:

- Moderate - within the study area, PCT 1236 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

**Vegetation integrity survey plots:** Q2\_20. See Appendix B for full floristic and structural data.

A comparison of PCT 1236 Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 5.14.



Photo 5.13 PCT 1236 Moderate condition



Photo 5.14 PCT 1236 Moderate condition





**Photo 5.15 PCT 1236 Moderate condition – periodically flooded low-lying areas**

**Table 5.13 PCT 1236 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	0	-
Shrubs	33	<i>Melaleuca ericifolia</i> (Swamp Paperbark), <i>Melaleuca linariifolia</i> (Snow-in Summer)
Grass and grass like	74	<i>Carex appressa</i> (Tall Sedge), <i>Phragmites australis</i> (Common Reed), <i>Typha orientalis</i> (Cumbungi)
Forb	12.5	<i>Commelina cyanea</i> (Native Wandering Jew), <i>Persicaria hydropiper</i> (Water Pepper), <i>Persicaria lapathifolia</i> (Pale Knotweed)
Fern	0	-
Other	0	-
Exotic	0	-
High threat weed	10.8	<i>Alternanthera philoxeroides</i> * (Alligator Weed), <i>Erythrina crista-galli</i> * (Cockspur Coral Tree), <i>Tradscantia fluminensis</i> * (Wandering Jew)

**Table 5.14 Comparison of PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>3</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>2</b>	<b>5</b>	<b>12</b>	<b>25</b>	<b>75</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>12</b>	<b>40</b>	<b>1</b>
Q2	0	2	3	3	0	0	0	33	74	12.5	0	0	3	10	0

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF\_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland), source (Environment Energy and Science, 2021c).

## PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.16 and Photo 5.17. An overview of floristic and structural composition is presented in Table 5.15 and Table 5.16. A general description is provided below.

**Vegetation formation:** KF\_CH9 Forested Wetlands

**Vegetation class:** Coastal Floodplain Wetland

**Estimate of percent cleared:** 90%

**Conservation status:**

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.
- EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – Endangered.

**Landscape position:** this vegetation type was associated with tidal flats of the Georges River.

**PCT Justification:** a canopy dominated by *Casuarina glauca* (Swamp Oak) that is associated with tidal influences of groundwater levels. PCT 1800 was considered as a candidate for this vegetation type however due to the tidal influences of the Georges River, PCT 1234 was assigned as the most appropriate fit.

**Vegetation zones:** Within the study area, PCT 1234 was recorded in a single condition class being:

- Moderate - within the study area, PCT 1234 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

**Vegetation integrity survey plots:** Q21\_20. See Appendix B for full floristic and structural data.

A comparison of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion plot data recorded against PCT condition benchmark data is provided in Table 5.16.



Photo 5.16 PCT 1234 Moderate condition



Photo 5.17 PCT 1234 Moderate condition

**Table 5.15 PCT 1234 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	65	<i>Acacia binervia</i> (Two-veined Hickory), <i>Acacia parramattensis</i> (Parramatta Wattle), <i>Casuarina glauca</i> (Swamp Oak),
Shrubs	12	<i>Melaleuca styphelioides</i> (Prickly-leaved Paperbark), <i>Melaleuca decora</i> (White feather honeymyrtle), <i>Bursaria spinosa subsp. spinosa</i> (Native Blackthorn)
Grass and grass like	5	<i>Microlaena stipoides var. stipoides</i> (Weeping grass)
Forb	4.6	<i>Tetragonia tetragonioides</i> (New Zealand Spinach), <i>Dichondra repens</i> (Kidney Weed), <i>Einadia hastata</i> (Berry Saltbush), <i>Solanum americanum</i> (Glossy Nightshade).
Fern	0	-
Other	0	-
Exotic	42.4	<i>Bidens pilosa</i> * (Farmer' friend), <i>Oxalis corniculata</i> * (Creeping Woodsorrel), <i>Sonchus oleraceus</i> * (Common Sowthistle)
High threat weed	38.3	<i>Ehrharta erecta</i> * (Panic Veldt Grass), <i>Tradescantia fluminensis</i> * (Wandering Jew)



**Table 5.16 Comparison of PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>3</b>	<b>9</b>	<b>8</b>	<b>8</b>	<b>2</b>	<b>5</b>	<b>12</b>	<b>25</b>	<b>75</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>12</b>	<b>40</b>	<b>1</b>
Q21	3	3	1	4	0	0	65	12	5	4.6	0	0	21	47	1

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion Keith Formation: KF\_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland), source (Environment Energy and Science, 2021c).

## PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

The occurrence of this vegetation type within the development site is illustrated in Figure 5.3 and Figure 5.4 with photographic representation provided in Photo 5.18 and Photo 5.19. An overview of floristic and structural composition is presented in Table 5.17 and Table 5.18. A general description is provided below.

**Vegetation formation:** KF\_CH9 Forested Wetlands

**Vegetation class:** Coastal Floodplain Wetland

**Estimate of percent cleared:** 60%

**Conservation status:**

- BC Act: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered.
- EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community – Endangered.

**Landscape position:** this vegetation type was associated with low-lying, periodically inundated alluvial riverflats in non-tidal areas. This vegetation zone occurred in scattered locations associated with disturbed drainage lines and depressions.

**PCT Justification:** a canopy dominated by *Casuarina glauca* (Swamp Oak) that is associated with low-lying, periodically inundated alluvial riverflats of the Cumberland Plain.

**Vegetation zones:** Within the study area, PCT 1234 was recorded in a single condition class being:

- Poor - within the study area, PCT 1800 was recorded in a single condition class that was allocated to a single discrete vegetation zone.

**Vegetation integrity survey plots:** Q20\_20 and Q26\_20. See Appendix B for full floristic and structural data.

A comparison of PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley plot data recorded against PCT condition benchmark data is provided in Table 5.18.



Photo 5.18 PCT 1800 Poor condition



Photo 5.19 PCT 1800 Poor condition

**Table 5.17 PCT 1800 overview of floristic and structural composition**

Growth form	Average % foliage cover	Dominant species (native and exotic)
Trees	37.5	<i>Casuarina glauca</i> (Swamp Oak)
Shrubs	0.5	<i>Melaleuca ericifolia</i> (Swamp Paperbark), <i>Aegiceras corniculatum</i> (River Mangrove)
Grass and grass like	0.2	<i>Microlaena stipoides</i> var. <i>stipoides</i> (Weeping Grass)
Forb	20	<i>Tetragonia tetragonioides</i> (New Zealand Spinach)
Fern	0	-
Other	0	-
Exotic	85.8	<i>Yucca sp.*</i> , <i>Syagrus romanzoffiana*</i> (Queen Palm)
High threat weed	76.6	<i>Ehrharta erecta*</i> (Panic Veldt Grass) <i>Tradescantia fluminensis*</i> (Wandering Jew), <i>Arundo donax*</i> (Giant Reed)

**Table 5.18 Comparison of PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley plot data against PCT condition benchmark data**

Plot	Tree richness	Shrub richness	Grass richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass cover	Forb cover	Fern cover	Other cover	Length timber	Leaf litter	Large tree
<b>BM</b>	<b>4</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>2</b>	<b>4</b>	<b>22</b>	<b>22</b>	<b>70</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>12</b>	<b>40</b>	<b>1</b>
Q20	1	0	1	0	0	0	35	0	0.2	0	0	0	5	70	0
Q26	1	2	1	1	0	0	40	0.9	0.1	40	0	0	0	40	3

Benchmark data for equivalent community in Sydney Basin IBRA bioregion (Vegetation Type PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley Keith Formation: KF\_CH9 Forested Wetland, Keith Class: Coastal Floodplain Wetland), source (Environment Energy and Science, 2021c).



## Miscellaneous ecosystem – Urban exotic / native landscape plantings

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was consistently recorded in all stages with the extent of being approximately: Photographic representation is provided in Photo 5.20 and Photo 5.21.

This vegetation type was typically recorded as planted canopy species fringing Henry Lawson Drive and within Bankstown Golf Club. This vegetation is highly modified with exotic vegetation dominating the understorey. These areas have been historically cleared of the original native vegetation and planted with the following:

- Landscape plantings of species which are locally indigenous to the Sydney Basin bioregion (e.g. *Melaleuca styphelioides* (Prickly-leaved Tea Tree), *Casuarina glauca* (Swamp Oak), *Corymbia maculata* (Spotted Gum) and other assorted species).
- Landscape plantings of plant species which are native to NSW but not locally indigenous species (e.g. *Eucalyptus microcorys* (Tallowwood)).
- Landscape plantings of species that are not indigenous to NSW but are indigenous in other parts of Australia (e.g. *Corymbia citriodora* (Lemon-scented Gum) and *Ficus microcarpa* (Chinese Banyan)).
- Landscape plantings of species that are exotic (not indigenous to Australia) (e.g. *Phoenix canariensis*\* (Canary Island Date Palm), *Jacaranda mimosifolia*\* (Jacaranda) and *Cinnamomum camphora*\* (Camphor Laurel)).



**Photo 5.20** Misc. ecosystem – Urban exotic/native landscape plantings



**Photo 5.21** Misc. ecosystem – Urban exotic/native landscape plantings

## Miscellaneous ecosystem – Non-native vegetation

This vegetation type does not align to any recognised plant community type in NSW due to its limited native vegetation and degraded condition. As such, it has been aligned to Highly disturbed areas with no or limited native vegetation. Within the study area this vegetation type was consistently recorded in all stages with the extent of being approximately: Photographic representation is provided in Photo 5.22 and Photo 5.23.

Associated with cleared areas typically dominated by exotic perennial grass species such as *Axonopus fissifolius*\* (Narrow-leaf Carpet Grass), *Cenchrus clandestinus*\* (Kikuyu), *Eragrostis curvula*\* (African Love Grass) and *Paspalum dilatatum*\* (Paspalum). This vegetation zone also includes weed plumes such as *Lantana camara* (Lantana) and *Rubus fruticosus* agg.\* (Blackberry).



**Photo 5.22** Misc. ecosystem – Non-native vegetation



**Photo 5.23** Misc. ecosystem – Non-native vegetation

## Miscellaneous ecosystem – Waterbodies

Within the study area water bodies including and associated with Georges River have been aligned to water bodies, rivers, lakes, streams (not wetlands). Photographic representation is presented below in Photo 5.24 and Photo 5.25.



**Photo 5.24** Georges River



**Photo 5.25** Water body – tributary of Georges River

### 5.3 Threatened ecological communities

A total of four threatened ecological communities (TECs) listed under the BC Act were recorded to occur within the study area. These included:

- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

A summary of each TEC listed above, associated PCTs and extent within the study area and EIS proposal area is summarised in Table 5.19.

An analysis of each TEC recorded within the study area against the corresponding final scientific determination for each TEC listing criteria is provided below in Section 5.3.1 to Section 5.3.4. Specifically, each section details how each PCT meets each element of the scientific determination, including how many characteristic species occur and details of the soils and geology associated with the PCT.

The location of each TEC in relation to the study area and the EIS proposal area is provided in Figure 5.5.

**Table 5.19 Summary of TECs listed under the BC Act recorded within the study area**

Threatened ecological community	BC Act 1	Associated PCT within the study area	Extent (ha)	
			Study area	EIS proposal area
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	E	PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	2.93	0
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	0.21	0.02
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion	2.96	0.02
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0.84	0.01
		PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	1.32	0.20
		PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	0.90	0
Total			9.16	0.25

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.



### 5.3.1 Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion is listed as Endangered under the BC Act. One PCT recorded within the study area is considered to be associated with the TEC; being PCT 725 Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion.

A comparison of PCT 725 within the study area against the final scientific determination listing criteria for Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion TEC is provided in Table 5.20.

**Table 5.20 Correlation of BC Act-listed Cooks/River Ironbark Forest TEC and associated PCT 725**

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Sydney Basin	Found on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally, occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Occurs on clay soils associated with Tertiary alluvium.	The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.	There are 88 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 725: Broad-leaved Ironbark - <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Sydney Basin	Recorded in wet areas where moist depressions and surface water were observed. Drainage lines associated within tributaries of Georges River were observed in Airport Reserve.	Clays derived from Tertiary alluvium.	Occurs as open forest	All vegetation assigned to this PCT was floristically characteristic of Cooks River/Castlereagh Ironbark Forest Community. Total diagnostic species per plot: <ul style="list-style-type: none"> <li>Q1 – 19 sp.</li> <li>Q3 – 12 sp.</li> </ul>	This PCT was recorded in two condition types; Moderate and Poor (regrowth)
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion



### 5.3.2 Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion is listed as Endangered under the BC Act. One PCT recorded within the study area is considered to be associated with the TEC; being PCT 781 Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion

A comparison of PCT 781 within the study area against the final scientific determination listing criteria for Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion TEC is provided in Table 5.21

**Table 5.21 Correlation of BC Act-listed Freshwater Wetland TEC and associated PCT 781**

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	North Coast, Sydney Basin and South East Corner bioregions	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands.	Typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains.	The structure of the community may vary from sedgeland and reedlands to herbfields, and woody species of plants are generally scarce. Typically dominated by herbaceous plants and have very few woody species	There are 66 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination.  Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	Sydney Basin	Recorded in within freshwater tributaries of the Georges River.	Recorded in silt soils in moist alluvial depressions.	The vegetation is recorded as reedland in both occurrences.	All vegetation assigned to this PCT was floristically characteristic of Freshwater Wetlands. Total diagnostic species per plot: <ul style="list-style-type: none"> <li>Q23 – 1 sp.</li> </ul>	Patches of the community identified have characteristic native species dominant (>75% of species are characteristic) for at least one of the structural layers present.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

### 5.3.3 River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion is listed as Endangered under the BC Act. One PCT recorded within the study area is considered to be associated with the TEC; being PCT 835 Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion

A comparison of PCT 835 within the study area against the final scientific determination listing criteria for River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion TEC is provided in Table 5.22.

**Table 5.22 Correlation of BC Act-listed River-flat Eucalypt Forest TEC and associated PCT 835**

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions Threatened Ecological Community	North Coast, Sydney Basin and South East Corner bioregions	Found on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Generally occurs below 50 m elevation, but may occur on localised river flats up to 250 m above sea level.	Alluvium; silts, clay-loams and sandy loams	The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.	There are 88 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination.  Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 835: Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Sydney Basin	Occurs on streams / drainage lines at <50 m elevation within the study area.	Occurs on alluvium and clay-loams within the study area.	Structure of the community on the site is variable, consisting of partially cleared open forest/woodland with or without a shrub layer.	All plots assigned to the PCT contain <i>Eucalyptus amplifolia</i> , <i>Eucalyptus tereticornis</i> or <i>Eucalyptus baueriana</i> and some diagnostic understorey species. Total diagnostic species per plot: <ul style="list-style-type: none"> <li>Q7 – 8 sp. Q12 – 8 sp.</li> <li>Q18 – 10 sp. Q24 – 10 sp.</li> </ul>	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.  NB: tree and shrub layers are considered to be absent where they are only represented by isolated (widely-spaced) individuals.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion

### 5.3.4 Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregion

Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregion is listed as Endangered under the BC Act. Three PCTs recorded within the study area is considered to be associated with the TEC being:

- PCT 1236 Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 Swamp Oak Swamp PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion
- PCT 1800 Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

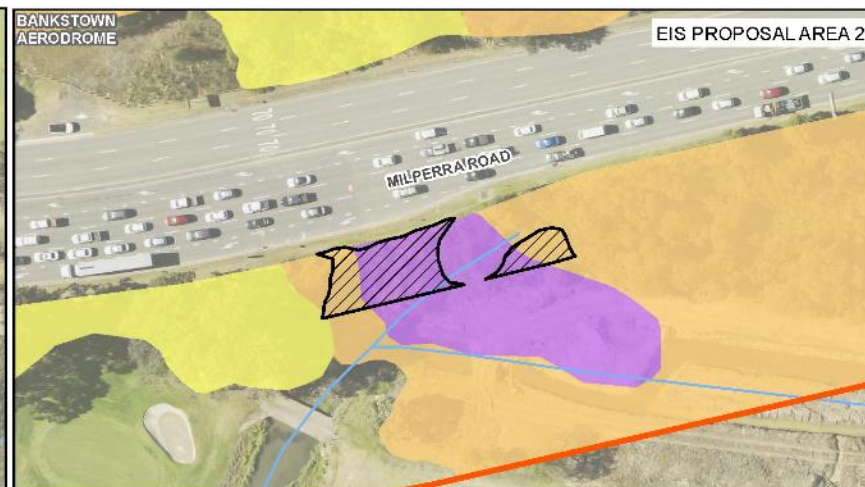
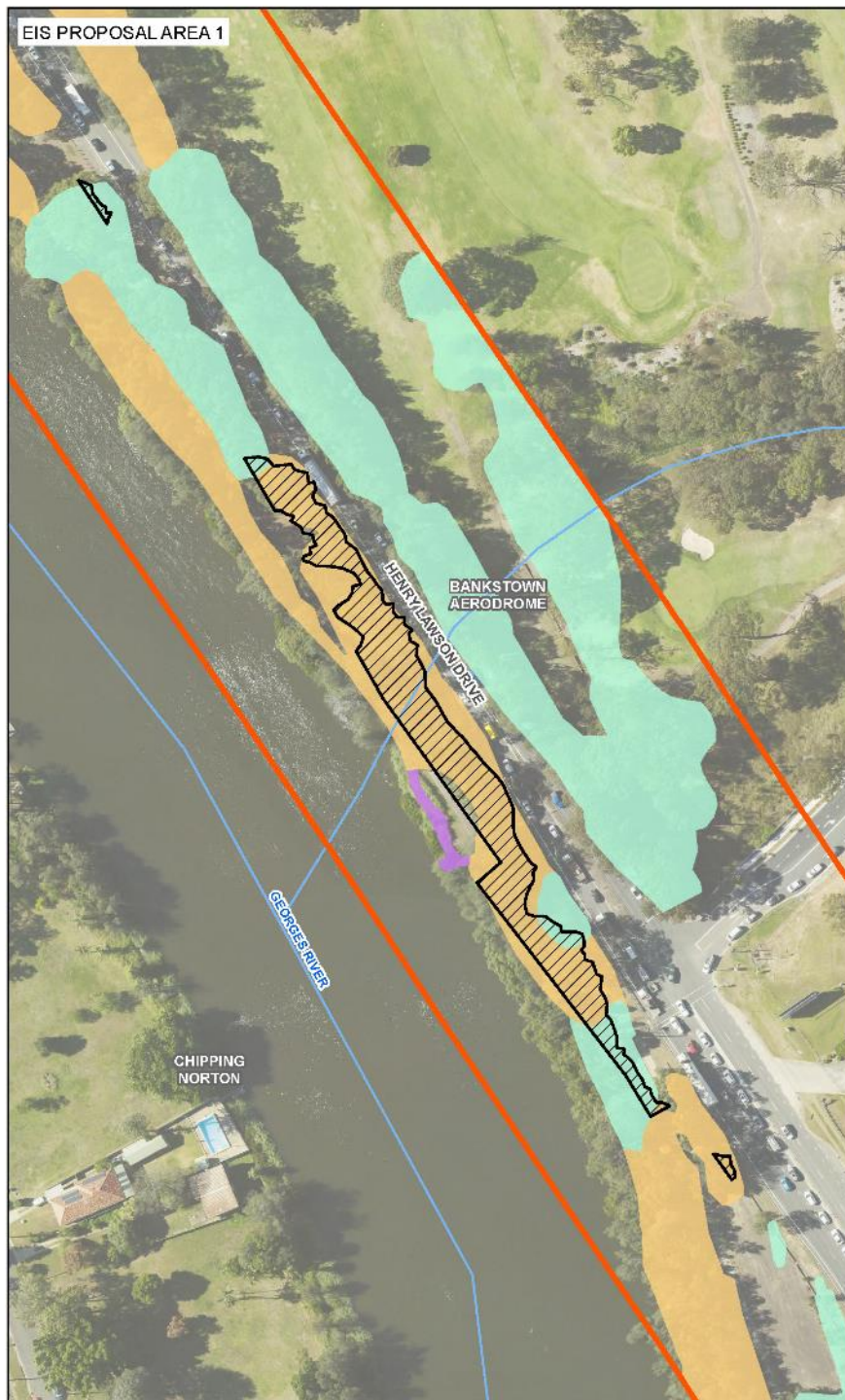
A comparison of PCT 1236, PCT 1234 and PCT 1800 within the study area against the final scientific determination listing criteria for Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregion TEC is provided in Table 5.23.

**Table 5.23 Correlation of BC Act-listed Swamp Oak Floodplain Forest TEC and associated PCT 1236, PCT 1234 and PCT 1800**

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions Threatened Ecological Community	North Coast, Sydney Basin and South East Corner bioregions	It generally occupies low-lying parts of floodplains, alluvial flats, drainage lines, lake margins and fringes of estuaries; habitats where flooding is periodic and soils show some influence of saline ground water.	Alluvium; silts, clay-loams and sandy loams	The structure of the community may vary from open forests to low woodlands, scrubs or reedlands with scattered trees.	Dominated by a tree canopy of either <i>Casuarina glauca</i> or, more rarely, <i>Melaleuca ericifolia</i> with or without subordinate tree species; the relatively low abundance of Eucalyptus species; and the prominent groundcover of forbs and graminoids. There are 45 characteristic species listed for this community. The total species list of the community is larger with many species present at a small number of sites or in low abundance.	There is no condition threshold described for this community in the determination.  Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.
PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Sydney Basin	Located on alluvial flats and drainage lines on the Georges River floodplain	Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Occurs as a low shrubland or scrub	Dominated by <i>Melaleuca ericifolia</i> mostly without subordinate tree species. Total diagnostic species per plot: <ul style="list-style-type: none"> <li>• Q2 – 4 sp.</li> </ul>	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.

Threatened ecological community and PCT comparison	Bioregion	Landform and altitudinal range	Soil/ geology	Structure	Species assemblage	Condition thresholds
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	Sydney Basin	Located on alluvial flats of the Georges River	Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Occurs as an open forest structure	Tree canopy dominated by <i>Casuarina glauca</i> . Total diagnostics per plot: <ul style="list-style-type: none"> <li>Q21 – 5 sp.</li> </ul>	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Sydney Basin	Associated with alluvial flats and drainage lines associated with Prospect Creek floodplain	Alluvium; silts, clay-loams and sandy loams associated with the Prospect Creek floodplain	Occurs as an open forest structure	Tree canopy dominated by <i>Casuarina glauca</i> . Total diagnostic species per plot: <ul style="list-style-type: none"> <li>Q20 – 2 sp.</li> </ul>	Patches of the community identified have characteristic native species dominant (>50% of cover of layer) for at least one of the structural layers present.
Comparison	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion	Meets criterion





**Figure 5.5**  
Threatened ecological communities

**Legend**

- Watercourse
- Study area
- EIS proposal area
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (Endangered - BC Act)
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered - BC Act)
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act)
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered - BC Act)



Coord. data system: CDA 1954 MGA Zone 55

Scale ratio: correct when printed at A3

Date: 19-Apr-21

Data sources: M44PMap, NSW Government Australia, DECC, Geospatial, and the GIS user community

This document is the property of WSP. It is to be used only for the purpose for which it was prepared. It is not to be used for any other purpose without the written consent of WSP. WSP does not accept any liability for any loss or damage arising from the use of this document. It is to be used only for the purpose for which it was prepared. It is not to be used for any other purpose without the written consent of WSP. WSP does not accept any liability for any loss or damage arising from the use of this document.

## 5.4 Groundwater dependent ecosystems

The presence and characteristics of groundwater dependent ecosystems in the study area is described in this section.

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater (Department of Land and Water Conservation, 2002). When considering GDEs, groundwater is generally defined as the saturated zone of the regolith (the layer of loose rock resting on bedrock, constituting the surface of most land) and its associated capillary fringe, however it excludes soil water held under tension in soil pore spaces (the unsaturated zone or vadose zone) (Eamus et al., 2006).

GDEs include a diverse range of ecosystems. These ecosystems range from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water) (Hatton and Evans, 1998). Eamus et al. (2006) considers the following broad classes of these ecosystems:

- Aquifer and cave ecosystems, where stygofauna (groundwater-inhabiting organisms) may reside within the groundwater resource. The hyporheic zones of rivers and floodplains are also included in this category because these ecotones often support stygobites (obligate groundwater inhabitants).
- All ecosystems dependent on the surface expression of groundwater. This category includes base-flow rivers and streams, wetlands, some floodplains and mound springs and estuarine seagrass beds. While it is acknowledged that plant roots are generally below ground, this class of groundwater dependant ecosystems requires a surface expression of groundwater, which may, in many cases, then soak below the soil surface and thereby become available to plant roots.
- All ecosystems dependent on the subsurface presence of groundwater, often accessed via the capillary fringe (non-saturated zone above the saturated zone of the water table) when roots penetrate this zone. This class includes terrestrial ecosystems such as River Red Gum (*Eucalyptus camaldulensis*) forests on the Murray–Darling basin. No surface expression of groundwater is required in this class of groundwater dependant ecosystems.

Groundwater levels throughout the overall proposal area are expected to be shallow due to the location on alluvium and the close proximity of the Georges River, between 0 to 8 m below the surface, varying seasonally (higher in winter, lower in summer) (Aurecon, 2021). GDEs which are surface expressions of groundwater within the locality of the study area (<10 km) include the Georges River. Other GDEs which are reliant on subsurface groundwater in the study area include:

- PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner.
- PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin.
- PCT 1236 - Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion.
- PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner.



## 6 Threatened species

---

This chapter addresses threatened species in accordance with Chapter 5 and Chapter 6 of the BAM and matters relating to the BC Act.

### 6.1 Threatened species methodology

#### 6.1.1 Assessing habitat suitability for threatened species

In the BAM, threatened species are assessed as either ecosystem credit species, species credit species or a combination of the two (referred to as 'dual credit species'). The BAM defines these threatened species categories as follows:

- Ecosystem credit species (predicted): are those threatened species where the likelihood of occurrence and/or elements of its habitat can be confidently predicted by vegetation surrogates and landscape features.
- Species credit species (candidate): are those threatened species that cannot be reliably predicted by habitat surrogates.
- Dual credit species: are those threatened species where part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat) and part as a species credit (e.g. breeding habitat). In this report, dual credit species will be included in both ecosystem and species credit assessment.

The BAM sets out six steps for assessing habitat suitability for threatened species (ecosystem credit species and species credit species), these are:

Ecosystem and species credit species (includes dual species):

- Step 1: Identify threatened species for assessment (BAM subsection 5.2.1).
- Step 2: Assess the habitat constraints and vagrant species on the subject land (BAM subsection 5.2.2).

Species credits species only (includes dual species):

- Step 3: Further assessment of candidate species credit species (BAM subsection 5.2.3).
- Step 4: Determine the presence of a candidate species credit species (BAM subsection 5.2.4).
- Step 5: Determine the area or count, and location of suitable habitat for a species credit species (a species polygon) (BAM subsection 5.2.5).
- Step 6: Determine the habitat condition within the species polygon for species credit species assessed by area (BAM subsection 5.2.6).

These six steps were used to assess the suitability of habitat within the EIS proposal area for threatened species. The threatened species habitat suitability assessments completed for the EIS proposal are provided in Appendix A and summarized in Chapter 6 of this report.

The BAM also requires the assessor to review additional information about threatened species to determine if any predicted or candidate species inclusions are applicable. This involved searches of threatened species databases and likelihood of occurrence assessments which are described below.

#### Database searches

A list of threatened species databases accessed for this report to provide additional information about threatened species and to determine the EIS proposal's candidate species as presented in Table 6.1.

**Table 6.1 Database searches undertaken**

Database	Search date	Area searched	Reference
Bionet Atlas of NSW Wildlife	03/03/2021	10 km buffer around the study area	(Environment Energy and Science, 2021b)
EPBC Act Protected Matters Search Tool (PMST)	03/03/2021	10 km buffer around the study area	Department of Agriculture Water and the Energy (2021c)
PlantNet NSW	08/07/2020	LGA spatial search	Royal Botanic Gardens (2021)
Biodiversity Assessment Method Calculator (BAM-C)	05/03/2021	Search of candidate species predicted species using BAM data from vegetation within the EIS proposal area	Environment Energy and Science (2021a)
Fisheries Spatial Data Portal and critical habitat register	03/03/2021	Spatial search of EIS proposal area and study area	Department of Primary Industries (2021)

### Likelihood of occurrence assessment

Likelihood of occurrence assessment were undertaken for all threatened species, populations and migratory species identified through database searches. These assessments were conducted for both BC Act and EPBC Act listed species. Likelihood of occurrence assessments enabled justification for any identification of species inclusions for both ecosystem and species credit species. They also enabled identification of species considered MNES under the EPBC Act for further assessment in Chapter 6 of this report.

Criteria used to determine likelihood of occurrence for threatened flora and fauna species in outlined in Table 6.2. A likelihood of occurrence assessment has been undertaken for all identified threatened species in Appendix A.

**Table 6.2 Likelihood of occurrence classification and criteria**

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



## Further assessment of candidate species credit species

Step 3 for assessing habitat suitability for threatened species in the BAM considers a candidate species credit species unlikely to occur on the subject land (or a specific vegetation zone) if one of the following applies:

After carrying out a field assessment:

- The assessor determines that microhabitats required by the species are absent from the subject land (or specific vegetation zone); or
- An expert report states that the species is unlikely to be present on the subject land or specified vegetation zones.

As such, a candidate species credit species that is not considered to have suitable habitat on the study area does not require further assessment on the study area.

Surveys completed to identify microhabitats present within the EIS proposal area are detailed in Section 6.1.2 to Section 6.1.4.

### 6.1.2 Terrestrial targeted flora survey

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence (Appendix A). Targeted flora surveys were completed by conducting reference checks, parallel line traverses, random meanders and during BAM VI plot surveys in accordance with the relevant guidelines. A summary of the targeted flora surveys completed is outlined below with a comprehensive overview provided in Table 6.3.

#### Vegetation integrity plots

Plot and transect surveys were carried out in accordance with the BAM (Department of Planning Industry and Environment, 2020a). At each plot and transect survey location, dedicated 20 minute searches were conducted for threatened species assessed as having a moderate or high likelihood of occurrence within each vegetation type sampled. The number of plots completed for each identified vegetation zone is provided in Table 5.2 with the location of each transect/plot identified in Table 5.3, Figure 5.2 and Figure 5.3.

#### Parallel line traverses

Targeted flora surveys in the form of parallel line transverses were used to search for threatened species assessed as having a moderate or high likelihood of occurrence within the high condition vegetation within the study area. This involved two ecologists searching along parallel transverses across potential habitat for each threatened species. This methodology is consistent with the current guidelines for NSW threatened plant surveys (Office of Environment & Heritage, 2016, Department of Planning Industry and Environment, 2020d).

#### Random Meander

Random meander surveys are a variation of the transect type survey and were completed in accordance with the technique described by Cropper (1993), whereby the recorder walks in a random meander throughout the study area recording dominant and key plant species (e.g. threatened species, priority weeds), boundaries between various vegetation communities and condition of vegetation. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Random meander surveys were conducted to locate candidate threatened species and populations within area of suitable habitat. Where a threatened flora species was located, parallel field traverses were then conducted to determine the size and extent of the population.

**Table 6.3 Survey timing for candidate threatened flora (species credit species) within the study area**

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Optimal survey period (TBDC)	Vegetation types and habitat constraints	Survey technique	Survey timing
<b>Non-candidate species credit species recorded within the study area</b>							
<i>Acacia pubescens</i>	Downy Wattle	V	V	All year	PCT 725 – only recorded outside the EIS proposal area	BAM VI plots, parallel line traverses and random meanders	21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
<b>Candidate threatened species credit species within the EIS proposal area</b>							
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	October to January	PCT 835	BAM VI plots, parallel line traverses and random meanders	15 November; 4 December 2018 and 1 October 2020
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	All year	PCT 835		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	All year	PCT 835		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	V	August to October	PCT 835		19 September 2018; 29 and 30 September and 1 October 2020
<i>Hibbertia puberula</i> subsp. <i>glabrescens</i> (syn. <i>Sp. Bankstown</i> )	-	CE	CE	September to December	PCT 835		19 September, 15 November; 4 December 2018; 29 and 30 September 2020 and 1 October 2020

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Optimal survey period (TBDC)	Vegetation types and habitat constraints	Survey technique	Survey timing
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2	-	November to February	PCT 835		15 November; 4 December 2018 and 1 October 2020
Melaleuca biconvexa	Biconvex Paperbark	V	V	All year	PCT 1234		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
Persoonia hirsuta	Hairy Geebung	E	E	All year	PCT 835		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
Haloragis exalta subsp. exalta	Square Raspwort	V	V	All year	PCT 1234 and PCT 1236 Waterbodies: Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100m		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
Persicaria elatior	Tall Knotweed	V	V	December to May	PCT 781 and PCT 835 Semi-permanent/ ephemeral wet areas and swamps: within 50 m Waterbodies: including Wetlands, or within 50 m		21 - 25 & 31 May; 4 December 2018 and 6-7 April 2020

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Optimal survey period (TBDC)	Vegetation types and habitat constraints	Survey technique	Survey timing
<i>Maundia triglochinos</i>	-	V	-	November to March	PCT 1234 Other: Riparian areas/drainage lines, water ponding, man-made dams and drainage channels up to 1 m deep Swamps: Shallow swamps up to 1 m deep Waterbodies: Shallow waterbodies up to 1 m deep		15 November and 4 December 2018 and 1 October 2020
<i>Pilularia novae-hollandiae</i>	Austral Pilwort	E	-	October to December	PCT 835		15 November and 4 December 2018 and 1 October 2020
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E2	-	All year	PCT 835		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Wilsonia backhousei</i>	Narrow-leafed <i>Wilsonia</i>	V	-	All year	PCT 1234 Other: Beaches and rock platforms adjacent to beaches, or anywhere saline		21 - 25 & 31 May; 1 & 21 June 2018, 19 September, 15 November and 4 December 2018; 6-7 April 2020; 29 and 30 September 2020 and 1 October 2020
<i>Zannichellia palustris</i>	-	E	-	October to January	PCT 781 Waterbodies: Freshwater or slightly brackish estuarine areas (10%)		15 November and 4 December 2018 and 1 October 2020

(1) Vulnerable (V), Endangered (E), Endangered Population (E2), Critically Endangered (CE) as listed on the BC Act

(2) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.



### 6.1.3 Terrestrial targeted fauna surveys

Targeted threatened fauna surveys were undertaken over a five-day period between the 21 to 25 May 2018 and a four-day period of 4-5 and 12-13 December 2018. Opportunistic surveys were carried out over a further three days on 31 May, 1 & 21 of June 2018. Additional field survey was undertaken on the 6 & 7 of April, 2020 and 29 September – 1<sup>st</sup> October 2020.

Targeted fauna surveys were undertaken in accordance with the following guidelines:

- Cumberland Plain Land Snail – Environmental Impact Assessment Guidelines for Cumberland Land Snail (*Meridolum corneovirens*) (National Parks and Wildlife Service, 2000).
- SAT – method endorsed by the Australian Koala Foundation, recognised industry standard that is useful for determining presence/absence and habitat preference of Koala.
- Survey Guidelines for Australia's Threatened Bats (Department of Environment Water Heritage and the Arts, 2010a).
- Survey Guidelines for Australia's Threatened Birds (Department of Environment Water Heritage and the Arts, 2010b).
- Survey Guidelines for Australia's Threatened Frogs (Department of the Environment Water Heritage and the Arts, 2010).
- Survey Guidelines for Australia's Threatened Mammals Commonwealth of Australia (Department of Environment Water Heritage and the Arts, 2011).
- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (Department of Environment and Climate Change, 2009).

Survey effort undertaken for threatened fauna species for the EIS proposal are summarised in Table 6.4 and illustrated on Figure 5.2.

#### Nocturnal surveys

Nocturnal surveys consisted of spotlighting and call playback, targeting threatened owls, threatened arboreal mammals and threatened amphibians.

Spotlighting was used to target arboreal, flying and ground-dwelling mammals, as well as, nocturnal birds and amphibians. Spotlighting was completed after dusk (May 2018 & December 2018). Surveys were completed on foot using high-powered headlamps and hand torches. Sighted animals were identified to the species level.

Call playback was used to survey for nocturnal birds, arboreal mammals and amphibians (e.g. Powerful Owl, Squirrel Glider, Koala & Green and Golden Bell Frog), using standard methods (Debus, 1994, Debus and Chafer, 1994, Debus and Rose, 1994). Call playback was completed after dusk at numerous locations.

For each survey, an initial listening period of 10 to 15 minutes was undertaken, followed by a spotlight search for 10 minutes to detect any animals in the immediate vicinity. The calls of the target species were then played intermittently for five minutes followed by a 10 minute listening period. After the calls were played, another 10 minutes of spotlighting was done in the vicinity to check for animals attracted by the calls, but not vocalising. Calls from Stewart and Pennay (Pennay et al., 2004, Stewart, 1998) were broadcast using a portable media player and megaphone.

#### Diurnal bird surveys

Formal 20 minute diurnal bird searches were completed within the study area/subject land. Bird surveys were completed by actively walking through the nominated site (transect) over a period of 20-minutes (Department of Environment Water Heritage and the Arts, 2010b). All birds were identified to the species level, either through direct observation or identification of calls. Bird surveys were completed during different times of the day, but generally occurred during morning hours or evening. Birds were also recorded opportunistically during all other surveys.

Where seasonal conditions for some species including flowering eucalypts were not suitable during the timing of onsite investigations, as was the case for threatened blossom nomads

such as the Regent Honeyeater and Swift Parrot, likelihood of occurrence assessments were conducted based on the presence/absence of suitable habitat and its condition. This is a conservative approach that takes into account the presence or absence of suitable habitats to assess a difficult to detect species when survey conditions were not appropriate. Where suitable habitat is present, the species is assumed to occur.

### **Remote camera**

Remote motion sensing infra-red cameras were positioned in the study area/subject land to target arboreal mammals (e.g. Squirrel Glider). Seven remote cameras were used to target threatened arboreal mammals in appropriate microhabitats in the study area/subject land for four consecutive nights in May 2018. Cameras were placed approximately 2 m above the ground aimed at semi-mature or mature flowering native trees or likely foraging habitat. Cameras were also used to target other animals occurring within survey locations including introduced species.

### **Koala spot assessments**

In areas where habitat assessment was undertaken, a Spot Assessment Technique (SAT) was undertaken within the study area/subject land to identify the presence of Koala usage within native vegetation. The SAT identifies whether local Koala tree species preferences by measuring the rate at which each species is utilised by Koalas.

The SAT involves measuring activity within the immediate area surrounding a tree of any species known to have been utilised by Koalas, or otherwise considered to be of some importance for Koala conservation and/or assessment purposes. A minimum of 29 surrounding trees are sampled systematically for Koala faecal pellets for 1 metre around the base of each tree. The activity of Koala usage for each SAT is then expressed as the percentage equivalent of the proportion of the surveyed trees within each SAT. The percentage is then compared to prescribed ranges for activity levels for Koalas within NSW (Phillips and Callaghan, 2011).

### **Active invertebrate searches**

Active invertebrate searches involve diurnal hand searches (i.e. disturbance of habitat) and visual searches targeting specific habitat. In relation to threatened invertebrate species (i.e. Cumberland Plain Land Snail) specific habitat preferences include under logs and other debris, amongst leaf litter and bark accumulations around bases of trees and sometimes in clumps of grass. Invertebrates are also known to shelter under rubbish, disposed building materials and abandoned car parts (National Parks and Wildlife Service, 2000).

Active invertebrate searches were undertaken where habitat assessments were recorded. Surveys were completed by two persons over a 30-minute period with all ground shelter returned to their original position.

### **Shorebird surveys**

A formal 20-minute diurnal bird survey was completed within the study area/subject land where potential shorebird habitat occurred (i.e. tidal areas & mudflats along the Georges River). Shorebird surveys were completed by actively walking through the potential areas (transect) over a period of 20-minutes (Department of Environment Water Heritage and the Arts, 2010b). Surveys were undertaken during summer months (December 2018) when migratory birds are likely to occur within the region and during both low and high tides periods. All birds were identified to the species level, either through direct observation or identification of calls.

### **Anabats**

Ultrasonic Anabat bat detection (Titley Electronics) was used to record and identify the echolocation calls of microbats foraging across several native vegetation communities and at potential roosting culverts in the study area/subject land. Passive monitoring of these survey sites was achieved by setting Anabat bat detectors to record from sunset to sunrise within the study area/subject land. Bat call analysis was completed by Nathan Cooper (WSP), with the presentation of data considering the guidelines of the Australasian Bat Society. Bat calls of

New South Wales Sydney Basin region (Pennay et al., 2004) was used as a reference collection for bat call identification.

Daytime inspections of culverts and bridges were undertaken within the study area and subject land to identify microbats and/or potential roosting sites. This involved searching for roosting bats, signs of microbat presence (chattering, staining, flying) and potential roost sites including disused fairy martin nests.

### **Opportunistic sightings**

Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees
- aquatic habitats
- rock outcrops
- habitat type boundaries.

### **Fauna habitat assessment**

Fauna habitat assessments were undertaken to assess the likelihood of threatened fauna species (those species known or predicted to occur within the locality from the literature and database review) occurring within the study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species are likely to occur within the study area, if they are not observed during field surveys. Fauna habitat characteristics assessed included:

- Structure and floristics of the canopy, understorey and ground cover, including the presence of flowering and fruiting trees representing potential foraging resources.
- Presence of hollow-bearing trees offering potential roosting and breeding habitat for arboreal mammals, birds and herpetiles.
- Presence of ground cover vegetation, leaf litter, rock outcrops and fallen timber increasing niche opportunity for ground-dwelling mammals, birds and herpetiles.
- Presence of waterways (ephemeral or permanent) and water bodies.

### **Condition of Fauna habitat**

The following criteria were used to evaluate the condition of habitat values:

- **Good:** A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate:** Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor:** Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

Results from fauna habitat assessments were used to inform likelihood of occurrence and habitat suitability assessments following field survey.

**Table 6.4 Survey effort for threatened fauna species within the study area**

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
<b>Amphibians</b>							
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V	Species	Nocturnal call playback (One playback on each of two separate nights) Systematic day habitat search (One hour per stratification unit) Night habitat search of damp and watery sites (30 minutes on two separate nights) Night watercourse search (Two hours per 200 m of water body edge) Minimum of one site per defined water body (retaining potential habitat) in the early evening and completed on each of four separate nights.	TBDC: November–March	4-5 December & 12-13 December 2018: <ul style="list-style-type: none"> <li>Call playback (4 nights after heavy rainfall event (&gt;50mm). Multiple sites</li> <li>Spotlighting and active searches – 26 person hours</li> <li>4 days of opportunistic sightings</li> </ul>
<b>Birds – migratory and shorebirds</b>							
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	CE; M; Ma	Dual species/ ecosystem	Standard 20 minute search of a 2 ha area Incidental records	TBDC: n/a Other: September - March	4-5 December & 12-13 December 2018: <ul style="list-style-type: none"> <li>20-minute shorebird surveys</li> </ul>
Great Egret	<i>Ardea alba</i>	-	Ma	n/a		TBDC: n/a Other: November to April	
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	V	M; Ma	Dual species/ ecosystem		TBDC: May to April September to December	
Black-tailed Godwit	<i>Limosa limosa</i>	V	M; Ma	Dual species/ ecosystem		TBDC: May to April September to December	



Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Birds – predatory							
Eastern Osprey	<i>Pandion cristatus</i>	V	-	Dual species/ ecosystem	Standard 20 minute search of a 2 ha area	TBDC: April to November	21-25 May 2018: <ul style="list-style-type: none"><li>• 16 person hours</li><li>• 5 days of opportunistic sightings (70 person hours)</li></ul> 6-7 April 2020: <ul style="list-style-type: none"><li>• 14 hours</li><li>• 2 days of opportunistic sightings</li></ul> 19 September, 15 November and 4 December 2018: <ul style="list-style-type: none"><li>• 21 hours</li><li>• 3 days of opportunistic sightings</li></ul> 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"><li>• 21 hours</li><li>• 3 days of opportunistic sightings</li></ul>
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	Dual species/ ecosystem	Incidental record	TBDC: August to October	
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-	Dual species/ ecosystem	Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: September to January	
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	Ma	Dual species/ ecosystem		TBDC: July to December	
Birds – large forest owls							
Masked Owl	<i>Tyto novaehollandiae</i>	V	-	Dual species/ ecosystem	Call playback	TBDC: May - August	21-25 May 2018: <ul style="list-style-type: none"><li>• Call playback – 4 consecutive nights across multiple sites</li><li>• Spotlighting – 4 consecutive nights (16 person hours)</li></ul>
Barking Owl	<i>Ninox connivens</i>	V	-	Dual species/ ecosystem	(5 visits per site for Powerful Owl, Barking Owl & and 8 visits per site for the Masked Owl).	TBDC: May - August	
Powerful Owl	<i>Ninox strenua</i>	V	-	Dual species/ ecosystem	Spotlight surveys Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: May - August	

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
<b>Birds – other</b>							
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	-	Ecosystem	Standard 20 minute search of a 2 ha area. Two separate one-day survey completed over study area in appropriate habitat within optimum season Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests	TBDC: n/a Other: All year	21-25 May 2018: <ul style="list-style-type: none"> <li>6 person hours</li> <li>5 days of opportunistic sightings (70 person hours)</li> </ul> 4-5 December & 12-13 December 2018: <ul style="list-style-type: none"> <li>4 days of opportunistic sightings</li> </ul> 6-7 April 2020: <ul style="list-style-type: none"> <li>14 hours</li> <li>2 days of opportunistic sightings</li> </ul> 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> <li>21 hours</li> <li>3 days of opportunistic sightings</li> </ul>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	-	Dual species/ecosystem		TBDC: April to August	
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-	Ecosystem		TBDC: n/a Other: All year	
Gang Gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	-	Dual species/ecosystem		TBDC: October and December	
Rufous Fantail	<i>Rhipidura rufifrons</i>	-	M; Ma	n/a		TBDC: n/a Other: All year	
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	Ecosystem		TBDC: n/a Other: All year	
White-throated Needletail	<i>Hirundapus caudacutus</i>	-	V; M; Ma	Species		TBDC: October to April	
Bush-stone Curlew	<i>Burhinus grallarius</i>	E	-	Species credit	Habitat constraints (i.e. fallen / standing dead timber including logs): searches of suitable habitat constraints	TBDC: April to May September to December	Opportunistic micro habitat surveys during bird surveys. 4-5 December & 12-13 December 2018: <ul style="list-style-type: none"> <li>4 days of opportunistic sightings</li> </ul>
Swift Parrot	<i>Lathamus discolor</i>	E	CE	Dual species/ecosystem	EPBC survey guidelines: Targeted searches for 20 hours over 8 days Breeding habitat (dual species credit habitat components): searches of suitable habitat for actively used breeding nests (note: species only breeds in Tasmania).	TBDC: n/a Other: Mar–July (May–Aug breeding)	21-25 May 2018: <ul style="list-style-type: none"> <li>16 person hours</li> <li>5 days of opportunistic sightings (70 person hours)</li> </ul> 6-7 April 2020: <ul style="list-style-type: none"> <li>14 hours</li> <li>2 days of opportunistic sightings</li> </ul>

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
<b>Invertebrates</b>							
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E	-	Species	Active searches - diurnal searches per fauna habitat stratification	TBDC: All year	21-25 May 2018: <ul style="list-style-type: none"> <li>Active searches within relevant habitat (16 person hours)</li> </ul>
<b>Mammals</b>							
Koala	<i>Phascolarctos cinereus</i>	V	V	Dual species/ ecosystem	Call playback for relevant species (2 sites surveyed on 2 nights) Spotlight surveys (2 observers on 1 km transect for 1 hour) Camera traps - remote sensing cameras per fauna habitat stratification for four nights SATs Incidental records	TBDC: All year	21-25 May 2018: <ul style="list-style-type: none"> <li>Spotlighting – 4 consecutive nights (16 person hours)</li> <li>SATs x4 within relevant PCTs with food trees</li> <li>Call playback – 4 consecutive nights across multiple sites</li> <li>5 days of opportunistic sightings (70 person hours)</li> </ul>
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V	-	Species credit	Spotlight surveys (2 observers on 1 km transect for 1 hour) Camera traps - remote sensing cameras per fauna habitat stratification for four nights Incidental records	TBDC: May	21-25 May 2018: <ul style="list-style-type: none"> <li>Spotlighting – 4 consecutive nights (16 person hours)</li> <li>Remote cameras (28 trap nights)</li> </ul>
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	-	Species	Call playback for relevant species (2 sites surveyed on 2 nights) Spotlight surveys (2 observers on 1 km transect for 1 hour) Camera traps - remote sensing cameras per fauna habitat stratification for four nights Incidental records	TBDC: All year	21-25 May 2018: <ul style="list-style-type: none"> <li>Spotlighting – 4 consecutive nights (16 person hours)</li> <li>Remote cameras (28 trap nights)</li> <li>Call playback – 4 consecutive nights across multiple sites</li> </ul>

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
<b>Mammals – bats</b>							
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	-	Ecosystem	Active and passive ultrasonic bat detection (Two recording devices utilised for the entire night (a minimum of four hours), starting at dusk for two nights. Harp trapping (Four trap nights over two consecutive nights with one trap placed outside the flyways for one night). Breeding habitat (species credit breeding/important habitat components): searches of suitable habitat for actively used breeding habitat e.g. culverts, rocky cliffs etc.	TBDC: n/a Other: summer months	4-5 Dec & 12-13 Dec 2018: <ul style="list-style-type: none"> <li>Anabat acoustic recordings - 20 recording nights at potential culverts / habitat over 4 nights</li> </ul> 7 April 2020: <ul style="list-style-type: none"> <li>Daytime inspections of culverts and bridges for potential roosting sites</li> </ul> 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> <li>Daytime inspections of culverts and bridges for potential roosting sites</li> </ul>
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V	-	Ecosystem		TBDC: n/a Other: summer months	
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V	-	Ecosystem		TBDC: n/a Other: summer months	
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	-	Dual species/ecosystem		TBDC: December to February	
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	Dual species/ecosystem		TBDC: November to January	
Little Bent-winged Bat	<i>Miniopterus australis</i>	V	-	Dual species/ecosystem		TBDC: December to January	
Southern Myotis	<i>Myotis macropus</i>	V	-	Species		TBDC: October to March	
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V	-	Ecosystem		TBDC: n/a Other: summer months	



Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Credit type	Minimum survey requirements	Optimal survey period	Survey effort
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	Dual species/ ecosystem	Spotlight surveys (2 observers on 1 km transect for 1 hour) Daytime survey for roosting sites. Habitat assessment; habitat assessed for roosting potential, presence of camps and the presence of important (winter-flowering) feed trees	TBDC: October to December	21-25 May 2018: <ul style="list-style-type: none"> <li>Spotlighting – 4 consecutive nights (16 person hours)</li> <li>5 days of opportunistic sightings (70 person hours) – searches for daytime roosts</li> </ul> 4-5 Dec & 12-13 Dec 2018: <ul style="list-style-type: none"> <li>20 person hours</li> <li>4 nights of opportunistic sightings</li> </ul> 6 & 7 April 2020: <ul style="list-style-type: none"> <li>30 person hours</li> </ul> 29 and 30 September 2020 and 1 October 2020: <ul style="list-style-type: none"> <li>21 hours</li> <li>3 days of opportunistic sightings</li> </ul>

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act

(2) Vulnerable (V), Endangered (E), Critically Endangered (CE), Migratory (M) as listed on the EPBC Act.

#### 6.1.4 Aquatic surveys

The aquatic habitats within the study area were assessed against the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). The *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Lincoln-Smith, 2003) was used to guide the level of aquatic assessment required.

The condition of the aquatic habitat was assessed using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman *et al.*, 1997) (see Appendix B). This assessment involved evaluation and scoring of the characteristics of the adjacent land, the condition of riverbanks, channel and bed of the watercourse and degree of disturbance evident at each site. The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13) indicates a heavily channelled stream without any riparian vegetation and can be considered to be in poor condition. The RCE score was divided into poor, moderate and good condition categories as follows:

- poor condition = 13-25
- moderate condition = 26-39
- good condition = 39-52.

Twelve aquatic habitat assessment sites were surveyed within the study area over the three days on 29<sup>th</sup> and 30<sup>th</sup> September and 1<sup>st</sup> October 2020 (see Figure 6.1).

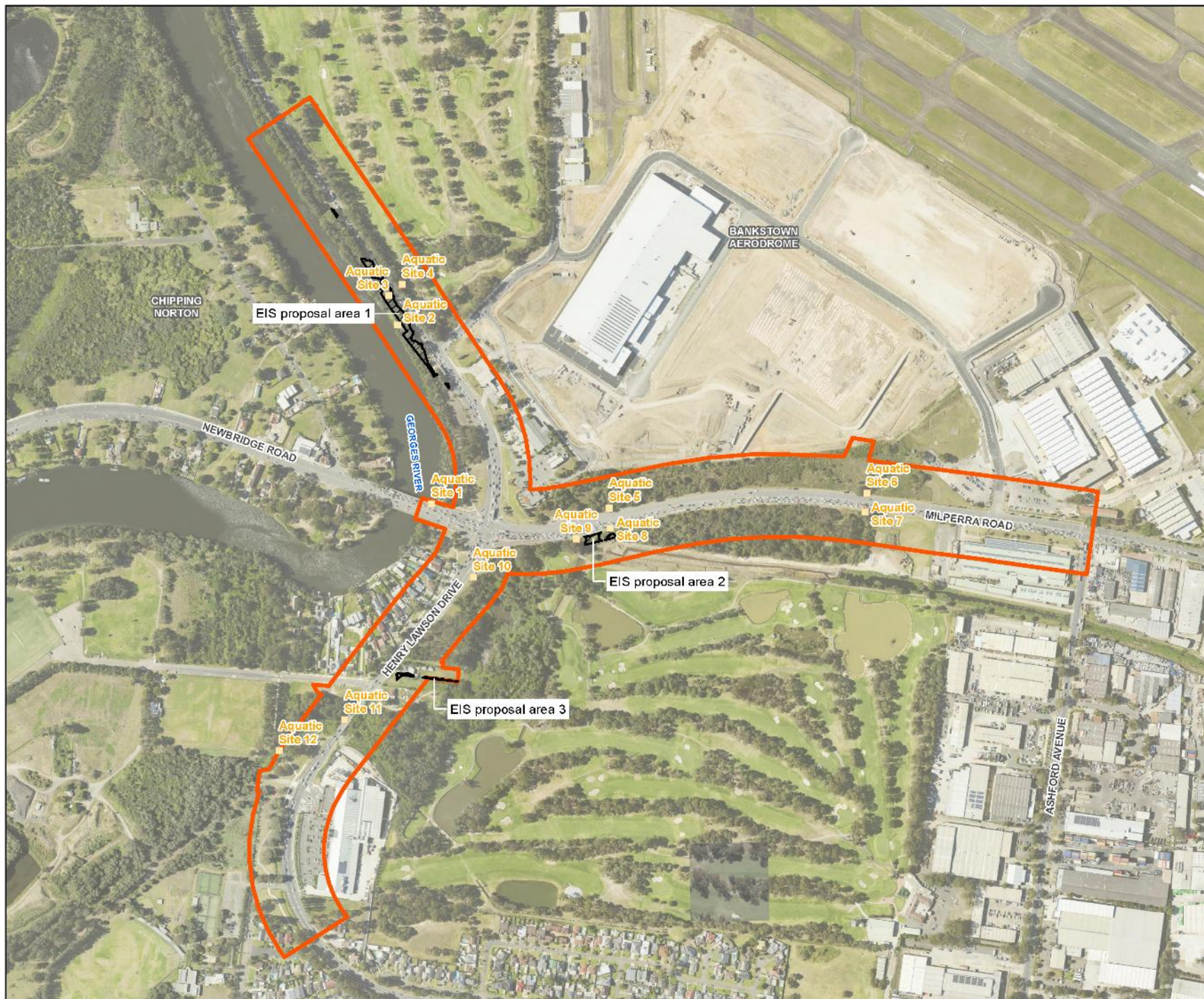
The occurrence of sensitive Key Fish Habitat (KFH) (including the presence of native aquatic macrophytes, large wood debris, large rocks and/or gravel beds) were noted. Surrounding land uses, condition of riparian vegetation, barriers to fish passage (natural or anthropogenic) and the species of macrophytes were noted at each site. The Class and Type of the watercourse at each site was classified according to the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013).



**Figure 6.1**  
Aquatic habitat assessment  
survey locations

### Legend

- Aquatic habitat
- Study area
- EIS proposal



Scale 1:6,000

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A3

1:6,000 Date: 16-Apr-21

Data sources: NGA 1:50,000 Topographic Series, Google Earth Pro, Esri, HERE, Garmin, OpenStreetMap contributors, and the GIS user community

This document is the property of WSP. It is to be used for the purpose of the project for which it was prepared. It is not to be distributed, copied, or reproduced in any form without the written consent of WSP. WSP accepts no liability for any errors or omissions in this document. The user of this document is responsible for its use and for any consequences arising from its use.



## 6.2 Identifying habitat suitability for ecosystem credit species

Ecosystem credit threatened species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the TBDC (Environment Energy and Science, 2021d) as required by section 5.2 of the BAM and Part 3 of the BAM 2020 Operational Manual – Stage 1 (Department of Planning Industry and Environment, 2020b).

An overview of the process for determining predicted ecosystem credit species is presented below:

1. All PCTs, associated vegetation zones and plot data from within the EIS proposal area loaded into the BAM-C.
2. A list of predicted ecosystem credit species is generated from the BAM-C (see Section 6.2.1).
3. Justification for inclusion of any additional predicted ecosystem credit species based on the outcome from other database searches, local data sources and habitat suitability assessments (see Section 6.2.2 and Appendix A).
4. Justification for exclusion of any predicted ecosystem credit species identified in the steps above (see Section 6.2.3 and Appendix A).
5. Finalise predicted ecosystem credit species associated with each vegetation zone within the EIS proposal area (Appendix F).

### 6.2.1 Predicted ecosystem credit species generated from BAM-C

A preliminary list of predicted ecosystem credit species was generated from the BAM-C based on associated vegetation types within the EIS proposal area. This predicted ecosystem credit species list is presented in Table 6.5.

**Table 6.5 List of BAM-C generated predicted ecosystem credit species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)
Australian Painted Snipe	<i>Rostratula australis</i>	E	No	PCT 781, PCT 1234 and PCT 1236
Australasian Bittern	<i>Botaurus poiciloptilus</i>	E	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Barking Owl	<i>Ninox connivens</i>	V	No	PCT 835, PCT 1234 and PCT 1236
Black Bittern	<i>Botaurus poiciloptilus</i>	E	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	No	PCT 835
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E	No	PCT 781 and PCT 1234
Black-tailed Godwit	<i>Limosa limosa</i>	V	No	PCT 781
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	V	No	PCT 781
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	No	PCT 835 and PCT 1234
Comb-crested Jacana	<i>Irediparra gallinacea</i>	V	No	PCT 781
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	Yes	PCT 781
Diamond Firetail	<i>Stagonopleura guttata</i>	V	No	PCT 835
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236



Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Eastern Osprey	<i>Pandion cristatus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Flame Robin	<i>Petroica phoenicea</i>	V	No	PCT 835 and PCT 1234
Freckled Duck	<i>Stictonetta naevosa</i>	V	No	PCT 781
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	No	PCT 835 and PCT 1234
Grey-headed Flying-fox	<i>Phascolarctos cinereus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	No	PCT 835
Koala	<i>Phascolarctos cinereus</i>	V	No	PCT 835, PCT 1234 and PCT 1236
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	Yes	PCT 781, PCT 835, PCT 1234 and PCT 1236
Little Bent-winged Bat	<i>Miniopterus australis</i>	V	Yes	PCT 781, PCT 835, PCT 1234 and PCT 1236
Little Eagle	<i>Hieraaetus morphnoides</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Masked Owl	<i>Tyto novaehollandiae</i>	V	No	PCT 835, PCT 1234 and PCT 1236
Painted Honeyeater	<i>Grantiella picta</i>	V	No	PCT 835
Powerful Owl	<i>Ninox strenua</i>	V	No	PCT 835 and PCT 1234
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	Yes	PCT 835, PCT 1234 and PCT 1236
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	V	No	PCT 1234 and PCT 1236
Scarlet Robin	<i>Petroica boodang</i>	V	No	PCT 835
Speckled Warbler	<i>Chthonicola sagittata</i>	V	No	PCT 835 and PCT 1234
Spotted Harrier	<i>Circus assimilis</i>	V	No	PCT 781, PCT 1234 and PCT 1236
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Square-tailed Kite	<i>Lophoictinia isura</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V	No	PCT 1234
Swift Parrot	<i>Lathamus discolor</i>	E	Yes	PCT 835, PCT 1234 and PCT 1236
Turquoise Parrot	<i>Neophema pulchella</i>	V	No	PCT 835, PCT 1234 and PCT 1236
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	No	PCT 835, PCT 1234 and PCT 1236
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)
White-fronted Chat	<i>Epthianura albifrons</i>	V, E2	No, Yes	PCT 781 and PCT 1234
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236

(1) Vulnerable (V), Endangered (E), Endangered Population (E2), Critically Endangered (CE) as listed on the BC Act.

### 6.2.2 Justification for inclusion of any additional predicted ecosystem credit species

In identifying an ecosystem credit species list for further assessment, no additional ecosystem credit species were included to the BAM-C for consideration.

### 6.2.3 Justification for exclusion of any predicted ecosystem credit species

In refining the candidate ecosystem species list for further assessment, no ecosystem credit species predicted by the BAM-C were excluded from the BAM-C candidate list.

## 6.3 Identifying habitat suitability for species credit species

Species credit species were assessed using information about site context, PCTs and vegetation integrity attributes collected during field surveys, and data from the TBDC (Environment Energy and Science, 2021d), as required by section 5.2 of the BAM and Part 3 of the BAM 2020 Operational Manual – Stage 1 (Department of Planning Industry and Environment, 2020b) in conjunction with a habitat assessment.

An overview of the process for determining candidate species credit species is presented below:

1. All PCTs, associated vegetation zones and plot data from within the EIS proposal area loaded into the BAM-C.
2. A list of preliminary candidate species credit species is generated from the BAM-C (see Section 6.3.1 and Section 6.3.2).
3. Justification for inclusion of any additional species credit species based on the outcome from other database searches, local data sources and habitat suitability assessments (see Section 6.3.1, Section 6.3.2 and Appendix A).
4. Justification for exclusion of any BAM-C predicted candidate species credit species identified above (see Section 6.3.1, Section 6.3.2 and Appendix A).
5. Undertake targeted surveys for candidate threatened species or prepare an expert report or assume presence (see Section 6.3.1, Section 6.3.2 and Section 6.1.3).
6. Assessment of candidate threatened species to determine the EIS proposal affected species list (see Section 6.3.1 and Section 6.3.2).
7. Define threatened species impact (individual count or species polygon area count) (see Chapter 9).
8. Calculate threatened species impact using BAM-C (see Chapter 11 and Appendix F).

### 6.3.1 Threatened flora species credit species

#### Candidate threatened flora species credit species generated by the BAM-C

A preliminary list of candidate threatened flora species credit species was generated from the BAM-C based on associated vegetation types recorded within the EIS proposal area. This preliminary candidate threatened flora species are presented in Table 6.6.

**Table 6.6 List of BAM-C candidate threatened flora species credit species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	No
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	No
<i>Eucalyptus benthami</i>	Camden White Gum	V	No
<i>Haloragis exalta</i> subsp. <i>exalta</i>	Square Raspwort	V	No
<i>Hibbertia</i> sp. <i>Bankstown</i>	-	CE	Yes
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	-	E2	No
<i>Maundia triglochinosides</i>	-	V	No
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	No
<i>Persicaria elatior</i>	Tall Knotweed	V	No
<i>Persoonia hirsuta</i>	Hairy Geebung	E	Yes
<i>Pilularia novae-hollandiae</i>	Austral Pilwort	E	Yes
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	No
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell	E2	No
<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia	V	No
<i>Zannichellia palustris</i>	-	E	No

(1) Vulnerable (V), Endangered (E), Endangered Population (E2), Critically Endangered (CE) as listed on the BC Act.

#### **Justification for inclusion of any additional threatened flora species credit species**

In identifying a candidate threatened flora species list for further assessment, no additional species were included to the BAM-C preliminary candidate list for consideration.

#### **Justification for exclusion of any predicted threatened flora species credit species**

In refining the candidate threatened flora species list for further assessment, no threatened flora species predicted by the BAM-C were excluded from the BAM-C candidate list.

#### **Assessment of candidate flora determined to be affected**

Fifteen candidate threatened flora species were considered to have potential associated habitat within the EIS proposal area and as such, were subject to targeted surveys as summarised below in Table 6.7.

Two candidate threatened flora species were recorded within the study area during targeted surveys completed for this investigation; being *Acacia pubescens* and *Callistemon linearifolius*, which are both listed as Vulnerable under the BC Act.

A discussion of *Acacia pubescens* and *Callistemon linearifolius* within the study area and the results of targeted survey completed for all candidate threatened flora species credit species is presented below.

**Table 6.7 Summary results of targeted seasonal surveys completed for candidate threatened flora species credit species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	PCT(s)	Species presence	Affected species?
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	No	PCT 835	No (surveyed)	No – although species was recorded within the study area no individuals nor any areas of the <i>Callistemon linearifolius</i> species polygon occur within the EIS proposal area. As such, species is not considered to be an affected species.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	No	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Eucalyptus benthamii</i>	Camden White Gum	V	No	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Haloragis exalta</i> subsp. <i>exalta</i>	Square Raspwort	V	No	PCT 1234 and PCT 1236	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Hibbertia puberula</i> subsp. <i>glabrescens</i> (syn. Sp. <i>Bankstown</i> )	-	CE	Yes	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2	No	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Maundia triglochinos</i>	-	V	No	PCT 1234	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	No	PCT 1234	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.



Scientific name	Common name	BC Act <sup>1</sup>	SAIL	PCT(s)	Species presence	Affected species?
<i>Persicaria elatior</i>	Tall Knotweed	V	No	PCT 781 and PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	Yes	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Pilularia novae-hollandiae</i>	Austral Pilwort	E	Yes	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	No	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	E2	No	PCT 835	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V	No	PCT 1234	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<i>Zannichellia palustris</i>	-	E	No	PCT 781	No (surveyed)	No – no individuals recorded within the EIS proposal area during targeted surveys completed. As such, this species has not been considered further as an affected species.
<b>Other threatened species credit species recorded in the study area</b>						
<i>Acacia pubescens</i>	Downy Wattle	V	No	PCT 725 – not recorded in the EIS proposal area	No (surveyed)	No – targeted surveys did not identify <i>Acacia pubescens</i> individuals within the EIS study area. The species was however recorded within the study area within PCT 725. As no individuals nor the species polygon for the population recorded will be impacted upon by the EIS proposal, this species has not been considered further as an affected species.

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

### ***Acacia pubescens* (Downy Wattle)**

Twelve individuals of *Acacia pubescens* (Downy Wattle) were recorded within Ashford Reserve along Milperra Road (Photo 6.1). *Acacia pubescens* (Downy Wattle) is listed as vulnerable under both the BC Act and the EPBC Act. During the initial survey period individuals were not identified due to leaf senescence caused by a period of extreme prolonged drought. Current individuals all show signs of recovery post drought in the form of epicormic growth.

This sub-population is known from two locations in the eastern and western portion of the reserve. A dead wattle specimen was observed during the initial survey period in the eastern section of Ashford Reserve that was considered most likely to have been *Acacia pubescens*. This eastern record is dated from 2010 (SICGI0016944) and is accompanied by sighting notes that state it could be a planted specimen (Appendix B).

A species polygon was applied to the *Acacia pubescens* records within the study area. No individuals and no area of the species polygon for *Acacia pubescens* occurs within the EIS proposal area. As such, this species was not considered an affected species for the EIS proposal.



**Photo 6.1      *Acacia pubescens***

### ***Callistemon linearifolius* (Netted Bottle Brush)**

A small number of specimens (about 18 individuals) were recorded from Ashford Reserve in the study area (Photo 6.2). Given considerable variation was observed in leaf length, width, venation and that no specimens were in flower, plant material was collected and was forwarded to the Royal Botanical Gardens (RBG) herbarium for positive identification. Two samples of *Callistemon* were forwarded to the RBG under enquiry number 20657 and the broad leaf sample was positively identified as *Callistemon linearifolius* - det. Peter G. Wilson, 2nd July 2018 – retained (Appendix B). The second sample, a narrow leaf form was identified as *Callistemon linearis* - det. Peter G. Wilson, 2nd July 2018 – retained (Appendix B).

There are four previous records from Ashford Reserve that are all dated from 2010 (SICGI0016969, SICGI0016970, SICGI0016972, SICGI0016973). The species sighting notes do not provide any details on whether voucher specimens were lodged for these records.

A species polygon was applied to the *Callistemon linearifolius* records within the study area. No individuals and no area of the species polygon for *Callistemon linearifolius* occurs within the EIS proposal area. As such, this species was not considered an affected species for the EIS proposal.



**Photo 6.2** *Callistemon linearifolius* within Ashford Reserve

### 6.3.2 Threatened fauna species credit species

#### Candidate threatened fauna species credit species generated by the BAM-C

A preliminary list of candidate threatened fauna species credit species was generated from the BAM-C based on associated vegetation types recorded within the EIS proposal area. This preliminary candidate threatened fauna species are presented in Table 6.8.

**Table 6.8** List of BAM-C candidate threatened fauna species credit species

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	No	PCT 835
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	Yes	PCT 781
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	No	PCT 835 and PCT 1234
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	No	PCT 835
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Hieraaetus morphnoides</i>	Little Eagle	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	No	PCT 781
<i>Limosa limosa</i>	Black-tailed Godwit	V	No	PCT 781
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	No	PCT 781
<i>Lophoictinia isura</i>	Square-tailed Kite	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	No	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	Yes	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	Yes	PCT 781. PCT 835, PCT 1234 and PCT 1236
<i>Myotis macropus</i>	Southern Myotis	V	No	PCT 835, PCT 1234 and PCT 1236
<i>Ninox connivens</i>	Barking Owl	V	No	PCT 835, PCT 1234 and PCT 1236
<i>Ninox strenua</i>	Powerful Owl	V	No	PCT 835 and PCT 1234

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)
<i>Pandion cristatus</i>	Eastern Osprey	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	No	PCT 835
<i>Phascolarctos cinereus</i>	Koala	V	No	PCT 835, PCT 1234 and PCT 1236
<i>Tyto novaehollandiae</i>	Masked Owl	V	No	PCT 835, PCT 1234 and PCT 1236

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

### Justification for inclusion of any additional threatened fauna species credit species

In identifying a candidate threatened flora species list for further assessment, no additional species were included to the BAM-C preliminary candidate list for consideration.

### Justification for exclusion of any additional threatened fauna species credit species

In refining the candidate threatened fauna species list for further assessment, four threatened fauna species predicted by the BAM-C was excluded from the BAM-C candidate list. A summary of the justification for these exclusions is provided in Table 6.9.

**Table 6.9 Justification for exclusion of any predicted threatened fauna species credit species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Justification for exclusion
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	No	No breeding camps
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	Yes	No breeding habitat
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	Yes	No breeding habitat
<i>Lathamus discolor</i>	Swift Parrot	CE	Yes	No breeding habitat

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

### Assessment of candidate fauna determined to be affected

Twenty candidate threatened fauna species were considered to have potential associated habitat within the EIS proposal area and as such, were subject to targeted survey. One candidate threatened fauna species as recorded within the study area during targeted surveys completed for this investigation; being Southern Myotis, which is listed as Vulnerable under the BC Act.

A discussion of Southern Myotis within the study area and the results of targeted survey completed for all candidate threatened fauna species credit species is presented in Table 6.10.



**Table 6.10 Summary results of targeted seasonal surveys completed for candidate threatened fauna species credit species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	PCT(s)	Species presence	Affected species?
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	No	PCT 781	No – surveyed – micro habitat only	No – not recorded Species considered extinct in the Sydney region, therefore is not considered to be an affected species.
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	Yes	PCT 781	No - surveyed	No – not recorded
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	No	PCT 835 and PCT 1234	No - surveyed	No – not recorded
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	No	PCT 835	No - surveyed	No – not recorded
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Hieraaetus morphnoides</i>	Little Eagle	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	No	PCT 781	No - surveyed	No – not recorded
<i>Limosa limosa</i>	Black-tailed Godwit	V	No	PCT 781	No - surveyed	No – not recorded
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	No	PCT 781	No - surveyed	No – not recorded
<i>Lophoictinia isura</i>	Square-tailed Kite	V	No	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	No	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	Yes	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	Yes	PCT 781. PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	PCT(s)	Species presence	Affected species?
<i>Myotis macropus</i>	Southern Myotis	V	No	PCT 835, PCT 1234 and PCT 1236	Yes - surveyed	Yes – species recorded roosting in artificial structure within the study area. Suitable habitat for the species as listed in the TBDC has been included in the species polygon for this species in accordance with BAM. As areas of the species polygon occur within the EIS prososal area this species is considered as an affected species.
<i>Ninox connivens</i>	Barking Owl	V	No	PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Ninox strenua</i>	Powerful Owl	V	No	PCT 835 and PCT 1234	No - surveyed	No – not recorded
<i>Pandion cristatus</i>	Eastern Osprey	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	No	PCT 835	No - surveyed	No – not recorded
<i>Phascolarctos cinereus</i>	Koala	V	No	PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded
<i>Tyto novaehollandiae</i>	Masked Owl	V	No	PCT 835, PCT 1234 and PCT 1236	No - surveyed	No – not recorded

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.



**Figure 6.2**  
Threatened species and  
hollow-bearing trees



### Legend

Study area

EIS proposal area

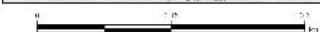
### Threatened

● Microbat roosting culvert (Southern Myotis)

● *Acacia pubescens*

● *Callistemon linearifolius*

● Hollow-bearing tree



Coordinate system: GDA 1994 MGA Zone 56

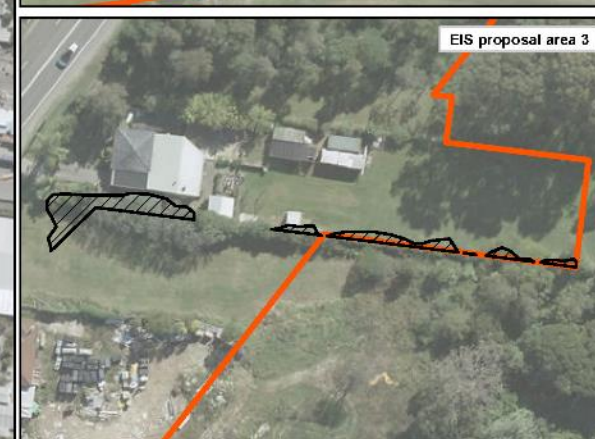
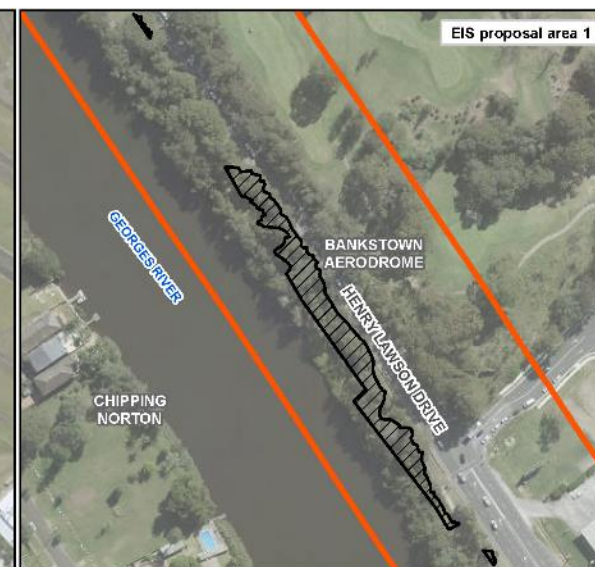
Scale ratio correct when printed at A3

1:6,000 Date: 07-May-21

Data sources: NGA Map ITSS, Geospatial data, Esri, HERE, Garmin, OpenStreetMap contributors, and the GIS user community

This document is the property of WSP. It is to be used only for the purpose for which it was prepared. It is not to be used for any other purpose without the written consent of WSP. WSP does not accept any liability for any loss or damage, whether direct or indirect, arising from the use of this document. The user of this document is advised to consult with a qualified professional before using the information contained herein. WSP is not responsible for any errors or omissions in this document. WSP is not responsible for any loss or damage, whether direct or indirect, arising from the use of this document. WSP is not responsible for any loss or damage, whether direct or indirect, arising from the use of this document.











Twenty (20) candidate threatened fauna species (species credit species) have been identified by the BAM calculator as potentially occurring within the study area due to habitat requirements. Targeted surveys were carried out for each species, with Southern Myotis being recorded.

#### Southern Myotis (*Myotis Macropus*)

The Southern Myotis is found along coastal areas of Australia, from Northern Territory to Victoria. Foraging habitat occurs over streams and pools catching insects and small fish by raking their feet across the water surface. Colonies usually never occur far from waterbodies (Van Dyck and Strahan, 2008). It generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.

Within the study area there is potential for the species to utilise culverts and bridges that have waterbodies within proximity. They also may utilise hollow-bearing trees that are close to waterbodies within the area (i.e. areas near Georges River). Targeted surveys at identified artificial structures or potential hollow-bearing trees were undertaken during December 2018, September and October 2020. An individual was identified utilising one culvert along the Georges River (Figure 6.4). It is also likely that the species may be utilising native vegetation and waterbodies surrounding these potential artificial roosting sites within the study area.

## 6.4 Aquatic habitat

The Georges River is a drowned river valley with a catchment that drains over 790 km<sup>2</sup> south west of Sydney and contributes the majority of flow into Botany Bay. The catchment includes reasonably intact areas of bushland and areas of substantial urbanisation and development. The river is approximately 221 km long with an average water depth of 10.5 m. The Liverpool Weir, built in 1830s, marks the tidal limit approximately 49 km from the river mouth.

The study area lies entirely in the Lower Georges River where approximately two thirds of the 439 km<sup>2</sup> catchment has been largely cleared and developed. The southern tributaries flow through forested sub catchments in Dharawal Nature Reserve and Holsworthy Military Reserve and include Harris Creek, Williams Creek and Deadman's Creek. These creeks are in good condition; whilst the northwestern (left bank) tributaries are somewhat degraded as they drain extensively cleared and highly modified catchments. These waterways include Hinchinbrook Creek, Cabramatta Creek, Clear Paddock Creek, Orphan School Creek and Prospect Creek.

All river and creek reaches within the study area are tidal and hence are considered estuarine. Other waterbodies and wetlands in the study area include a series of small wetlands along the northern and western perimeter of Bankstown Golf Club, bounded by Henry Lawson Drive to the west and Milperra Rd to the north, and an unnamed ephemeral creek draining the golf course, flowing westward under Henry Lawson Drive to the border of Gordon Parker Reserve, Milperra.

Two small patches of habitat matching the vegetation category Coastal Freshwater Lagoon of the Sydney Basin and South East Corner (PCT 781, VZ2) occurred within the study area. Vegetation typically present included Marsh Clubrush (*Bolboschoenus fluviatilis*), *Eleocharis sphacelata*, Cumbungi (*Typha orientalis*), Slender knotweed (*Persicaria decipiens*) and exotic grass species including Kikuyu (*Cenchrus clandestinus*).

### 6.4.1 Habitat condition

The condition of the aquatic habitat was assessed based on the results of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman *et al.*, 1997) (see Appendix D). This assessment involved evaluation and scoring of the characteristics of the adjacent land, the condition of riverbanks, channel and bed of the watercourse and degree of disturbance evident at each site. The maximum score (52) indicates a stream with little or no obvious physical disruption and the lowest score (13) indicates a heavily channelled stream without any riparian vegetation and can be considered to be in poor condition.

A summary of the RCE results is provided in Table 6.11. The waterways at all surveyed habitat assessment sites were in moderate condition (RCE scores varying from 29 to 38) with the scores largely driven by relatively wide riparian zones composed of native and exotic trees and shrubs, fully stabilised banks, medium to deep channel form (apart from artificial waterways), and little channel sediment accumulation. Photos of the waterways at each survey site are provided in Photo 6.3 to Photo 6.26.

**Table 6.11 Summary of RCE results**

Aquatic survey site	Overall RCE score (out of 52)	Aquatic habitat condition
Aquatic Site 1	37	Moderate
Aquatic Site 2	34	Moderate
Aquatic Site 3	32	Moderate
Aquatic Site 4	34	Moderate
Aquatic Site 5	37	Moderate
Aquatic Site 6	33	Moderate
Aquatic Site 7	33	Moderate
Aquatic Site 8	33	Moderate
Aquatic Site 9	29	Moderate
Aquatic Site 10	30	Moderate
Aquatic Site 11	38	Moderate
Aquatic Site 12	35	Moderate



**Photo 6.3 Aquatic Site 1 - Georges River looking north from the Newbridge Road bridge showing riparian zone**



**Photo 6.4 Aquatic Site 1 - Georges River looking west from the cycle path adjacent to the Newbridge Road Bridge**





**Photo 6.5** Aquatic Site 1 - Georges River looking north west from the Newbridge Road bridge



**Photo 6.6** Aquatic Site 2 - Georges River looking south west from the cycle path back to the Newbridge Road bridge showing riparian zone



**Photo 6.7** Aquatic Site 3 - The unnamed stream that exits Georges River Golf Course showing the culvert and riparian zone on the western side of Henry Lawson Drive



**Photo 6.8** Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive



**Photo 6.9** Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing culvert



**Photo 6.10** Aquatic Site 4 - The unnamed first order stream that exits Georges River Golf Course on the Eastern side of Henry Lawson Drive showing water clarity





**Photo 6.11** Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing riparian zone



**Photo 6.12** Aquatic Site 11 - The unnamed second order stream at the Auld Avenue bridge showing water clarity



**Photo 6.13** Aquatic Site 12 - The unnamed stream upstream of the Auld Avenue bridge showing riparian zone



**Photo 6.14** Aquatic Site 5 - The unnamed stream and culvert on the northern side of Milperra Road



**Photo 6.15** Aquatic Site 5 - Inside the culvert under Milperra Road showing the unnamed first order stream which drains south to the Milperra Drain



**Photo 6.16** Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road which drains south to the Milperra Drain showing water clarity





**Photo 6.17** Aquatic Site 5 - The unnamed first order stream on the northern side of Milperra Road showing riparian zone



**Photo 6.18** Aquatic Site 8 - The unnamed first order stream on the southern side of Milperra Road showing riparian zone



**Photo 6.19** Aquatic Site 8 - The unnamed stream on the southern side of Milperra Road showing mapped Coastal Wetland



**Photo 6.20** Aquatic Site 6 - The unnamed stream in the east of the study area on the northern side of Milperra Road showing the culvert



**Photo 6.21** Aquatic Site 6 - The unnamed first order stream in the east of the study area on the northern side of Milperra Road



**Photo 6.22** Aquatic Site 6 - The unnamed first order stream in the east of the study area showing inside the culvert





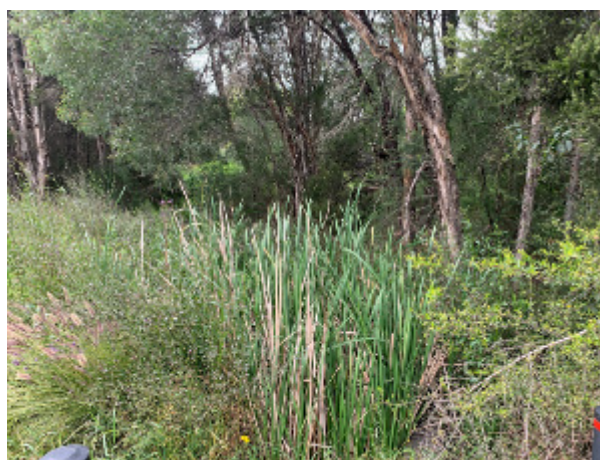
**Photo 6.23** Aquatic Site 7 - The unnamed first order stream in the east of the study area on the southern side of Milperra Road



**Photo 6.24** Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the riparian zone



**Photo 6.25** Aquatic Site 9 - A stormwater drain on the southern side of Milperra Road showing the pipe exit



**Photo 6.26** Aquatic Site 10 - A stormwater drain on the eastern side of Henry Lawson Drive showing macrophytes

### 6.4.2 Key Fish Habitat

The Georges River has a waterway classification of Class 1: Major key fish habitat with habitat sensitivity Type 2: Moderately sensitive key fish habitat as defined in the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013). This is due to the Georges River being a permanently flowing estuarine waterway. Key Fish Habitats are mapped in Figure 4.3.

### 6.4.3 Riparian areas

In the study area the banks of the Georges River are lined by seedlings, shrubs and trees of River mangroves (*Aegiceras corniculatum*) and Grey mangroves (*Avicennia marina*) (PCT 920). This observation confirmed the broad-scale map of mangrove distribution in the waterways.

Fringing mangroves were mixed with and backed by Swamp oaks (*Casuarina glauca*) (PCT 1234), Forest Red Gum-Rough-barked Apple Grassy Woodland community (PCT 835, Forest Red gum and Blue Box variants) and a variety of weeds and exotic plants and shrubs. This vegetation mosaic dominated both banks of the Georges River, with discontinuities where residences or commercial or recreational developments backed onto the river front. For most its length, the riparian zone along the eastern bank of the Georges River includes a shared pathway. Its average width is 33 m with a range of 19 m to 47 m wide. The banks near the

boat ramp at Rabaul Rd and behind some residences and developments have been reinforced with rock.

#### **6.4.4 Threatened fish species**

Based on the review of the Fisheries Spatial Data Portal (freshwater threatened species maps), the freshwater fish community of the Georges River is rated as Good (based on data derived from fish sampling records 2009 – 2011). Habitat for threatened freshwater fish is not mapped in the Georges River. Threatened fish species returned from the PMST search including Macquarie Perch and Black Rockcod are not known to occur in the study area.

#### **6.4.5 Coastal Management SEPP**

The Coastal Management SEPP was introduced to provide an integrated policy for coastal assets. Under the Coastal Management SEPP, areas of 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' have been mapped across the state.

The study area occurs within and immediately adjacent to areas mapped as 'Coastal Wetlands' and 'Proximity Coastal Wetlands (100 metre buffer)' as determined by the Coastal Management SEPP. An overview of the extent of these wetlands and the EIS proposal area is provided in Figure 4.3.

Impacts associated with the EIS proposal on Coastal Wetlands mapped by the Coastal Management SEPP are discussed in Section 9.6.1.

### **6.5 Prescribed impacts**

Potential prescribed biodiversity impacts on threatened entities in accordance with Chapter 6 of the BAM have been identified in Table 6.12 in accordance with Part 4 of the BAM 2020 Operational Manual – Stage 1 (Department of Planning Industry and Environment, 2020b).



**Table 6.12 Prescribed impacts identified within the study area**

Feature	Present (yes/no)	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BDAR where prescribed impacts are addressed
Karst, caves, crevices, cliffs, rocks or other geological features of significance	No	No karst, caves, crevices, cliffs or other features of geological significance in or adjoining the study area	n/a	n/a	Section 9.3.1 and Figure 4.4
Human-made structures	Yes	Human-made structures such as culverts beneath surface roads and bridges, offer potential roosting habitat to locally occurring threatened microbat species	Direct and indirect impacts such as alteration/removal or replacement of existing bridges and culverts that may offer roosting habitat for microbat species and removal of native vegetation surrounding these areas	Southern Myotis	Section 9.3.2
Non-native vegetation	Yes	Non-native vegetation includes the miscellaneous ecosystems described in Section 5.2	Direct and indirect impacts including Loss of potential foraging habitat offered by non-native vegetation	Trees and shrubs associated with non-native vegetation offers foraging, nesting and sheltering habitat to locally occurring including threatened birds, threatened microbats and Grey-headed Flying-fox	Section 9.3.3 and Figure 5.3
Habitat connectivity	Partial	Habitat within and adjoining the study area is currently fragmented by linear infrastructure and residential and commercial development	Increase existing fragmentation as Henry Lawson Drive would be widened which may partially affect the movement patterns of a number of terrestrial fauna species	River-flat Eucalypt Forest TEC, Swamp Oak Floodplain Forest TEC and Freshwater Wetlands TEC	Section 9.3.4 and Figure 4.2

Feature	Present (yes/no)	Description of feature characteristics and location	Potential impact	Threatened species or community using or dependent on feature	Section of the BDAR where prescribed impacts are addressed
Waterbodies, water quality and hydrological processes	Partial	Georges River, Prospect Creek and unnamed tributaries Coastal Wetlands protected under the Coastal Management SEPP	Unmanaged construction activities in proximity to watercourses or waterbodies could lead to indirect impacts such as increasing levels of turbidity and sediment deposition, decrease dissolved oxygen and change pH levels in receiving environments.  Direct impact: removal of 0.28 ha of Coastal Wetland and associated habitat	Southern Myotis Coastal Management SEPP listed Coastal Wetlands River-flat Eucalypt Forest TEC, Swamp Oak Floodplain Forest TEC and Freshwater Wetlands TEC	Section 9.3.5 and Figure 4.3
Wind farm development	No	n/a	No wind farm proposed on site	n/a	Section 9.3.6
Vehicle strikes	Yes	Duplication of Henry Lawson Drive within study area	Increased width of road may further restrict wildlife movements for non-mobile species. Terrestrial fauna species that attempt to cross these widened roads, may be more susceptible to vehicle strike, as they move between areas of habitat on either side of the road to obtain food, shelter, and breeding resources, and to disperse from natal areas or undertake seasonal migrations.	Mainly species that feed on road kill i.e. threatened raptors and owls such as the Powerful Owl	Section 9.3.7

## 7 Matters of National Environmental Significance

---

Matters of National Environmental Significance (MNES), listed under the EPBC Act, are addressed in this section. The following biodiversity MNES protected under the EPBC Act were considered for their relevance to the EIS proposal:

- wetlands of international importance (Ramsar) (EPBC Act sections 16 and 17B)
- listed threatened species and communities (EPBC Act sections 18 and 18A)
- listed migratory species (EPBC Act sections 20 and 20A).

### 7.1 Wetlands of International Importance

One wetland of international importance (Ramsar) occurs within 10km of the study area which is the Towra Point Nature Reserve. Towra Point Nature Reserve lies on the northern side of Kurnell Peninsula, forming the southern and eastern shores of Botany Bay. As such, given the distance of the EIS proposal from Towra Point Nature Reserve there will not be any direct impact from the EIS proposal and indirect downstream impacts are also predicted to be negligible (see impacts to aquatic habitat discussed in Section 9.6.1). The EIS proposal is unlikely to impact any wetlands of international importance.

#### 7.1.1 Voyager Point Nationally Important Wetland

Listed on the Register of the National Estate, Voyager Point wetland is located downstream of the study area at the confluence of the Williams River with the Georges River. The wetland includes freshwater wetlands and estuarine sedgeland and herbland near the mouth of Williams Creek. Vegetation present is dominated by Sea Rush (*Juncus kraussii*), Bare Twig-rush (*Baumea juncea*), and Common Reed (*Phragmites australis*), and several saltmarsh species are present including Creeping Brookwood (*Samolus repens*), Samphire (*Sarcocornia quinqueflora*, *Sporobolus virginicus*) and Wilsonia (*Wilsonia backhousei*).

The freshwater wetlands support a reedland dominated by Tall Spike-rush (*Eleocharis sphacelata*), Water Ribbons (*Triglochin procera*) and Cumbungi (*Typha orientalis*). Open water areas support Water-milfoil (*Myriophyllum* sp.), Marshwort (*Nymphoides geminate*) and Knotweed (*Persicaria* sp.). The Voyager Point wetlands support vegetation communities not well protected in the region, and provide habitat for threatened and migratory species listed under the EPBC Act.

### 7.2 Threatened communities listed under the EPBC Act

Results of the protected matters database search identified 11 TECs listed under the EPBC Act as being likely to occur within the locality as follows:

- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion
- Subtropical and Temperate Coastal Saltmarsh
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
- Western Sydney Dry Rainforest and Moist Woodland on Shale.



Of these 11 TECs, the study area contains vegetation corresponding to three EPBC Act listed TECs (see Table 7.1):

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

An examination of the vegetation within the study area compared to the key diagnostic characteristics and condition thresholds for the three TECs identified above is presented in the following Sections.

**Table 7.1 A summary of TECs listed under the EPBC Act recorded within the study area**

Threatened ecological community	EPBC Act status <sup>1</sup>	Associated PCT and vegetation zone within the study area	Extent in the study area (ha)	Extent in EIS proposal area (ha)
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community	E	VZ12 – PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition	1.12	0.20
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	CE	VZ1 – PCT 725: Broad-leaved Ironbark - <i>Melaleuca decora</i> shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion – Moderate condition	2.33	0
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CE	VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)	2.30	0.02
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CE	VZ4 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	0.64	0
<b>Total</b>			<b>6.41</b>	<b>0.22</b>

(1) Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

### 7.2.1 Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community

Within the study area the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community corresponds directly to the following PCTs:

- PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion.
- PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

The location of the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community is illustrated in Figure 5.5.

To be considered part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community the vegetation within the study area must meet the description of the TEC provided in the *Conservation advice (incorporating*

listing advice) for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community (Department of the Environment and Energy, 2018) and the vegetation must meet both the key diagnostic characteristics and at least the minimum condition thresholds for Category C. Provided that the patch meets the key diagnostic characteristics and condition thresholds, revegetated or replanted sites or areas of regrowth are not excluded from the listed ecological community (Department of the Environment and Energy, 2018).

### Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community as outlined by the Department of the Environment and Energy (2018), against the candidate PCTs from within the study area is presented in Table 7.2.

From the examination of key diagnostic characteristics, PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion, a PCT that may have potentially corresponded to this TEC has been excluded. The remaining PCTs: PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion, and PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley, meet the key diagnostic characteristics for this TEC.

**Table 7.2 Comparison of Coastal Swamp Oak (*Casuarina glauca*) Forest in the NSW and South East Queensland ecological community key diagnostics against candidate PCTs**

Key diagnostic characteristics	PCT 1234	PCT 1236	PCT 1800
Occurs from south-east Queensland to southern NSW within the South-Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	Yes Sydney Basin	Yes Sydney Basin	Yes Sydney Basin
Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.	Yes Associated with alluvial flats and drainage lines (<50m) associated with the Georges River floodplain	Yes Located on alluvial flats and drainage lines (< 50m) on the Georges River floodplain	Yes Located on alluvial flats (< 50m) of the Georges River
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain	Yes Alluvium; silts, clay-loams and sandy loams associated with the Georges River floodplain
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 per cent.	Yes Occurs as an open forest structure	No Occurs as a low shrubland	Yes Occurs as an open forest structure
Has a canopy of trees dominated by <i>Casuarina glauca</i> (swamp-oak, swamp she-oak).	Yes Tree canopy dominated by <i>Casuarina glauca</i>	No Dominated by <i>Melaleuca ericifolia</i>	Yes Tree canopy dominated by <i>Casuarina glauca</i>
<b>Comparison</b>	<b>Meets key diagnostic characteristics</b>	<b>Does not meet key diagnostic characteristics</b>	<b>Meets key diagnostic characteristics</b>

## Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community as taken from the *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community* (Department of the Environment and Energy, 2018) are presented in Table 7.3.

A patch of the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community is defined a discrete and mostly continuous area of the ecological community, as defined by the key diagnostics, but can include small-scale variations, gaps and disturbances (Department of the Environment and Energy, 2018). The edge of the patch extends to the outer edge of swamp oak tree canopy. Where the canopy is sparse or interrupted, the edge of the patch is defined by the shortest distance between the outer edges of the canopies of each of the outermost trees (Department of the Environment and Energy, 2018). When it comes to defining a patch of the ecological community allowances are made for “breaks” up to 30 metres wide between areas that meet the key diagnostic characteristics (Department of the Environment and Energy, 2018). These breaks may be the result of watercourses or drainage lines, tracks, paths, roads, gaps made by exposed areas of soil, and areas of localised variation in vegetation that do not meet the key diagnostics (Department of the Environment and Energy, 2018). Based on this definition of a patch, there would be six separate patches of *Casuarina glauca* dominated vegetation that meet the key diagnostic characteristics of the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community (this excludes areas of PCT 1236).

There is one patch of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion located along the edge of the Georges River and Henry Lawson Drive that meets the minimum patch size threshold to be considered part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community (see Figure 5.5). This patch is about 2.11 ha in size. The remaining identified patches of *Casuarina glauca* dominated vegetation that meet the key diagnostic characteristics of the Coastal Swamp Oak (*Casuarina glauca*) Forest of NSW and South East Queensland ecological community are too small to meet the minimum 0.5 ha condition threshold.

Plot data collected from this larger patch and random meander survey indicated that the patch quality is variable but would meet moderate quality – Category C as outlined in Table 7.3. This is based on the patch exhibiting some native understorey, non-native species comprise <80% cover and transformer weeds are <50% of the total understorey cover.

**Table 7.3 Coastal Swamp Oak (*Casuarina glauca*) Forest of the NSW and South East Queensland ecological community minimum condition thresholds (Department of the Environment and Energy, 2018)**

Condition thresholds  Patch size classes→  ↓ Vegetation quality classes	Large patch The patch is at least 5 ha	Medium patch The patch is at least 2 ha and less than 5 ha	Small contiguous** patch The patch is at least 0.5 ha and less than 2 ha, and is connected to a larger area of native vegetation of at least 5 ha	Small patch The patch is at least 0.5 ha and less than 2 ha
<b>HIGH QUALITY</b> <b>Predominantly native understorey</b> Non-native species comprise <b>less than 20%</b> of total understorey vegetation cover*	<b>CATEGORY A</b> A <u>large patch</u> that meets <b>key diagnostics</b> and has a <u>predominantly</u> native understorey	<b>CATEGORY B</b> A <u>medium patch</u> that meets <b>key diagnostics</b> and has a <u>predominantly</u> native understorey OR A <u>small patch</u> that meets <b>key diagnostics</b> and has a <u>predominantly</u> native understorey and is <u>contiguous**</u> with another <u>large area</u> of native vegetation	<b>CATEGORY C</b> A <u>small patch</u> that meets <b>key diagnostics</b> and has a <u>predominantly</u> native understorey	
<b>GOOD QUALITY</b> <b>Mostly native understorey</b> Non-native species comprise <b>less than 50%</b> of total understorey vegetation cover* AND transformer species*** comprise <b>less than 30%</b> of total understorey vegetation cover*	<b>CATEGORY B</b> A <u>large patch</u> that meets <b>key diagnostics</b> and has a <u>mostly</u> native understorey	<b>CATEGORY C</b> A <u>medium patch</u> that meets <b>key diagnostics</b> and has a <u>mostly</u> native understorey OR A <u>small patch</u> that meets <b>key diagnostics</b> and has a <u>mostly</u> native understorey and is <u>contiguous**</u> with another <u>large area</u> of native vegetation		
<b>MODERATE QUALITY</b> <b>Some native understorey</b> Non-native species comprise <b>less than 80%</b> of total understorey vegetation cover* AND transformer species*** comprise <b>less than 50%</b> of total understorey vegetation cover*	<b>CATEGORY C</b> A <u>large or medium patch</u> that meets <b>key diagnostics</b> and has <u>some</u> native understorey			
<p>*Refers to total perennial understorey vegetation cover for the patch of the ecological community. Includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil. Areas of little to no understorey vegetation cover (e.g. plant litter) are included if key diagnostics are met and non-native species are below thresholds.</p> <p>**Contiguous means the patch is connected or in close proximity (within 30 m) to another area of native vegetation.</p> <p>***Transformer species (e.g. <i>Chrysanthemoides monilifera</i>, <i>Asparagus</i> spp, <i>Pennisetum</i> spp, <i>Ipomoea</i> spp. etc.) are non-native plant species with the potential to permanently change the character, condition, form or nature of patches of the ecological community. See p. 43 for further information on weeds, including transformer species. Annual weeds, such as <i>Symphyotrichum subulatum</i> (saltmarsh aster), may be seasonally very abundant and temporarily restrict the development of native species, but would not be counted as transformer weeds in determining condition.</p>				

## 7.2.2 Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion

Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC occurs in the study area and is associated with PCT 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (see Figure 5.5). This vegetation type was recorded in two condition classes being moderate (VZ1) and poor (VZ1a).

To be considered part of the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC the vegetation within the study area must meet the description of



the TEC provided in the *Approved Conservation Advice (including listing advice) for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion* (Department of the Environment, 2015). The vegetation must also meet the key diagnostic characteristics and condition thresholds.

### Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC as outlined by the Department of the Environment (2015), against the candidate PCTs from within the study area is presented in Table 7.4.

From the examination of key diagnostic characteristics, PCT 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion within the study area meets the key diagnostic characteristics for this TEC.

**Table 7.4 Comparison of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC key diagnostic characteristics against PCT 725 within the study area**

Key diagnostic characteristics	PCT 725
Confined to the Sydney Basin Bioregion	Yes Located in the Sydney Basin
Primarily occurs in w 100 m above sea level	Yes Occurs below 100 m above sea level
Occurs in the Cumberland Subregion with clay soils derived from predominantly Tertiary alluvium and on Wianamatta Shale derived soils found next to Tertiary alluvium (in eastern areas of the ecological community's distribution, a sandstone influence is evident)	Yes Occurs in the Cumberland Subregion with clay soils derived from predominantly Tertiary alluvium and on Wianamatta Shale derived soils found next to Tertiary alluvium
Is a dry sclerophyll open-forest to low woodland typically dominated by an overstorey of <i>Eucalyptus fibrosa</i> and <i>Melaleuca decora</i> , with <i>Eucalyptus longifolia</i> also often present	Yes It is a dry sclerophyll open-forest to low woodland dominated by an overstorey of <i>Eucalyptus fibrosa</i> and <i>Melaleuca decora</i> , with <i>Eucalyptus longifolia</i> also present
Usually includes a moderate to dense mid/shrub stratum, commonly including <i>Melaleuca nodosa</i> and <i>Lissanthe strigosa</i> , and to a lesser extent <i>Melaleuca decora</i>	Yes includes a moderate to dense mid/shrub stratum, commonly including <i>Melaleuca nodosa</i> and to a lesser extent <i>Melaleuca decora</i>
The ground layer is variable and generally sparse with a mix of grasses and other graminoids, forbs, and low shrubs	Yes The ground layer is variable and generally sparse with a mix of grasses and other graminoids, forbs, and low shrubs

Key diagnostic characteristics	PCT 725
Patches typically contain many of the plant species presented at Table A1 (Appendix A) and may contain fauna species presented in Section 1.4	<p>Yes</p> <p>The patches contain many of the plant species presented at Table A1 (Appendix A) including <i>Acacia decurrens</i>, <i>Acacia falcata</i>, <i>Acacia pubescens</i>, <i>Allocasuarina littoralis</i>, <i>Angophora floribunda</i>, <i>Aristida vagans</i>, <i>Astroloma humifusum</i>, <i>Bursaria spinosa</i>, <i>Brunoniella australis</i>, <i>Cheilanthes sieberi</i>, <i>Cassytha glabella</i>, <i>Dianella longifolia</i>, <i>Dichondra repens</i>, <i>Echinopogon caespitosus</i>, <i>Entolasia stricta</i>, <i>Eragrostis brownii</i>, <i>Eucalyptus fibrosa</i>, <i>Eucalyptus longifolia</i>, <i>Glycine clandestina</i>, <i>Glycine tabacina</i>, <i>Hakea sericea</i>, <i>Hibbertia aspera</i>, <i>Kunzea ambigua</i>, <i>Laxmannia gracilis</i>, <i>Lepidosperma laterale</i>, <i>Leucopogon juniperinus</i>, <i>Lobelia purpurascens</i>, <i>Lomandra filiformis</i>, <i>Lomandra longifolia</i>, <i>Lomandra multiflora</i>, <i>Melaleuca decora</i>, <i>Melaleuca nodosa</i>, <i>Microlaena stipoides</i>, <i>Notelaea longifolia</i>, <i>Oxalis perennans</i>, <i>Ozothamnus diosmifolius</i>, <i>Paspalidium distans</i>, <i>Pimelea linifolia</i>, <i>Pultenaea villosa</i>, and <i>Veronica plebeia</i></p>
Comparison	Meets key diagnostic characteristics

### Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the EPBC Act listed Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC as outlined by the Department of the Environment (2015), are presented in Table 7.5.

For Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion, categories A and B are considered a moderate quality condition class and the minimum thresholds for a patch of the ecological community to be subject to the referral, assessment and compliance provisions of the EPBC Act (Department of the Environment, 2015).

A patch of the Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion TEC is defined a discrete and mostly continuous area of the ecological community (Department of the Environment, 2015). Patches can be spatially variable and often there are one or more areas within a patch that do not meet the condition threshold criteria that are surrounded by areas of higher quality that meet the condition thresholds (Department of the Environment, 2015).

Therefore, a patch may include small-scale disturbances, such as tracks or breaks, watercourses/drainage lines or small-scale (up to 0.1 ha) variations in vegetation that do not significantly alter its overall functionality (Department of the Environment, 2015). Based on this definition of a patch, there would be three discrete patches defined as:

- Patch 1 – all occurrences within Airport Reserve are considered contiguous and function as a single patch. This patch is >0.5 hectares in size
- Patch 2 – is a small <0.5-hectare area and is in the western portion of Ashford Reserve
- Patch 3 – is >0.5-hectare area and is the remaining extent of this vegetation zone within Ashford Reserve.

Based on patch size threshold (see Table 7.5), only patches 1 and 3 meet the minimum area requirement to form part of this community. Of the perennial understorey vegetation cover, native species make up greater than 70% in Patch 3 and as such this patch is in Category C – High Condition Class. Patch 1 has >30% of the perennial understorey vegetation cover made up of native species so is in the Category A – Moderate condition class (see Table 7.5).

**Table 7.5 Comparison of Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC condition thresholds against PCT 725 within the study area**

Category and rationale	PCT 725	PCT 1236
A. Moderate condition class Represented by medium to large-size patch as part of a larger native vegetation remnant and/or with mature trees	Patch size is $\geq 0.5$ ha (Patch size $> 0.1$ ha in areas east of Riverstone) And $> 30\%$ of the perennial understorey vegetation cover is made up of native species. And The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) $> 1$ ha in area. Or The patch has at least one tree with hollows or at least one large locally indigenous tree ( $> 80$ cm dbh).	Patch 1 = 1.54 ha And Patch 1 = 39.6% perennial understorey vegetation cover derived from BAM plots.
B. Moderate condition class Represented by medium to large size patch with high quality native understorey	Patch size is $\geq 0.5$ ha (Patch size $> 0.1$ ha in areas east of Riverstone) And $> 50\%$ of the perennial understorey vegetation cover is made up of native species.	Not applicable to patches in study area based on perennial understorey vegetation cover.
C. High condition class Represented by medium to large size patch with very high quality native understorey	Patch size is $\geq 0.5$ ha And $> 70\%$ of the perennial understorey vegetation cover is made up of native species.	Patch 3 = 1.29 ha And Patch 3 varies from 72% to 87.7% perennial understorey vegetation cover derived from BAM plots.
D. High condition class Represented by large size patch with high quality native understorey	Patch size is $\geq 2$ ha And $> 50\%$ of the perennial understorey vegetation cover is made up of native species.	Not applicable due to patch sizes $< 2$ ha.
Perennial understorey vegetation cover includes vascular plant species of the ground and mid/shrub layers with a lifecycle of more than two growing seasons. Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, plant litter or exposed soil but include plants that are subject to dieback. Contiguous means the patch of the ecological community is continuous with, or in close proximity (within 100 m), of another patch of vegetation (of the same or a different type) that is dominated by native species in each vegetation layer present.		

### 7.2.3 River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria

The River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria TEC occurs in the study area and is associated with PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin (see Figure 5.5).

To be considered part of the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria TEC the vegetation within the study area must meet the description of the TEC provided in the *Conservation Advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria* (Department of Agriculture, Water and the Environment, 2020). The vegetation must also meet the key diagnostic characteristics and condition thresholds.

#### Key diagnostic characteristics

An overview of key diagnostic characteristics for the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria TEC as outlined by the Department of Agriculture, Water and the Environment (2020), against the candidate PCT from within the study area is presented in Table 7.6.

From the examination of key diagnostic characteristics, PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin within the study area meets the key diagnostic characteristics for this TEC.

**Table 7.6 Comparison of River-flat eucalypt forest on coastal floodplains of the southern NSW and eastern Victoria TEC key diagnostics against PCT 835 within the study area**

Key diagnostic characteristics	PCT 835
Occurs in the South East Corner and Sydney Basin IBRA7 Bioregions, in eastern Victoria and south eastern New South Wales.	Yes Located in the Sydney Basin Bioregion.
Occurs within catchments of the eastern and southern watershed of the Great Dividing Range.	Yes Occurs within catchments of the eastern and watershed of the Great Dividing Range.
Occurs at elevations up to 250 metres above sea-level (ASL), but most typically below 50 metres ASL.	Yes Occurs at elevations below 250 metres above sea level.
Occurs on alluvial landforms related to coastal river floodplains and associated sites where transient water accumulates, including floodplains, river-banks, riparian zones, lake foreshores, creek lines (including the floors of tributary gullies), floodplain pockets, depressions, alluvial flats, fans, terraces, and localised colluvial fans.	Yes Occurs on alluvial landforms related to coastal river floodplains (Georges River).
Occurs on alluvial soils of various textures including silts, clay loams, sandy loams, gravel and cobbles. Does not occur on soils that are primarily marine sands, or aeolian sands.	Yes Occurs on alluvial soils.
Occurs as a tall closed-forest, tall open-forest, closed forest, open forest, tall woodland, or woodland. The canopy has a crown cover of at least 20 percent.	Yes Occurs as a woodland to open forest structure and has a crown cover of at least 20 percent.
Has a canopy dominated by one or a combination of the following species: <i>Angophora floribunda</i> , <i>A. subvelutina</i> , <i>Eucalyptus amplifolia</i> , <i>E. baueriana</i> , <i>E. benthamii</i> , <i>E. bosistoana</i> , <i>E. botryoides</i> , <i>E. botryoides</i> x <i>E. saligna</i> , <i>E. elata</i> , <i>E. grandis</i> , <i>E. longifolia</i> , <i>E. moluccana</i> , <i>E. ovata</i> , <i>E. saligna</i> , <i>E. tereticornis</i> , <i>E. viminalis</i> .	Yes The canopy is dominated by species including <i>Angophora floribunda</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus amplifolia</i> and <i>Eucalyptus baueriana</i> .



Key diagnostic characteristics	PCT 835
Comparison	Meets key diagnostic characteristics

### Condition thresholds

Condition thresholds are intended to function as a set of criteria that assists in identifying when the EPBC Act is likely to apply to an ecological community and provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a MNES, as defined under the EPBC Act. The condition thresholds for the EPBC Act listed River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria TEC as outlined by the Department of Agriculture, Water and the Environment (2020), are presented in Table 7.7.

A patch of the River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria TEC is defined as a discrete and mostly continuous area of the ecological community, as defined by the key diagnostic characteristics, but can include small-scale (<30 m) variations, gaps and disturbances within this area *Victoria* (Department of Agriculture, Water and the Environment, 2020). The smallest patch size that can be identified is 0.5 ha (Department of Agriculture, Water and the Environment, 2020). Based on this definition of a patch, there would be at least six discrete patches within the study area and three of the six patches are over 0.5 ha in size (see Figure 5.5)

- Patch 1 – all occurrences along the Georges River and Golf Course north of Milperra Road. This patch is >1.05 hectares in size.
- Patch 2 – all occurrences on the east of Henry Lawson Drive and south of Milperra Road. This patch is >5 hectares in size.
- Patch 3 – all occurrences to the west of Henry Lawson Drive and south of Milperra Road. This patch is >10 hectares in size.

Quadrats 12, 18 and 24 were done within PCT 835 in the study area. Quadrat 24 was done in a small patch that only has 1.7% perennial understorey vegetation cover, so it does not meet condition thresholds. Quadrat 12 and Quadrat 18 were done in the same patch (Patch 2) which is >5 ha in size. Quadrat 12 had a perennial native understorey vegetation cover of 30.3% while Quadrat 18 had a perennial native understorey vegetation cover of 12.2%. None of the patches within the study area are considered to be in High condition. Quadrat 12 had a perennial native understorey vegetation cover of 30.3% and ground cover richness was ≥4 native species (six forb and grass species, see plot data in Appendix B) which indicates that the patch is in the Moderate condition Class C2 as described by Department of Agriculture, Water and the Environment (2020). It is likely that Patch 1 and Patch 3 would also fall into this category, but we do not have plot data to confirm (note that the survey was done before the listing of this TEC under the EPBC Act, so the survey was not focused on this TEC).

As Quadrat 12 and Quadrat 18 were done in the same patch and the data is variable we have taken a precautionary approach and have assumed the whole patch meets the condition thresholds instead of attempting to break the patch apart into separate areas as we do not have the spatial data to draw accurate lines to delineate higher and lower condition sections.

**Table 7.7 River-flat eucalypt forest on coastal floodplains of the southern NSW and eastern Victoria community minimum condition thresholds (Department of the Environment and Energy, 2018)**

<div>Patch size thresholds →</div> <div>Biotic thresholds ↓</div>	Large patch Patch size ≥ 2 ha	Small contiguous <sup>7</sup> patch Patch size ≥ 0.5 ha within a larger area of native vegetation ≥ 5 ha	Small patch Patch size ≥ 0.5 ha
<b>High condition</b> ≥ 80% of its total perennial understorey vegetation cover <sup>1</sup> is comprised of native species AND Ground cover richness <sup>2</sup> ≥ 10 native species per sample plot AND ≥ 20 large trees <sup>3</sup> per ha	CLASS A1  Large or contiguous patch in high condition		CLASS B1  Small patch in high condition
<b>Good condition with arboreal mammals</b> ≥ 50% of its total perennial understorey vegetation cover <sup>1</sup> is comprised of native species AND Ground cover richness <sup>2</sup> ≥ 8 native species per sample plot AND At least 10 large trees <sup>3</sup> per ha AND Evidence of 4 or more species of arboreal mammals <sup>4</sup> detected <sup>5</sup> in the patch	CLASS A2  Large or contiguous patch in good condition with arboreal mammals		CLASS B2  Small patch in good condition with arboreal mammals
<b>Good condition</b> ≥ 50% of its total perennial understorey vegetation cover <sup>1</sup> is comprised of native species AND Ground cover richness <sup>2</sup> ≥ 8 native species per sample plot AND At least 10 large trees <sup>3</sup> per ha	CLASS B3  Large or contiguous patch in good condition		CLASS C1  Small patch in good condition
<b>Moderate condition</b> ≥ 30% of its total perennial understorey vegetation cover <sup>1</sup> is comprised of native species AND Ground cover richness ≥ 4 native species per sample plot <sup>2</sup>	CLASS C2  Large or contiguous patch in moderate condition		

<sup>1</sup> Perennial understorey vegetation cover includes vascular plant species of all layers below the canopy with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile plants of canopy species, but does not include annual plants, cryptogams, plant litter or exposed soil.

<sup>2</sup> Ground cover richness includes combined species richness of native grasses, forbs, ferns and sedges per 0.04 ha (20 x 20 m sample plot).

<sup>3</sup> Large eucalypt trees are greater than 45 cm [diameter at breast height (dbh)]. This is used as a surrogate for tree hollows and habitat values.

<sup>4</sup> Excluding micro-bats (Microchiroptera).

<sup>5</sup> Survey guidelines (DSEWPC 2011).

<sup>7</sup> Contiguous means the patch is connected to, or in close proximity to (i.e. within 30 m of), another area of native vegetation (i.e. an area where the total perennial vegetation cover is dominated (50 percent or more) by native plant species).

## 7.3 Listed threatened species

### 7.3.1 Threatened flora species listed under the EPBC Act

The search of the PMST identified 29 threatened flora species listed under the EPBC Act that have the potential to occur in the locality of the study area (see Appendix A). As identified above in Section 6.3.1, a population of *Acacia pubescens* (listed as Vulnerable) was recorded directly adjacent to the study area during the field survey on the southern side of Milperra Road within Ashford Reserve. The location of the recorded *Acacia pubescens* plants is shown in Figure 6.2 and Figure 6.3. The targeted flora surveys did not record any other EPBC Act listed threatened flora species from within or directly adjacent to the study area.

Given that the study area is outside of the known range of many species returned from the PMST, and that the study area lacks specific habitat features (e.g. sandstone soils) for some species, many threatened plants were removed from the assessment at the early habitat assessment stage (see Appendix A). Other species were removed from the assessment as the habitats within the study area are degraded to the point that the species is unlikely to be present (see Appendix A).

### 7.3.2 Threatened fauna species listed under the EPBC Act

The search of the PMST identified 52 threatened fauna species listed under the EPBC Act that have the potential to occur in the locality of the study area (see Appendix A). This includes 30 birds (including 22 sea birds or waders that were removed from the assessment based on lack of suitable habitat in the study area), four frogs (including *Litoria raniformis* which was removed from the assessment as the species does not occur in Sydney), nine mammals, six reptiles (this includes five sea turtles that were removed from the assessment based on lack of suitable habitat in the study area), one invertebrate, and two fish.

Given that the study area is outside of the known range of many species returned from the PMST, and that the study area lacks specific habitat features (e.g. sandstone geology, rocky outcropping, rainforest) for some species, many threatened animals were removed from the assessment at the early habitat assessment stage (see Appendix A). Other species were removed from the assessment as the habitats within the study area are degraded to the point that the species is unlikely to be present (see Appendix A). The two EPBC Act listed threatened fauna species that are considered at least moderately likely to occur within the study area on occasion include:

- Swift Parrot (listed as Critically Endangered)
- Grey-headed Flying-fox (listed as Vulnerable).

The Swift Parrot and Grey-headed Flying-fox are considered moderately likely to be present based on the presence of suitable foraging habitats. These species are known from the locality and it is assumed that the native vegetation within the study area provides suitable foraging habitat. There is no breeding habitat for these species within or adjacent to the study area.

The White-throated Needletail spends the non-breeding season in Australia and is primarily aerial. As such, this species may fly over the study area as part of normal movement patterns and this species not considered relevant to this assessment as no habitat for this species will be impacted directly or indirectly.

## 7.4 Listed Migratory species

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered MNES and are protected under the EPBC Act.

The search of the PMST identified 43 listed Migratory species listed under the EPBC Act that have the potential to occur in the locality of the study area (see Appendix A). This includes a number of Migratory Marine Birds (e.g. Albatrosses, Petrels, Shearwaters, Noddy, Frigatebird,

etc.) that would not use the habitats in the study area. The list of Migratory species returned by the PMST also includes a number of Migratory Marine Species including sea turtles and sharks and rays that do not have habitat in the study area. Likewise, the PMST returned a number of Migratory Wetlands Species (wading birds) that do not have any suitable habitat within the study area.

Of the listed Migratory species returned from the PMST, one is considered moderately likely to occur based on the presence of suitable habitats (see Table 7.8).

**Table 7.8 Migratory species with a moderate or higher likelihood of occurring within the study area**

Scientific name	Common name	EPBC Act	Likelihood of occurrence
Pandion cristatus	Eastern Osprey	M, Ma	<b>Moderate</b> – The species is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. There is potential for the species to forage along the Georges River.

(1) Migratory (M), Marine (Ma) as listed on the EBBC Act.



It should also be noted that habitats in the study area are unlikely to constitute important habitat for any of the listed migratory species (see Appendix A). The habitat present in the study area was unlikely to support significant proportions of populations of any migratory species nor are the habitats in the study area critical to any life stage of identified species. Due to its mobile nature, this species is likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur. Because of this, this species is not considered to be significantly impacted by the EIS proposal and are not considered further in this report.





**Figure 7.1**  
Matters of National  
Environmental Significance

### Legend

-  Study area  
 EIS proposal area

### EPBC Act threatened species records

- *Acacia pubescens*
- EPBC listed Threatened Ecological Communities**
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
  - Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
  - River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria TEC



Coordinate system: GDA 1994 MGA Zone 56



Scale ratio correct when printed at A3

1:6 CCG

Date: 07-May-21

Other sources: - NGA 1984p, TGSW, Geoscience Australia  
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

© 2001 American Psychological Association or one of its allied publishers. This article is intended solely for the personal use of the individual user and is not to be disseminated broadly. This article is intended solely for the personal use of the individual user and is not to be disseminated broadly.



# Stage 2 Impact assessment (biodiversity values and prescribed impacts)

## 8 Avoiding minimising impacts on biodiversity values

The following provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the EIS proposal. This information is provided to directly address Chapter 7 of the BAM.

### 8.1 Avoidance and minimisation of impacts on native vegetation and associated habitat

A preliminary biodiversity assessment of two alternative alignments (4 lane option and 6 lane option) were evaluated to identify the most environmentally acceptable alternative with the minimal loss in biodiversity values (WSP, 2019). This investigation was used to inform the avoidance and minimisation of impacts on biodiversity values associated with the EIS proposal.

In accordance with subsection 7.1.1 and subsection 7.1.2 of the BAM, efforts to avoid and minimise direct and indirect impact on native vegetation and habitat through overall proposal design have been considered. A summary of efforts taken to avoid and/or minimise impacts on native vegetation and associated habitat is addressed in Table 8.1.

**Table 8.1 Efforts to avoid and minimise impacts on native vegetation and habitat during the overall proposal design with reference to the EIS proposal.**

Principals	Proposal consistency
<b>Locating the proposal to avoid and minimise direct and indirect impacts on native vegetation and associated habitat (subsection 7.1.1 of the BAM)</b>	
a. <i>Locating the proposal in areas where there are no biodiversity values</i>	The EIS proposal area is heavily constrained by surrounding land uses and as such not all areas of biodiversity value could be entirely avoided. The EIS proposal widens an existing infrastructure corridor and best utilises existing transport infrastructure and established corridor routes. In many places, both sides of the corridor support areas of biodiversity values, particularly in EIS proposal areas 1 and 2. Temporary works, such as ancillary facilities are located in areas already cleared of native vegetation and highly disturbed in EIS proposal area 3. EIS proposal area 2 is impacted as a result of utilising and extending existing stormwater drainage infrastructure that discharge to coastal wetlands. By virtue of managing stormwater runoff from the proposed widened road corridor and broader catchment, it is not practicable to avoid undertaking works in and around EIS proposal area 2.
b. <i>Locating the proposal in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)</i>	Remnant native vegetation in the EIS proposal area is largely in poor to moderate condition, the areas of native vegetation that will be impacted by the EIS proposal mostly consists of existing roadside vegetation that is linear in nature and subject to edge effects. EIS proposal area 1 has edge effects from Henry Lawson Drive and the pathway that occurs through the middle of the vegetation. EIS proposal area 2 is subject to edge effects from Milperra Road. The EIS proposal area has been designed to impact the minimal amount of native vegetation, threatened species habitat and to avoid TECs. The current design is at the concept design stage and further refinements will be made at the detailed design stage.

Principals	Proposal consistency
c. <i>Locating the proposal in areas that avoid habitat for species that have a high biodiversity risk weighting or land mapped on the important habitat map, or native vegetation that is a TEC or a highly cleared PCT</i>	The EIS proposal area has been designed to minimise impact to areas of threatened species habitat, TECs and PCTs that are highly cleared as far as possible. No areas of important habitat are mapped within the EIS proposal area.
d. <i>Locating the proposal outside the buffer area around breeding habitat features such as nest trees or caves.</i>	Breeding habitat features identified in the EIS proposal area are restricted to breeding habitat features for Southern Myotis which occur in human-made structures (i.e. culverts and bridges). A population of Southern Myotis were recorded breeding and roosting in a culvert in EIS proposal area 1. Impacts to these structures and their buffers cannot be entirely avoided given their location under the road being upgraded. The EIS proposal has however been designed to avoid impacts to intact vegetation which forms part of the species buffer as far as practicable.
<b>Consideration of alternatives (subsection 7.1.1 of the BAM)</b>	
a. <i>an analysis of alternative modes or technologies that would avoid or minimise impacts on biodiversity values</i>	The EIS proposal is part of the overall proposal to widen the existing Henry Lawson Drive & Milperra Road road corridor. Given that the road infrastructure is existing, alternative transport modes have not been considered and would likely result in greater disturbance and biodiversity impacts. Alternative technologies and methods for operational water quality treatments have been considered and these will be further progressed during detailed design. EIS Proposal areas 1 and 3 are impacted by vegetated swales, which is one method of providing water quality treatments. These treatments, although having a direct impact on vegetation loss, also have an indirect beneficial impact to Coastal Wetlands and GDEs.
b. <i>an analysis of alternative routes that would avoid or minimise impacts on biodiversity values</i>	<p>Multiple design options were workshopped at the concept design stage these were as follows:</p> <ul style="list-style-type: none"> <li>• Widening to the west or east in consideration of land use, land ownership and biodiversity values.</li> <li>• Outlining the disturbance footprint considered constructability aspects, ground conditions (eg slopes), embankment widths and the presence of coastal wetlands and biodiversity values.</li> </ul> <p>The development footprint was developed in consideration of the above to assist in the retention of key biodiversity values. The following design recommendations were implemented:</p> <p>Avoidance hierarchy containing:</p> <ul style="list-style-type: none"> <li>• Threatened Ecological Communities</li> <li>• Threatened species and their habitat</li> <li>• Native vegetation recorded in good condition</li> <li>• Native vegetation recorded as moderate condition</li> <li>• Miscellaneous Ecosystem (non-native vegetation).</li> </ul> <p>As part of the concept design, the EIS proposal was positioned where minimal important habitat features are likely to be disturbed. However, this would be further refined to avoid biodiversity values listed above at the final design stage.</p>
c. <i>an analysis of alternative locations that would avoid or minimise impacts on biodiversity values</i>	
d. <i>an analysis of alternative sites within a property on which the proposal is proposed that would avoid or minimise impacts on biodiversity values.</i>	

Principals	Proposal consistency
<b>Designing a proposal to avoid and minimise impact on native vegetation and habitat (subsection 7.1.2 of the BAM)</b>	
a. <i>Reducing the clearing footprint of the proposal</i>	<p>The EIS proposal has been designed to minimise clearing impacts as far as practical given the highly constrained position in the landscape of where the proposal area sits (i.e. surrounded by Georges River, Coastal Management SEPP Wetlands and existing infrastructure).</p> <p>During detailed design phases of the overall proposal, the development footprint and layout of temporary construction sites and permanent sites will be determined. Where possible, the design and construction works will avoid direct impacts to vegetation commensurate with TECs and other intact vegetation surrounding the proposal area. In addition, recommendations to avoid disturbance to important habitat features (such as hollow bearing trees and Coastal Wetlands) will be implemented where practicable. Furthermore, the proposed compounds are proposed to be located within and adjoining EIS proposal area 3, which has no native vegetation.</p>
b. <i>Locating ancillary facilities in areas where there are no biodiversity values</i>	
c. <i>Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)</i>	
d. <i>Locating ancillary facilities in areas that avoid habitat for species and vegetation that has a high threat status (for example an EEC, CEEC or is an entity at risk of SAI)</i>	
e. <i>Making provision for the rehabilitation, ecological restoration and/or ongoing maintenance of retained areas of native vegetation, threatened species, TECs and their habitat in the subject land.</i>	<p>Landscaping plans will be developed for the EIS proposal to revegetate and rehabilitate temporary disturbed land. This will form part of the overall proposal's urban design and landscaping plan.</p> <p>Mitigation measures will be developed to address the direct and indirect impacts of the EIS proposal, which are outlined in Section 10. These will be reviewed and updated with future detailed design phases.</p>

## 8.2 Avoidance and minimisation of impacts on prescribed impacts

This section addresses prescribed biodiversity impacts that may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical in accordance with subsection 7.2.1 and subsection 7.2.2 of the BAM. Prescribed biodiversity impacts relevant to the EIS proposal have been identified in Table 8.2.

**Table 8.2 Efforts to avoid and minimise impacts on prescribed biodiversity during proposal design with reference to the EIS proposal**

Principals	Proposal planning
<b>Designing a proposal location to avoid and minimise impact on prescribed biodiversity (subsection 7.2.1 of BAM)</b>	
a. <i>locating the envelope of surface works to avoid direct impacts on the habitat features</i>	<p>The overall proposal is heavily constrained by surrounding land uses and as such not all areas containing habitat features could be entirely avoided. The overall proposal has however been designed to avoid impacts to intact vegetation and associated habitats containing habitat features as far as practicable. Where impacts on habitat features (i.e. hollow-bearing trees, bushrock and woody debris) are to be impacted, these features may be retained and utilised within adjacent habitat. This process would be guided and implemented in accordance with the comprehensive RMS Biodiversity Guidelines (2011); specifically including Guide 1 (Pre-clearing process), Guide 2 (Exclusion zones), Guide 4 (Clearing of vegetation and bushrock) and Guide 5 (re-use of woody debris and bushrock).</p>



Principals	Proposal planning
b. <i>locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating longwall panels away from geological features of significance or water dependent plant communities and their supporting aquifers</i>	The EIS proposal will require subsurface works for the extension of existing stormwater culverts and construction of additional stormwater drainage infrastructure in EIS proposal areas 1 and 2. These structures are located to allow for stormwater runoff and therefore the subsurface works cannot be avoided. These works will interact with the groundwater aquifers and are likely to impact upon on the GDEs. The EIS proposal would have direct and possible indirect impacts on (GDEs). Excavations for drainage infrastructure will have direct impact upon the coastal wetland located in EIS proposal area 2. Mitigation measures incorporating sedimentation and hydrology controls are outlined in Section 10
c. <i>locating the proposal to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or local movement pathways</i>	The overall proposal includes widening of Henry Lawson Drive and Milperra Road, which would result in an increase in the gap between areas of habitat. This impact cannot be avoided, however may be minimised during detailed design.
d. <i>optimising proposal layout to minimise interactions with threatened entities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies</i>	The development footprint has been designed to impact the minimal amount of native vegetation, TECs or threatened species habitat. The EIS proposal site is highly constrained by Coastal Wetlands, TECs, residential and commercial/ retail properties, properties identified as Airport Land, and properties subject to Aboriginal land claims. The overall proposal layout has been optimised to achieve a balance between all these constraints whilst meeting the overall proposal objectives. Direct impacts to Georges River, which provides important habitat features, has been avoided despite the overall proposal still being located in the Georges River riparian zone and floodplain. Given these considerations, the overall proposal's location in the landscape and achieving total avoidance of threatened entities is not possible.
e. <i>locating the proposal to avoid direct impacts on water bodies.</i>	The EIS proposal has been designed to minimise direct impacts on watercourses and waterbodies as far as practicable. Given the locality and position of the overall proposal in the landscape (i.e. occurs immediately adjacent Georges River, Prospect Creek, Coastal Wetlands and bounded by existing infrastructure) total avoidance of waterbodies is not possible.  As such, the EIS proposal would have direct and possible indirect impacts on watercourses and waterbodies within the study area. Mitigation measures incorporating sedimentation and hydrology controls are outlined in Section 10.
<b>Consideration of alternatives (subsection 7.2.1 of BAM)</b>	
a. <i>an analysis of alternative modes or technologies that would avoid or minimise prescribed biodiversity impacts</i>	These impacts are assessed in Table 8.1.
b. <i>an analysis of alternative routes that would avoid or minimise prescribed biodiversity impacts</i>	
c. <i>an analysis of alternative locations that would avoid or minimise prescribed biodiversity impacts</i>	

Principals	Proposal planning
d. <i>an analysis of alternative sites within a property on which the proposal is proposed that would avoid or minimise prescribed biodiversity impacts</i>	
<b>Designing the proposal to avoid or minimise prescribed impacts (subsection 7.2.2 of the BAM)</b>	
a. <i>engineering solutions, such as proven techniques to minimise fracturing of underlying features of geological significance, GDEs or their supporting aquifers and restoring connectivity and movement corridors</i>	Engineering solutions will be determined during detailed design phases. The use of culverts in the EIS proposal will be recommended as they provide potential breeding habitat for threatened microbats and potentially areas of connectivity for terrestrial fauna.
b. <i>design elements that minimise interactions with threatened entities, such as design turbines to dissuade perching, designing fencing to prevent animal entry to transport corridors and providing vegetated buffers rehabilitated with native species</i>	<p>This will be determined during future design phases of the EIS proposal. The following measures are likely to be implemented to reduce fauna vehicle strike:</p> <ul style="list-style-type: none"> <li>• Minimising the disturbance footprint from embankments in areas of biodiversity value with alternative options, such as retaining walls</li> <li>• Minimising the disturbance footprint by identifying the location of threatened species by ground survey on detailed design plans, enabling further opportunities to be identified for reducing direct impacts.</li> <li>• Identifying construction techniques that may further reduce the construction footprint and indirect impacts on areas of biodiversity value.</li> </ul>
c. <i>maintaining environmental processes that are critical to the formation and persistence of habitat features not associated with native vegetation</i>	The EIS proposal is not expected to adversely impact environmental processes critical to the formation and persistence of habitat features not associated with native vegetation, due to an absence of karst, caves, crevices, cliffs or other features of geological significance. Where rocky features are required to be removed (as part of vegetation clearing), these would be salvaged and translocated to areas of vegetation to be retained in the subject land.
d. <i>maintaining hydrological processes that sustain threatened entities</i>	Discharges associated with wastewater runoff during operation would be designed to improve or maintain water quality in the receiving environment. This includes Georges River and its tributaries. The EIS proposal would include the provision of water quality control measures along the alignment, which would include vegetated swales within EIS proposal area 1 and 3. Drainage infrastructure in EIS proposal area 2 will support continued hydrological flows to the Coastal Wetlands within and around Milperra Drain, a tributary to Georges River. These operational water quality treatments and hydraulic drainage design will be further developed in future design phases with the aim to maintain existing flood levels and regimes and water quality levels.

Principals	Proposal planning
<p>e. <i>controlling the quality of water released from the site, to avoid and minimise downstream impacts on threatened entities.</i></p>	<p>The overall proposal has been designed to include operational water quality treatments inclusive of bio-retention basins and vegetated swales. The EIS proposal areas 1 and 3 will include a portion of the vegetated swales. The bio-retention basins form part of the REF proposal. During construction, works would be undertaken in small construction catchments and a concept design erosion and sediment control (ERSED) strategy has been developed based on these catchments. The ERSED strategy provides the key principles to minimise erosion and offsite sedimentation and will be further developed during detailed design.</p> <p>Standard controls form part of the ERSED strategy to prevent soil erosion, siltation, and run-off during construction in accordance with Blue Book (Landcom 2004) requirements. Mitigation measures incorporating water management controls are outlined in Section 10.</p>

## 9 Assessment of impacts

The direct and indirect impacts of the EIS proposal on native vegetation, threatened ecological communities and threatened species habitat are discussed in this section.

### 9.1 Assessment of direct impacts

#### 9.1.1 Impacts on native vegetation and Threatened Ecological Communities

##### Direct impacts on native vegetation

The impacts of the EIS proposal on native vegetation including the area of each vegetation zone to be impacted and its corresponding legislative status are provided below in Table 9.1.

**Table 9.1 Direct impacts to native vegetation**

Vegetation zone	Status (BC Act)	HT <sup>1</sup>	Extent (ha) EIS proposal area
VZ2 – PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner – Moderate condition	E	N	0.02
VZ3 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)	E	Y	0.02
VZ11 – PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition	E	N	0.01
VZ12 – PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition		N	0.20
Sub-total area of native vegetation			0.25
VZ14 – Miscellaneous ecosystem - Urban exotic / native landscape plantings	Not listed	N/A	-
VZ15 – Miscellaneous ecosystem - Weeds / exotics – non-native vegetation	Not listed	N/A	0.02
VZ16 – Miscellaneous ecosystem - Waterbodies	Not listed	N/A	-
Sub-total of miscellaneous ecosystems			0.02
Total			0.27

- (1) HT = Hollow bearing trees. Data collected during vegetation integrity plots (see Table 9.6), total hollow counts to be determined during pre-clearing surveys



## Direct impacts on Threatened Ecological Communities

The EIS proposal will directly impact on 0.25 ha of BC Act-listed TECs. A summary of the EIS proposal's direct impacts on TECs is provided below in Table 9.2. Impacts on EPBC Act-listed TECs are described in Section 9.5.

**Table 9.2 Direct impacts to BC Act-listed TECs**

Threatened ecological community	BC Act Status	Associated PCT within the study area	Extent (ha) EIS proposal area
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	0.02
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion	0.02
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	0.01
		PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	0.20
		PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	-
Total			0.25

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

## Key threatening processes

Key threatening processes associated with the general habitat (native vegetation) removal are listed in Table 9.3.

**Table 9.3 Key threatening processes associated with the removal of native vegetation**

Key Threatening Processes	Legislation			Impact of the EIS proposal
	BC Act	FM Act	EPBC Act	
Clearing of native vegetation	✓	-	-	The EIS proposal will contribute to these processes through the clearing of 0.25 ha of native vegetation comprised of four native plant communities.
Land clearance	-	-	✓	
Degradation of native riparian vegetation along NSW courses	-	✓	-	The EIS proposal would contribute to this process through the clearing of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner. This native vegetation communities provide riparian habitat.

## 9.1.2 Impacts on threatened species and habitat

### Direct impacts on predicted ecosystem credit species

Direct impacts on predicted ecosystem credit species due to the EIS proposal is outlined in Table 9.4.

**Table 9.4 Direct impacts on predicted ecosystem species**

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)	Predicted habitat impacted (ecosystem credit) (ha)
Australasian Bittern	<i>Botaurus poiciloptilus</i>	E	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Australian Painted Snipe	<i>Rostratula australis</i>	E	No	PCT 781, PCT 1234 and PCT 1236	0.23
Barking Owl	<i>Ninox connivens</i>	V	No	PCT 835, PCT 1234 and PCT 1236	0.23
Black Bittern	<i>Botaurus poiciloptilus</i>	E	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	No	PCT 835	0.02
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	E	No	PCT 781 and PCT 1234	0.22
Black-tailed Godwit	<i>Limosa limosa</i>	V	No	PCT 781	0.02
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	V	No	PCT 781	0.02
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	No	PCT 835 and PCT 1234	0.22
Comb-crested Jacana	<i>Irediparra gallinacea</i>	V	No	PCT 781	0.02
Curlew Sandpiper	<i>Calidris ferruginea</i>	E	Yes	PCT 781	0.02
Diamond Firetail	<i>Stagonopleura guttata</i>	V	No	PCT 835	0.02
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Eastern Osprey	<i>Pandion cristatus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Flame Robin	<i>Petroica phoenicea</i>	V	No	PCT 835 and PCT 1234	0.22
Freckled Duck	<i>Stictonetta naevosa</i>	V	No	PCT 781	0.02
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	No	PCT 835 and PCT 1234	0.22
Grey-headed Flying-fox	<i>Phascogaleus cinereus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	No	PCT 835	0.02
Koala	<i>Phascogaleus cinereus</i>	V	No	PCT 835, PCT 1234 and PCT 1236	0.23

Scientific name	Common name	BC Act <sup>1</sup>	SAIL	Associated PCT(s)	Predicted habitat impacted (ecosystem credit) (ha)
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V	Yes	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Little Bent-winged Bat	<i>Miniopterus australis</i>	V	Yes	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Little Eagle	<i>Hieraaetus morphnoides</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Masked Owl	<i>Tyto novaehollandiae</i>	V	No	PCT 835, PCT 1234 and PCT 1236	0.23
Painted Honeyeater	<i>Grantiella picta</i>	V	No	PCT 835	0.02
Powerful Owl	<i>Ninox strenua</i>	V	No	PCT 835 and PCT 1234	0.22
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	Yes	PCT 835, PCT 1234 and PCT 1236	0.23
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	V	No	PCT 1234 and PCT 1236	0.21
Scarlet Robin	<i>Petroica boodang</i>	V	No	PCT 835	0.02
Speckled Warbler	<i>Chthonicola sagittata</i>	V	No	PCT 835 and PCT 1234	0.22
Spotted Harrier	<i>Circus assimilis</i>	V	No	PCT 781, PCT 1234 and PCT 1236	0.23
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Square-tailed Kite	<i>Lophoictinia isura</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	V	No	PCT 1234	0.20
Swift Parrot	<i>Lathamus discolor</i>	E	Yes	PCT 835, PCT 1234 and PCT 1236	0.23
Turquoise Parrot	<i>Neophema pulchella</i>	V	No	PCT 835, PCT 1234 and PCT 1236	0.23
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	No	PCT 835, PCT 1234 and PCT 1236	0.23
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25
White-fronted Chat	<i>Epthianura albifrons</i>	V, E2	No, Yes	PCT 781 and PCT 1234	0.22
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	V	No	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

## Direct impacts on threatened species credit species

Direct impacts on candidate species credit species due to the EIS proposal is outlined in Table 9.5. Key habitat features such as hollow-bearing trees and water bodies which may constitute breeding habitat are discussed where relevant.

**Table 9.5 Direct impacts on threatened species credit species**

Common name	Scientific name	BC Act <sup>1</sup>	Associated native vegetation types and habitat features	Direct impact (area / individuals)
Southern Myotis	<i>Myotis macropus</i>	V	Areas of PCT 835, PCT 1236 and PCT 1234 within the EIS proposal area which are within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies	0.25 ha

(1) Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act.

## Key threatening processes

Key threatening processes associated with the general habitat (native vegetation) removal are listed in Table 9.3. Key threatening processes associated with the removal of key fauna habitat features are outlined in Table 9.6 below.

**Table 9.6 Key threatening processes associated with removal of key fauna habitat features**

Key threatening processes	Legislation			Impact of the EIS proposal
	BC Act	FM Act	EPBC Act	
Loss of hollow-bearing trees	✓	–	–	Three hollow bearing trees were recorded within the EIS proposal area during vegetation integrity plots and random meanders. Total hollow counts to be determined during pre-clearing surveys.
Removal of dead wood and dead trees	✓	–	–	A few dead standing trees will require removal from the EIS proposal area. Dead wood on the ground, which is scattered through the EIS proposal area at low density, would also be removed.

## 9.2 Assessment of indirect impacts

This section outlines the general indirect impacts which can occur when the EIS proposal or activities relating to the construction or operation of the EIS proposal have a negative effect on native vegetation, threatened ecological communities and/or threatened species habitat.

### 9.2.1 Reduced viability of adjacent habitat due to edge effects

Edge effects create vulnerable areas subject to degradation by the establishment and spread of weeds, enriched run-off from road pavement and dumping of rubbish and have the potential to reduce the viability of adjacent habitat long-term. It is listed as a Key Threatening Processes under BC Act.

Currently, edge effects from the Henry Lawson Drive and Milperra Road impact native vegetation particularly through weed invasion. As the EIS proposal involves widening the road this impact is likely to exacerbate and introduce this impact into additional areas of native vegetation and habitat.

The vegetation recorded within the study area mostly occurred in linear patches with some degree of weed invasion. Vegetation recorded in moderate condition and/or with connectivity



to larger patches of vegetation is most vulnerable to edge effects. The viability of these areas may be reduced by the EIS proposal if not appropriately managed.

### 9.2.2 Transport of weeds from the site to adjacent vegetation

The upgrade of Henry Lawson Drive would be susceptible to weed establishment due to earthworks carried out in widening the road. Construction around native vegetation in moderate or contain connectivity to larger areas of native vegetation would also be highly susceptible to weed establishment.

This indirect impact corresponds to several Key Threatening Processes listed under BC Act:

- Invasion and establishment of exotic vines and scramblers. Species recorded within the study area include:
  - *Acetosa sagittata* (Potato Vine)
  - *Andredera cordifolia* (Maderia Vine)
  - *Araujia sericifera* (Moth Vine)
  - *Asparagus asparagoides* (Bridal Creeper)
  - *Asparagus aethiopicus* (Asparagus Fern)
  - *Cardiospermum grandiflorum* (Balloon Vine)
  - *Lonicera japonica* (Japanese Honeysuckle)
  - *Passiflora subpeltata* (Passion Flower)
  - *Tradescantia fluminensis* (Wandering Jew).
- Invasion, establishment and spread of *Lantana camara* (Lantana).
- Invasion of native plant communities by *Olea europaea subsp. cuspidate* (African Olive).
- Invasion of native plant communities by *Chrysanthemoides monilifera* (Bitou Bush).
- Invasion of native plant communities by exotic perennial grasses. Species recorded include:
  - *Pennisetum clandestinus* (Kikuyu)
  - *Eragostis curvula* (African Lovegrass)
  - *Ehrharta erecta* (Panic Veldtgrass).
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants. The species recorded within the study area include:
  - *Bryophyllum delagoense* (Mother of Millions)
  - *Cinnamomum camphora* (Camphor Laurel).

### 9.2.3 Transport of pathogens from the site to adjacent vegetation

The EIS proposal has the potential to increase the spread of pathogens that threaten native biodiversity values, such as the soil-borne pathogen *Phytophthora cinnamomi* (Phytophthora) and *Austropuccinia psidii* (Myrtle rust).

Phytophthora infects root systems whereas Myrtle Rust deforms leaves and leads to heavy defoliation. Both pathogens are associated with damage and death to native plants and may be dispersed over large distances. Phytophthora can be spread through flowing water, such as stormwater runoff and offsite sedimentation, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of Phytophthora may also be dispersed by vehicles and earth moving equipment not properly cleaned, animals, walkers and movement of soil. Myrtle rust spores can be spread easily via contaminated clothing, hair, skin and personal items, infected plant material, equipment as well as by insect/animal movement and wind dispersal.

Neither of these two pathogens were observed within the EIS proposal area. However, if vehicles, earth moving equipment are not cleaned properly there is a high risk of contamination imported from other sites. Myrtle Rust is common and has spread throughout NSW. This pathogen infects species from the Myrtaceae family and has resulted in some common species becoming threatened due to the high infection rate. The EIS proposal's

construction activities are likely to lead to an increased risk of dispersal of *Phytophthora* and/or Myrtle Rust through works involving soil disturbance.

This indirect impact corresponds to several Key Threatening Processes listed under BC Act:

- Infection of native plants by *Phytophthora cinnamomic*.
- Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae*.

#### 9.2.4 Reduced viability of adjacent habitat due to noise, dust or light spill

Noise, dust, light and contaminant pollution are indirect impacts that are likely to result from activities associated with the EIS proposal. These impacts are likely to have cumulative effects. Noise, dust, light and contaminant pollution are likely to occur, if not managed from all EIS proposal activities, although will be greatest where activities take place near vegetated areas and during construction.

During all stages of the EIS proposal increased noise and vibration levels in the study area and immediate surrounds are likely due to vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. The noise and vibration from activities associated with the EIS proposal would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. The impacts from noise emissions are likely to be localised to the construction areas and are not considered likely to have a significant, long-term impact on wildlife populations outside the area of impact.

Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to the EIS proposal activities. This has the potential to reduce photosynthesis and transpiration and cause abrasion and heating of leaves resulting in reduced growth rates and decreases in overall health of the vegetation. Dust is likely to be generated throughout the lifecycle of the EIS proposal, although dust pollution is likely to be greatest during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather conditions. However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary and is therefore not considered likely to be a major impact of the EIS proposal.

Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from a passing vehicles), that can have potentially adverse effects on wildlife (Longcore and Rich, 2004). Some night works would be required during construction and lighting will be installed on the roadside. As such, the immediate area surrounding the EIS proposal activities, and areas lit during operation, will be subject to artificial lighting, essentially creating permanent 'daylight' conditions.

Ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle. Some species (i.e. light tolerant microbat bats) may benefit from the lighting due to increased food availability (insects attracted to lights) around these areas. Due to the frequency and sustained nature of the lighting, it is likely that animals would alter their behaviour in response to the light disturbance and a long-term impact in the area of lighting is likely. Due to the urban environment of the study area most, if not all, areas of habitat are already impacted by ecological light pollution associated with existing fixed lighting, residences and road vehicle movements. The changes to light conditions associated with the EIS proposal, though essentially permanent, would therefore be unlikely to have a significant impact on local fauna populations. Lighting associated with the EIS proposal would be designed to minimise 'light spill' for the benefit of surrounding residents and this would also reduce potential impacts on fauna populations.

#### 9.2.5 Mobilisation of Contaminants

During the construction phase localised release of contaminants (i.e. hydraulic fluids, oils, fluids, etc.) into the surrounding environment (including drainage lines) could accidentally occur. The most likely result of contaminant discharge would be the localised contamination of soil and potential direct physical trauma to flora, fauna and GDEs that come into contact with contaminants. Any accidental release of contaminants is likely to be localised and would be

unlikely to have a significant effect on the environments of the study area, particularly due to the implementation of mitigation measures to immediately address any spills.

Furthermore, excavations could mobilise any potential contaminants that could be present within subsurface soils and groundwater. EIS proposal area 1 is located within proximity to a petrol service station and Bankstown Airport identified as potential sources of contaminants, EIS proposal area 2 is located about 150m south of Bankstown Airport and EIS proposal area 3 is located about 150m north of a former landfill site, now developed as the Flower Power business complex. Mitigation measures for the potential release of contaminants is outlined in Section 10.

### 9.2.6 Loss of breeding habitats

The loss of breeding habitat such as hollow-bearing trees and artificial structures (e.g. culverts) is likely to occur because of the EIS proposal and has the potential to affect native animals such as;

- Hollow-dependent bats (including threatened species)
- Hollow-nesting and canopy-nesting birds
- Arboreal mammals
- Reptiles.

Loss of hollow-bearing trees is currently assumed to be three based on data recorded during vegetation integrity plots, hollow-bearing tree assessment and random meander surveys. All of the three hollow-bearing trees are located in EIS proposal area 1. The total number of hollow-bearing trees to be impacted will be quantified during detailed design and pre-clearing surveys.

An inspection of the culverts and drainage pipes within EIS proposal area 1 recorded the cave dwelling microbat, Southern Myotis (*Myotis macropus*) roosting in the northern culvert (see Figure 6.2). Inspection of the remaining culverts and pipes in EIS proposal areas 1 and 2 showed most culverts and pipes had little to no roosting niches for microbats. No culverts or drainage pipes were recorded in EIS proposal area 3.

The installation of new culverts in EIS proposal area 1 and 2 may provide additional habitat for cave-dwelling microbats such as the Southern Myotis (*Myotis macropus*).

### 9.2.7 Trampling of threatened flora species

Although the EIS proposal will not require the removal of any threatened flora individuals it will come within 30 m of *Acacia pubescens* (Downy Wattle) individuals recorded within the study area. Although no *Acacia pubescens* individuals nor areas of the species' species polygon require removal indirect impacts may eventuate given its location in respect to the EIS proposal area.

No impacts are anticipated to occur to *Callistemon linearifolius* as a result of the EIS proposal.

Indirect impacts associated with the introduction of pathogens and weed incursions may occur as a result of the EIS proposal if not appropriately managed. The following indirect impacts are not expected to be relevant or to be exacerbated by the EIS proposal:

- rubbish dumping
- increased risk of starvation, exposure and loss of shade or shelter
- inhibition of nitrogen fixation and increased soil salinity
- fertiliser drift
- wood collection
- bush rock removal and disturbance
- increase in predatory species populations
- increase in pest animal populations
- increased risk of fire
- disturbance to specialist breeding and foraging habitat.

Indirect impacts will be reviewed and finalised following detailed design to determine the final development footprint. Mitigation measures provided in Section 10 will be developed specially to mitigate indirect impacts.

### 9.3 Assessment of prescribed biodiversity impacts

The BC Regulation (clause 6.1) identifies actions that are prescribed as impacts to be assessed under the BOS. Prescribed biodiversity impacts must be assessed in accordance with section 8.3 of the BAM.

A summary of the prescribed biodiversity impacts is provided in Table 9.7.

**Table 9.7 Summary of prescribed biodiversity impacts listed under the BC Regulation**

Prescribed biodiversity impact (BAM)	Relevance to EIS proposal
<i>Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance</i>	None – no karst, caves, crevices, cliffs or other features of geological significance in or adjoining the study area.
<i>Impacts of development on the habitat of threatened species or ecological communities associated with rocks</i>	None – no rock outcrops occur within and adjacent to the study area. No direct or indirect impacts of the EIS proposal would impact fauna species that occur in association with rocky habitats.
<i>Impacts of development on the habitat of threatened species or ecological communities associated with human-made structures</i>	<b>Yes</b> – human-made structures occur within and adjacent to the study area. Human-made structures such as culverts beneath surface roads and bridges, offer potential roosting habitat to locally occurring threatened microbat species. Direct and indirect impacts of the EIS proposal may affect threatened fauna species that could utilise these human-made structures. Specifically, for the Southern Myotis.
<i>Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation</i>	<b>Partially</b> – a small amount of non-native vegetation occurs within all of EIS proposal areas. The majority are exotic shrubs and vines, which provide habitat for small passerine birds. A few non-native trees occur within EIS area 3. These provide non-native vegetation offers foraging, nesting and sheltering habitat to locally occurring threatened birds and Grey-headed Flying-fox. The removal of this non-native vegetation would have minor impacts upon native fauna.
<i>Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range</i>	<b>Partially</b> – EIS proposal areas 1 and 2 will involve the widening of Henry Lawson Drive and Milperra Road respectively. The widening of these two roads will increase the connectivity to a minor degree than currently occurring. The increase in habitat fragmentation may partially affect the movement patterns of some terrestrial fauna species, however it is unlikely to significantly affect the movement or life-cycle of species in which already occurs within EIS proposal area 1 and 2.
<i>Impacts of the development on movement of threatened species that maintains their life cycle</i>	
<i>Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities</i>	<b>Partially</b> - unmanaged construction activities in proximity to watercourses or waterbodies could increase levels of turbidity and sediment deposition, decrease dissolved oxygen, and change pH levels in receiving environments.
<i>Impacts of wind turbine strikes on protected animals</i>	No – no wind turbines are proposed as part of this EIS proposal.



Prescribed biodiversity impact (BAM)	Relevance to EIS proposal
<i>Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC</i>	<b>Yes</b> – the proposal involves the widening of roads in proximity to areas of fauna habitat, such as the widening of Henry Lawson Drive where it occurs adjacent to remnant riparian vegetation along the Georges River and north west of the Bankstown Golf Course. Terrestrial fauna species that attempt to cross these widened roads, may be more susceptible to vehicle strike, as they move between areas of habitat on either side of the road to obtain food, shelter, and breeding resources, or undertake seasonal migrations.

### 9.3.1 Areas of geological significance

No areas of geological significance or important geological habitat was identified within the study area. The EIS proposal is not required to impact on any areas of geological significance or areas where significant rock habitat occurs such as karst, caves, crevices or cliffs.

### 9.3.2 Human-made structures

Threatened species are known or considered likely to use habitat associated with human-made structures such as those located within the EIS proposal area. The following human-made structures that occur within EIS proposal area:

- EIS proposal area 1 – box culvert under Henry Lawson Drive (known to provide habitat for Southern Myotis)
- EIS proposal area 2 – traverse drainage across the Milperra Road corridor that discharges into Milperra Drain (this structure does not provide threatened species habitat).

The nature, extent and duration of short and long-term effects of the removal, disturbance and/or alteration of human-made structures as well as the consequences of the impacts for the local and bioregional persistence of these species or ecological communities is assessed in Table 9.8.

**Table 9.8 Potential impacts on species and ecological communities associated with human-made structures within the EIS proposal area**

Species or ecological communities	Human-made structures and/or non-native vegetation with potential to be habitat	Nature, extent and duration of short and long-term impacts due to removal of structures and/or non-native vegetation	Importance within the bioregion of the habitat to these species or ecological communities	Consequences of the impacts for the local and bioregional persistence
Southern Myotis ( <i>Myotis macropus</i> )	Culverts	<p>The EIS proposal would involve the alteration of culverts along Henry Lawson Drive and Milperra Road that offer roosting habitat for these species.</p> <p>The EIS proposal may require removal and replacement of these structures, along with removal of native vegetation surrounding these areas.</p>	<p><b>Low</b> – Potential roosting habitat may be temporarily affected by noise and vibration while culverts are altered during construction of the EIS proposal.</p> <p>Potential foraging habitat to be removed consists of PCTs that adjoin roadside vegetation, most of these are small areas of mostly planted exotic and native trees from road verges, parks and urban landscaped areas.</p> <p>The area of foraging habitat to be removed is negligible at a bioregional scale. Similar or higher quality foraging habitat is readily available throughout the surrounding locality and wider bioregion</p>	<p><b>Negligible</b> –</p> <p>Potential roosting habitat would be temporarily affected during construction and replacement, and could be utilised by the species upon the completion of construction. These structures are also not likely significant breeding habitat for these species.</p> <p>Potential foraging habitat to be removed does not comprise a significant proportion of foraging habitat available to this species in the surrounding locality or wider bioregion.</p> <p>The loss of a small area of potential foraging habitat is not expected to adversely impact the persistence of these species at a local nor bioregional scale</p>

### 9.3.3 Non-native vegetation

A small area (0.02ha) of non-native vegetation, being the miscellaneous ecosystem weeds / exotics, which occurs in EIS proposal area 3 (Figure 5.3). This area is a cleared area containing exotic pasture weeds and exotic shrubs. This non-native vegetation provides foraging habitat for commonly occurring birds with no habitat for threatened species.

### 9.3.4 Habitat connectivity

The removal of native vegetation and splitting of habitat patches can result in habitat fragmentation which is to 'physical dividing up of once continuous habitats into separate smaller 'fragments'' (Fahrig, 2002). The EIS proposal is considered unlikely to result in a large increase to landscape scale fragmentation and to further limit connectivity and movement corridors than what already exists in the study area, as it largely follows existing roadways. The impacts from the EIS proposal would largely involve 'trimming' the edges of vegetation patches adjacent to the existing road corridor, which would not result in additional habitat fragmentation.

The EIS proposal is however likely to result in a reduction in vegetation patch sizes resulting in minor increases in localised fragmentation of the regional wildlife patches along the Georges River. Due to the importance of connectivity, dispersal opportunities and habitat quality for species at a local scale, this impact has the potential to be negative to the dispersal of relatively sedentary species such as mammals, frogs, and reptiles. However, due to the disturbed, urban setting of the EIS proposal, most if not all native animal species which are sensitive to habitat fragmentation and predation (e.g. native ground-dwelling mammals, arboreal mammals (except for adaptable common possum species) and monitor lizards) are likely to have already been lost from the habitats in the study area. Mobile species such as birds and bats are unlikely to be affected by this fragmentation as the landscape in which they currently exist is fragmented and the predicted level of fragmentation would not be enough to restrict their dispersal between habitat patches.

The predicted level of fragmentation from the EIS proposal is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches. The existing functional connectivity for many species would remain in the study area.

### 9.3.5 Waterbodies, water quality and hydrological processes

The existing hydrological conditions of the EIS proposal area are already affected by altered landform and altered stormwater runoff and velocity as a result of surrounding land uses. The EIS proposal may result in further alteration to the hydrology of the study area due to changes in landform and increase in surface water runoff due to increase in impervious surfaces.

A summary of potential impacts to hydrology and associated biodiversity habitat is provided in Table 9.9.

**Table 9.9 Summary of potential impacts to hydrology associated with biodiversity habitat**

Potential impact	Construction of the EIS proposal (short-term impacts)	Operation of the EIS proposal (long-term impacts)
Reduction in water quality	<ul style="list-style-type: none"> <li>Unmanaged construction activities (such as earthworks, relocation of utilities and removal of vegetation) could result in: soil erosion, siltation and off-site movement of eroded sediments by stormwater, contributing to increased levels of turbidity and sediment deposition, decreased dissolved oxygen, and change pH levels in waterways. In addition, accidental fuel and chemical spills and contaminated runoff from construction vehicles, plant, equipment or chemical storage areas have the potential to reach waterbodies and streams within and adjacent to the study area.</li> </ul>	<ul style="list-style-type: none"> <li>An increase in impervious surfaces (e.g. EIS proposal area 1) would likely result in an increased volume of runoff, which would lead to increased scouring, erosion and sedimentation. Run-off may carry increased sediment loads, pollutants and nutrients (such as nitrogen and phosphorus), discharging to surrounding waterbodies and streams (e.g. EIS proposal area 2) within and adjacent to the study area.</li> </ul>
Changes to the geomorphology of watercourses	<ul style="list-style-type: none"> <li>Open channels occur in all EIS proposal areas. The water from these channels flows from stormwater drains from the urban environment, Bankstown Airport and Bankstown Golf Course. In EIS proposal area 1, there is one channel and this drains directly into the Georges River in an open channel which flows under Henry Lawson Drive. In EIS proposal area 2 an open channel drains into PCT 781 Coastal Freshwater Lagoons and then flows along eastern edge of Bankstown Golf Course to bushland adjoining EIS proposal area 3 with the outflow to the Georges River. Temporary changes in water flow and velocities as a result of the EIS proposal may result in a small increase in water flows downstream. Realignment works would be staged at each point the EIS proposal crosses any of the open channels to ensure water flows and velocities are not significantly changed and to avoid downstream erosion and bed and bank stability impacts to the open channels.</li> <li>Mobilised sediment could build up in the open channels downstream of the EIS proposal areas which flow into the Georges River.</li> <li>Impermeable surfaces created by the EIS proposal would lead to increases in the volume and rate of runoff, which could cause erosion within the open channels.</li> </ul>	<ul style="list-style-type: none"> <li>Changes to the geomorphology of watercourses from surface water runoff during operation of the EIS proposal is considered negligible, given that EIS proposal stormwater discharges would be via the stormwater network into the Georges River. Drainage works would be designed to prevent scouring of the open channels.</li> </ul>



Potential impact	Construction of the EIS proposal (short-term impacts)	Operation of the EIS proposal (long-term impacts)
Loss of freshwater and riparian habitat, waterbodies and streams	<ul style="list-style-type: none"> <li>Riparian vegetation at EIS proposal area 1 would be impacted. Part of the removal is riparian vegetation associated with Georges River. In the north of EIS proposal area 1 a small area of open channel riparian vegetation would require removal.</li> <li>In EIS proposal area 2 an area of coastal freshwater wetland vegetation and surrounding riparian vegetation.</li> <li>The removal of riparian vegetation at EIS proposal area 1 and 2 has the potential to these impact bank stability and surface water quality.</li> <li>The impact to the coastal freshwater wetland habitat in EIS proposal area 2 has the potential to upon water quality and water levels if mitigation measures are not implemented.</li> </ul>	<ul style="list-style-type: none"> <li>The riparian vegetation impacted at both EIS proposal areas 1 and 2 would be re-vegetated to replicate a natural creek bank environment. The coastal wetlands currently has high weed levels and the area retained would be rehabilitated where possible to improve water quality and biodiversity of native vegetation. Existing culverts would be either widened or additional culverts installed to improve flow capacity.</li> </ul>

The above prescribed hydrological impacts (Table 9.9) may impose potential impacts to threatened species and communities within the EIS study area.

### 9.3.6 Wind farm development

The EIS proposal involves the upgrade of a section of Henry Lawson Drive between Keys Parade in Milperra and Tower Road in the suburb of Bankstown Airport, NSW (see Section 1.1 and Section 1.2 for the proposal description). The EIS proposal is not a wind farm development.

### 9.3.7 Vehicle strikes

All roads have potential to result in the mortality (roadkill) of native animals. The risk of vehicle strike and roadkill is higher where roads and/or associated landscaped areas:

- Traverse areas of substantial animal habitat
- Are located near natural or artificial water bodies
- Contain food sources (e.g. Mown grass verges, nectar-producing shrubs) which attract animals to the road edge
- Have high speed limits
- Provide poor visibility of wildlife (e.g. due to bends, crests and poor lighting).

No threatened terrestrial fauna were predicted to occur within the study area due to the disturbed, urban setting of the EIS proposal, a large proportion of native animal species which are prone to vehicle strike (e.g. native ground-dwelling mammals, arboreal mammals (except for adaptable common possum species) and monitor lizards are likely to have already been lost from the habitats in the study area. Impacts due to vehicle strike would be greatest in areas where the EIS proposal is adjacent to larger tracts of native vegetation communities (for example, EIS proposal area 1) associated with riparian vegetation along the Georges River remnant vegetation north west of the Bankstown Golf Course and from the vegetation south of Bankstown Airport to Ashford Reserve and wetlands south of Milperra Road.

Threatened birds and bats likely to occur within the impact area are at low risk of roadkill, since majority of threatened species are mobile (fly) and generally feed high in the canopy of vegetation. However, some species such as Forest Owl and Predatory Birds (Raptors) would readily feed on roadkill and would be placed at some risk of vehicle-strike mortality.

While it is not possible to eliminate the risk of roadkill occurring, it is possible to minimise roadkill through consideration of the above factors in the design of roads and associated landscaping and infrastructure.

It is also possible to reduce roadkill risk by encouraging animals to cross roads more safely through provision of features such as:

- Fauna underpasses
- Fauna fencing
- Fauna rope bridges
- Landscaping which encourages birds and bats to fly higher over roads.

Due to the unlikely occurrence of majority of native ground-dwelling fauna the EIS proposal is unlikely to result in significant levels of roadkill mortality. A summary of the potential impacts to threatened species (mainly threatened species that feed on roadkill - i.e. owls and raptors) are summarised in Table 9.10.

**Table 9.10 Potential impacts of vehicle strikes on threatened species or on animals that form part of a TEC**

Species at risk of vehicle strike	Likelihood of vehicle strike	Estimate vehicle strike rates	Consequences of the impacts for the local and bioregional persistence of the species
Powerful Owl ( <i>Ninox strenua</i> )	<b>Low</b> – species are highly mobile and likely to evade vehicles quickly. Feeds on carrion and potential to forage on animals previously struck by vehicles. Unlikely to regularly be susceptible to vehicle strike.	Vehicle strike estimates can be difficult to estimate due to a number of variables likely to increase probability of strikes (i.e. availability of prey species, breeding in close proximity and available habitat in locality). However, vehicle strike impact has been predicted for some predatory birds, such as the Powerful Owl. Within the Sydney Basin vehicle strike was estimated to impact 9% of the regional population per year (David Bain et al., 2014). Most strikes occurred within the breeding season and in proximity to breeding sites, suggesting that individuals being struck are sub-adults. Due to the study area not containing known breeding sites (for any of the identified species) this may reduce the likelihood of vehicle strike on predatory birds. The study area does contain potential foraging habitat and known prey species (i.e. possums) were recorded. However, due to the study areas urban setting and the lower abundance of prey species (especially terrestrial fauna) within the area it is unlikely vehicle strike would be high and therefore unlikely that large amounts of carrion would occur due to the EIS proposal. It is likely that vehicle strike rates would be negligible.	<b>Minimal</b>  Due to low prey abundances and no known breeding sites for identified species observed within the study area it is likely that the potential for vehicle strike would be low.  Landscaping which encourages birds to fly higher over roads would reduce potential vehicle strike.

## 9.4 Serious and Irreversible Impacts

This section identifies every potential serious and irreversible impact (SAIL) entity that is listed under the BC Act that would be impacted by the EIS proposal. When considering impacts on SAIL entities the principals for determining SAILs detailed in the '*Guidance to assist a decision-maker to determine a serious and irreversible impact*' (Department of Planning Industry and Environment, 2019) was taken into consideration.

#### 9.4.1 Threatened Ecological Communities SAI entities

One TEC listed as SAI entity under the BC Act was recorded within the study area; being Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion. Approximately 2.93 ha of Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion TEC occurs within the study area.

Although the Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion was recorded within the study area the TEC does not occur within the EIS proposal area and therefore will not be impacted upon by the EIS proposal. As such, the entity has not been considered further.

#### 9.4.2 Threatened flora SAI entities

No threatened flora species listed as SAI entities under the BC Act were recorded are considered likely to occur within the EIS proposal area.

#### 9.4.3 Threatened fauna SAI entities

Three threatened fauna species listed as SAI entities under the BC Act are considered to have a moderate likelihood of occurring within or using habitat within the EIS proposal area. These three species, their habitat components which form SAI entities as per the TBDC and the presence or absence of these habitat components within the EIS proposal area are provided in Table 9.11.

**Table 9.11 Threatened fauna SAI entities with potential to occur within the study area**

Common name	Scientific name	Habitat component that forms SAI entity under BC Act (TBDC)	Was the SAI habitat component recorded within EIS proposal area?
Swift Parrot	<i>Lathamus discolor</i>	Mapped important areas	No areas of mapped important habitat for the Swift Parrot occur within the EIS proposal area
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	Breeding habitat to be identified by survey including caves, tunnels, mines, culverts or other structure(s) known or suspected to be used for breeding	Targeted surveys using Anabat recorders and stag watches at dusk where undertaken at artificial structures (Figure 5.2) during December 2018. Despite targeted surveys for these species, no individuals were seen or recorded at these locations. Visual inspections of the culverts identified limited roosting potential, it is unlikely that the targeted culverts provide significant roosting habitat. It is unlikely that impacts of these structures would be considered SAIs for these species.
Little Bent-winged Bat	<i>Miniopterus australis</i>	Breeding habitat to be identified by survey including cave, tunnels, mines, culverts or other structure(s) known or suspected to be used for breeding	

As no habitat components which form part of SAI entities for these species were identified within the EIS proposal area, no threatened fauna SAI entities are considered to be impacted by the EIS proposal.

## 9.5 Matters of National Environmental Significance

### 9.5.1 Terrestrial MNES

#### Listed threatened ecological communities

The study area contains vegetation corresponding to three EPBC Act listed TECs as follows:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

Assessments for each species was done in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (see Appendix E) and a summary of the outcomes of these are provided in Table 9.12. There would be no direct impact to Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion TEC.

**Table 9.12 A summary of predicted impacts to TECs listed under the EPBC Act**

Threatened ecological community	EPBC Act status <sup>1</sup>	Extent in EIS proposal area (ha)	Significant impact?
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community	E	0.20	No - The EIS proposal will impact on up to 0.20 ha of Coastal Swamp Oak Forest which is consistent the EPBC Act listing, this will represent about 17.8% of this community recorded within the study area. Coastal Swamp Oak Forest within and surrounding the study area consists of relatively small, fragmented patches that are subject to existing edge effects associated with disturbed roadsides with predominately exotic understorey. The locality contains approximately 96 ha of PCT 1234. Proportional impact to the local occurrence is approximately 0.2%.  Given the relatively small extent that will be affected by the EIS proposal, the impact of the EIS proposal on this community is unlikely to be significant.
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	CE	0.02	No - The EIS proposal will impact on up to 0.02 ha of River-flat Eucalypt Forest which is consistent the EPBC Act listing, this will represent about 0.8% of this community recorded within the study area. River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria within and surrounding the study area consists of relatively small, fragmented patches that are subject to existing edge effects associated with disturbed roadsides with predominately exotic understorey. The locality contains approximately 487 ha of PCT 835. Proportional impact to the local occurrence is approximately 0.005%.  Given the relatively small extent that will be affected by the EIS proposal, the impact of the EIS proposal on this community is unlikely to be significant.

(1) Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

#### Listed threatened species

##### Threatened flora species

A population of *Acacia pubescens* (listed as Vulnerable) was recorded directly adjacent to the study area during the field survey on the southern side of Milperra Road within Ashford Reserve. The location of the recorded *Acacia pubescens* plants is shown in Figure 6.2 and



Figure 6.3. The targeted flora surveys did not record any other EPBC Act listed threatened flora species from within or directly adjacent to the study area.

*Acacia pubescens* was not recorded within the development footprint so there will not be any direct impact to known individuals.

### Threatened fauna species listed under the EPBC Act

The two EPBC Act listed threatened fauna species that are considered at least moderately likely to occur within the study area on occasion include:

- Swift Parrot (listed as Critically Endangered)
- Grey-headed Flying-fox (listed as Vulnerable).

The Swift Parrot and Grey-headed Flying-fox are considered moderately likely to be present based on the presence of suitable foraging habitats. The predicted impact to foraging habitat for these two species is presented in Table 9.13. Assessments for Swift Parrot and Grey-headed Flying-fox were done in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (see Appendix E). The impact of the EIS proposal on these species is unlikely to be significant.

**Table 9.13 A summary of predicted impacts to threatened fauna species listed under the EPBC Act**

Scientific name	Common name	EPBC Act <sup>1</sup>	Associated PCT(s)	Habitat extent in EIS proposal area (ha)	Significant impact?
Swift Parrot	<i>Lathamus discolor</i>	CE	PCT 835, PCT 1234 and PCT 1236	0.23	No - the EIS proposal would not have a significant impact on the species. The removal of 0.23 ha of potential foraging habitat, which contains varying abundance of the blossom trees that the species would intermittently utilise during seasonal movements, does not comprises a significant proportion of foraging habitat available to the species in the surrounding locality. There is about 602 ha of similar foraging habitat mapped in the locality so the proportion impact is 0.03%.
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	PCT 781, PCT 835, PCT 1234 and PCT 1236	0.25	No - the EIS proposal would not have a significant impact on the Grey-Headed Flying-Fox. The removal of 0.25 ha of vegetation, which contains varying abundance of the blossom and fruit trees that form part of the Grey-headed Flying fox diet, does not comprises a significant proportion of foraging habitat available to the species in the surrounding locality. There is about 652 ha of similar foraging habitat mapped in the locality so the proportion impact is 0.04%.  No roosting camps were identified within the study area or within close proximity to the study area, as a result no roosting camps will be impacted due to the EIS proposal.

(1) Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

## Listed Migratory species

Of the listed Migratory species returned from the PMST, one is considered moderately likely to occur based on the presence of suitable habitats:

- Eastern Osprey

The Eastern Osprey is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. There is potential for the species to forage along the Georges River, but no breeding habitat would be impacted.

The habitats in the study area are unlikely to constitute important habitat for this listed migratory species. The habitat present in the study area is unlikely to support significant proportions of populations of any migratory species nor are the habitats in the study area critical to any life stage of identified species. Due to its mobile nature, this species is likely to utilise higher quality habitat within the greater locality and where more extensive tracts of native vegetation occur. Because of this, this species is not considered to be significantly impacted by the EIS proposal and is not considered further in this report.

### 9.5.2 Aquatic MNES

#### Threatened and protected entities

Unmitigated impacts to aquatic habitats (specifically Georges River) may arise from construction activities. Based on the review of the Fisheries Spatial Data Portal (freshwater threatened species maps), habitat for threatened freshwater fish is not mapped in the Georges River. Threatened fish species returned from the PMST search including Macquarie Perch and Black Rockcod are not known to occur in the study area. As such, an impact to EPBC Act listed threatened fish is unlikely to occur.

The search of the PMST identified 22 sea birds or waders that were removed from the assessment based on lack of suitable habitat in the study area. Five sea turtles were also removed from the assessment based on lack of suitable habitat in the study area. As such, an impact to EPBC Act listed threatened sea birds, waders or turtles is unlikely to occur.

#### Indirect impact – Voyager Point Nationally Important Wetland

There is potential for a negative indirect impact on the Voyager Point wetland, due to an increase in suspended sediments in estuarine water that generally accompany vegetation removal and promote subsequent bank erosion. Prolonged elevated turbidity could reduce water quality and plant growth which in turn would reduce foraging and roosting habitat for listed threatened and migratory bird species.

The removal of the riparian vegetation adjoining the Georges River in EIS proposal area 1 and coastal wetland vegetation in EIS proposal area 2 have the potential to indirectly impact Voyager Point Wetland through increased levels of suspended sediments and potential bank erosion (EIS proposal area 1). Water quality treatment features such as vegetated swales, and bioretention basins being proposed at stormwater outlets.

Furthermore, an erosion and sediment control plan would be in place and a soil and water management plan to be implemented during construction. It is unlikely that the EIS proposal would have a significant impact upon this wetland. Therefore, it is unlikely that EPBC Act referral would be required.

### 9.5.3 Assessments of significance

An Assessment of Significance has been conducted for threatened species and ecological communities listed under the EPBC Act that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the EIS proposal area and subsequently have potential to be impacted by the EIS proposal.

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Specifically, whether or not an action is likely

to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts. Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility. This advice has been considered while undertaking the assessments.

A significant impact is considered unlikely for any MNES and as such a referral of the EIS proposal would not be required (see Table 9.14). Full details of the assessment of significance for threatened species under the EPBC Act are presented in Appendix E.

**Table 9.14 Summary findings of the EPBC Act significance assessments**

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population+	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
Threatened ecological communities											
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of NSW and South East Queensland ecological community	N	N	N	N	N	N	N	N	N	N/A	Unlikely
River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria	N	N	N	N	N	N	N	N	N	N/A	Unlikely
Vulnerable species*											
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	N	N	N	N	N	N	N	N	N	N	Unlikely
Critically Endangered species											
Lathamus discolor (Swift Parrot)	N	N	N	N	N	N	N	N	N	N	Unlikely

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

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- (1) reduce the extent of an ecological community
- (2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- (3) adversely affect habitat critical to the survival of an ecological community
- (4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- (5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
- (6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established, or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- (7) interfere with the recovery of an ecological community.

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

- (1) Lead to a long-term decrease in the size of a population
- (2) Reduce the area of occupancy of the species
- (3) Fragment an existing population into two or more populations
- (4) Adversely affect habitat critical to the survival of a species

- (5) Disrupt the breeding cycle of a population
- (6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- (7) Result in invasive species that are harmful to a species becoming established in the species' habitat
- (8) Introduce disease that may cause the species to decline
- (9) Interfere with the recovery of the species.

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

- (1) lead to a long-term decrease in the size of an important population of a species
- (2) reduce the area of occupancy of an important population
- (3) fragment an existing important population into two or more populations
- (4) adversely affect habitat critical to the survival of a species
- (5) disrupt the breeding cycle of an important population
- (6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- (7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- (8) introduce disease that may cause the species to decline, or
- (9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.

## 9.6 Other impacts

### 9.6.1 Aquatic impacts

Impacts to aquatic habitats (specifically Georges River) may arise from construction activities. The potential impacts on aquatic ecology are mainly due to the orientation of Henry Lawson Drive which runs parallel or adjacent to the Georges River for most of the study area.

Relatively high aquatic biodiversity values are associated with the riparian vegetation present along most of the study area which is dominated by fringing river mangroves which are interspersed with and backed by Swamp Oak forest and eucalypt forest vegetation communities. While riparian vegetation within the study area contains weeds and exotic species the mangrove habitat present represents a significant natural aquatic feature of high conservation value. These mangrove habitat areas do not occur within the EIS proposal area and as such will not be impacted upon by the EIS proposal.

Specific aquatic impacts with potential to occur because of the EIS proposal are described below.

#### Construction impacts

##### ***Direct impacts***

##### Direct removal of native aquatic and riparian vegetation

Under the current concept design, the estimated clearing of native aquatic and riparian vegetation is about 0.25 ha consisting of:

- 0.02 ha of PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner
- 0.02 ha of PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)
- 0.01 ha of PCT 1236: Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion – Poor condition



- 0.20 ha of PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner – Moderate condition.

Direct impacts on aquatic and riparian habitat would occur within EIS proposal areas 1 and 2. The habitat to be removed at these locations are associated with the Georges River (Figure 5.3).

Two KTPs associated with removal of riparian vegetation would be contributed to by the proposal and these have potential to impact aquatic ecology:

- Clearing of native vegetation, and
- The degradation of native riparian vegetation along New South Wales water courses.

Both KTPs address the potential consequences on aquatic ecology of removal of vegetation immediately along river and creek banks (such as mangroves) and behind them (such as Swamp Oak forest and eucalypt forest) which provide important ecosystem functions

#### Direct removal of aquatic threatened species habitat

No threatened aquatic species are considered likely to utilise aquatic habitat mapped within the EIS proposal area. As such, direct impacts on listed threatened fish species are unlikely due to the low probability of their occurrence in the study area.

#### Key fish habitat

The Georges River is the only mapped Key Fish Habitat within the study area. However, the mapped Key Fish Habitat of the Georges River is outside of the EIS proposal area so no direct impacts to mapped Key Fish Habitat will occur.

#### Injury and mortality of aquatic species

Fauna injury or death has the greatest potential to occur during construction when clearing of aquatic vegetation would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling amphibians) may find it difficult to rapidly move away from the clearing when disturbed. The study area is only likely to contain a limited number of aquatic species that may be impacted during vegetation removal.

Entrapment of aquatic wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

Mitigation measures designed to reduce an injury and mortality of aquatic fauna are provided in Section 10.2.

#### Direct impacts to mapped Coastal Wetlands

The EIS proposal has currently been designed to avoid direct impacts to mapped coastal wetlands as far as possible but will unavoidably result in some encroachment to coastal wetlands as the existing Henry Lawson Drive already sits within the area mapped under the Coastal Management SEPP.

A summary of the extent of mapped Coastal Wetlands potentially impacted by the EIS proposal is illustrated in Figure 4.3 and summarised in Table 9.15.

In total 0.28 ha of Coastal Wetlands mapped under the Coastal Management SEPP will be directly impacted by the EIS proposal. The discrepancy in Coastal Wetlands impacts (i.e. 0.28 ha) when compared to area of native vegetation to be impacted (i.e. 0.25 ha) is due to areas of mapped Coastal Wetlands being field validated as miscellaneous ecosystems as described in Section 5.2.

**Table 9.15      Extent of mapped Coastal Wetlands and Proximity Coastal Wetlands in the study area and extent potentially impacted by the EIS proposal**

Location	Area of mapped Coastal Wetland (ha)	Area of mapped Wetland 100 m buffer zone (ha)	Risk rating <sup>1</sup>
Study area	1.3	19.26	High
<b>EIS proposal area (development footprint)</b>	<b>0.28</b>	<b>0.00</b>	<b>Medium</b>

(1) Risk rating has been assigned based on the following criteria; Low: No impact on coastal wetland and <1-hectare impact within wetland buffer; Medium: Minor impact on coastal wetland and <2-hectare impact within wetland buffer; High: Impact on coastal wetland and > 2-hectare impact within wetland buffer

The impacts associated within the EIS proposal are likely to be minor based on the area of clearing being less than two hectares. This removal of Coastal Wetlands and riparian vegetation triggers the assessment of the proposal as designated development under Part 4 of the EPA& Act (hence the preparation of this BDAR).

Due to the relatively minor extent of impacts on Coastal Wetlands and given environmental safeguards will be implemented to minimise potential impacts it is unlikely that the EIS proposal would significantly affect Coastal Wetlands within the study area.

#### Groundwater dependent ecosystems

The possible effect of changes to groundwater flows on GDEs is assessed in this section.

GDEs include a diverse range of ecosystems from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water (Hatton and Evans, 1998)).

GDEs which are surface expressions of groundwater within the locality of the study area (<10 km) include the Georges River. Other GDEs which are reliant on subsurface groundwater in the EIS proposal area which would be impacted upon by the EIS proposal area include:

- PCT 781 – Coastal Freshwater Lagoons of the Sydney Basin and South East Corner.
- PCT 835 – Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin.
- PCT 1236 – Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion.
- PCT 1234 – Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner.

The groundwater impact assessment provided by Aurecon (2021) indicated the following:

- There are no planned works as part of construction of the EIS proposal areas that would result in flow obstruction or interference to groundwater.
- Based on current design information pavement, utility and drainage excavations for the EIS proposal are likely to be shallow (<1.5m – 2m) compared to groundwater levels generally being 2.8 – 5 mbgl. Therefore, no dewatering is expected.
- There is potential for impacts to aquatic and terrestrial GDEs through leaching of potential acid sulfate soils into GDE habitats during construction, stormwater discharges leading to burial by sediment and toxicological impacts from potential contaminants, and through transport of existing contaminant sources through preferential drainage paths (i.e. backfilled utilities trenches) during construction and operational phases.

Due to the relatively minor extent of excavations and the implementation of environmental groundwater safeguards it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the study area. The EIS proposal area is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

## ***Indirect impacts***

Potential indirect construction impacts associated with the EIS proposal on aquatic biodiversity values include:

- invasion and spread of pathogens and disease
- invasion and spread of weeds
- changes to hydrology and geomorphology of watercourses
- increased noise, dust, light and vibration
- mobilisation of contaminants and sedimentation.

Each of these indirect impacts are described in more detail in Section 9.2 and Section 9.3.5.

Key local indirect effects of removal of aquatic and riparian vegetation potentially include degraded water quality due to increased sediment-laden runoff, long term bank erosion, mobilisation of potential acid sulphate soils, decrease in food availability for aquatic biota and water birds and loss of bank-associated aquatic habitat such as overhangs and shade.

If not mitigated these indirect impacts could lead to reductions in water quality and associated aquatic habitat. Indirect impacts will be reviewed and finalised following detailed design to determine the final development footprint. Mitigation measures provided in Section 10 will be developed specially to mitigate indirect impacts.

### Voyager Point Nationally Important Wetland and key fish habitat

There is potential for a negative indirect impact on the Voyager Point wetland and key fish habitat, due to an increase in suspended sediments in estuarine water that generally accompany vegetation removal and promote subsequent bank erosion. Prolonged elevated turbidity could reduce water quality and plant growth which in turn would reduce foraging and roosting habitat for listed threatened and migratory bird species.

The EIS proposal will not impact on mangroves and as is the best practice design of the road upgrade has included environmental safeguards to control sediment runoff into the Georges River. Due to this, significant impacts on these wetland habitats would be unlikely. It is unlikely that EPBC Act referrals would be required.

## **Operational impacts**

### ***Direct impacts***

In addition to the potential direct impacts associated with the construction of the EIS proposal the following direct impacts are also likely to occur during the operation of the EIS proposal.

### Increases to existing habitat fragmentation and wildlife connectivity

Habitat fragmentation per se relates to the physical dividing up of once continuous habitats into separate smaller 'fragments'. The habitats within the study area are fragments that have formed since the initial habitat clearing that has occurred. The current alignment of Henry Lawson Drive and Milperra Road divide the remaining habitats in the study area. The barrier posed by the existing Henry Lawson Drive and Milperra Road serve to restrict fauna movements between habitat patches. However, functional habitat connectivity for more mobile species (e.g. birds, flying-foxes, insectivorous bats, insects, plants) is still present. The current roadways do not totally prevent fauna movement between habitat fragments (fauna can and likely do cross the road) but the roads do create a considerable hazard.

The EIS proposal would not break apart continuous habitats into separate smaller fragments. The EIS proposal would however result in an increase in isolation of habitats as the current habitat patches would be made smaller which would increase the physical distance between habitat fragments. The isolation that may be caused by the EIS proposal is not likely to have an appreciable impact on more mobile species however is likely to be detrimental to the dispersal of frogs and other aquatic fauna which are less mobile. These impacts however would only be marginally greater than that which is already experienced.

The predicted level of isolation from the EIS proposal is not likely to be enough to prevent the breeding and dispersal of aquatic plant pollinators or the dispersal of aquatic plant propagules

(i.e. seed or other vegetative reproductive material) between habitat patches. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species may result.

This impact would be of low magnitude and specific mitigation measures are not deemed to be necessary.

Mitigation measures would be implemented to limit impacts to aquatic habitat.

### **Indirect impacts**

Potential indirect long-term potential operational impacts association with the EIS proposal on aquatic biodiversity values include:

- Edge effects reducing the viability of adjacent higher quality remnant habitats in the long-term due to enriched run-off from road pavements, establishment and spread of weeds, pathogens and disease as well as the dumping of rubbish.
- Changes to hydrology and geomorphology of watercourses due to increases in impermeable surfaces and alterations to natural landforms.
- Increased noise, dust, light and vibration because of widening the existing roads.
- Mobilisation of contaminants and sedimentation.

These potential long-term indirect impacts have potential to result in the degradation of adjacent water quality and aquatic and riparian habitats due to increased sediment-laden runoff, long term bank erosion, mobilisation of potential acid sulphate soils, decrease in food availability for aquatic biota and water birds and loss of bank-associated aquatic habitat such as overhangs and shade. Environmental safeguards and mitigation measures implemented as part of the EIS proposal will minimise these impacts.

Each of these indirect impacts are described in more detail in Section 9.2 and Section 9.3.5.

### **9.6.2 Cumulative impacts**

The incremental effect of multiple sources of impact (past, present and future) are referred to as cumulative impacts (Contant and Wiggins, 1991, Council on Environmental Quality, 1978). Cumulative impact assessment considers a EIS proposal within the context of other past, present and likely future sources of impact. This is necessary to identify any impacts associated with the EIS proposal that may have an additive effect or interaction with impacts from other activities within the locality to the extent that the overall (cumulative) impact becomes significant when it would not otherwise have been significant.

The potential cumulative biodiversity impacts as a consequence of the construction and operation of the EIS proposal are discussed here within the context of the existing environment, present and likely future impacts.

Residential and infrastructure development in the locality in historic and recent times has led to extensive vegetation clearing in the locality and at the catchment scale. Remaining remnant vegetation/habitat has also been affected by a variety of disturbance mechanisms, including clearing of undergrowth, altered fire regimes, feral animals and weed invasion. This habitat loss and disturbance has resulted in the local extinction of a number of species which are less tolerant of habitat loss and disturbance (e.g. woodland birds and small mammals) and an increased risk of extinction to a number of vegetation communities.

Isolated remnant populations of disturbance-sensitive threatened species in such a landscape may be susceptible to local extinction due to seemingly small reductions in habitat area or quality, if the habitat is near the lower limit in size or quality necessary to support a viable population and a critical threshold is reached.

In assessing the cumulative impact of an EIS proposal, it is important to consider whether the additive effects of multiple proposals may cause such a critical threshold to be reached for any threatened biodiversity affected. The EIS proposal's removal of 0.25 hectares of native vegetation and habitats would represent an incremental increase to impacts on biodiversity associated with past, present and future projects within the locality. This incremental increase



is considered unlikely to significantly exacerbate impacts on biodiversity such that the critical threshold would be reached.

A number of developments are underway or planned in the locality, that also impact on biodiversity values that are likely to be impacted by the current EIS proposal. These are summarized in Table 9.16.

**Table 9.16 Past, present and future projects within the vicinity of the EIS proposal**

Project	Project Stage	Biodiversity value impacted
Bankstown Airport Redevelopment	Construction phase	<ul style="list-style-type: none"> <li>Impact to threatened flora species including; <i>Hibbertia glabrescens</i>, <i>Acacia pubescens</i></li> <li>Impact to Cooks River/Castlereagh Ironbark Forest</li> </ul>
Moorebank Intermodal Terminal	Construction phase	<ul style="list-style-type: none"> <li>Five threatened ecological communities including; <ul style="list-style-type: none"> <li>Castlereagh Scribbly Gum Woodland in Sydney Basin bioregion</li> <li>Castlereagh Swamp Woodland.</li> <li>River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions</li> <li>Cumberland Plain Woodland in the Sydney Basin Bioregion</li> <li>Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions</li> </ul> </li> </ul>
SIMTA Intermodal Facility	Construction phase	<ul style="list-style-type: none"> <li>Biodiversity – clearing of 1.23 hectares of native vegetation</li> </ul>
Glenfield Waste Services Materials Recycling Facility -	Planning and assessment phase	<ul style="list-style-type: none"> <li>9.5 hectares of critically endangered Cumberland Plain Shale Woodland and Shale Gravel Transition Forest</li> <li>5 threatened bat species recorded</li> </ul>
Riverlands subdivision - Milperra	Planning and assessment phase	<ul style="list-style-type: none"> <li>0.54 ha River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions</li> <li>0.48 ha Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions</li> <li>Southern Myotis</li> <li>Green and Golden Bell Frog</li> </ul>
Milperra Drain Widening	Construction phase	<ul style="list-style-type: none"> <li>0.83 ha of River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions</li> <li>0.15 ha of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions</li> </ul>
Henry Lawson Drive – REF proposal for Stage 1A	Planning and assessment phase	<ul style="list-style-type: none"> <li>0.21 ha of Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion</li> <li>0.07 ha of Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions</li> <li>0.96 ha River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions</li> <li>0.45 ha Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions</li> <li>Threatened species including Southern Myotis, <i>Acacia pubescens</i> and <i>Callistemon linearifolius</i></li> </ul>

### Cumulative impacts to Freshwater Wetlands on Coastal Floodplains

Both the EIS proposal and the REF proposal will have direct impacts on the Freshwater Wetlands on Coastal Floodplains threatened ecological community listed as Vulnerable under the BC Act. The combined impacted of the overall proposal would be the direct removal of 0.09 ha of PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner to coastal wetlands as summarised in Table 9.17.

**Table 9.17 Cumulative Impact to Freshwater Wetlands**

Proposal area	Area of Freshwater Wetland impacted (ha)
REF proposal area	0.07
EIS proposal area	0.02
<b>Total Impact</b>	<b>0.09</b>

Within the EIS proposal area, impacts to PCT 781 would be restricted to EIS proposal area 2. PCT 781 would also be directly impacted at two locations within the REF proposal area being; on the southern side of Milperra Road and to the south of Auld Avenue on the eastern side of Henry Lawson Drive.

The key potential operational impacts (i.e. long-term and ongoing impacts) associated with the EIS proposal on Freshwater Wetlands on Coastal Floodplains would include:

- Edge effects reducing the viability of adjacent higher quality remnant habitats in the long-term due to enriched run-off from road pavements, establishment and spread of weeds, pathogens and disease as well as the dumping of rubbish.
- Changes to hydrology and geomorphology of watercourses due to increases in impermeable surfaces and alterations to natural landforms.
- Increased noise, dust, light and vibration because of widening the existing roads.
- Potential mobilisation of contaminants and sedimentation.

These potential long-term indirect impacts have potential to result in the degradation of adjacent water quality and coastal wetland habitats. Environmental safeguards and mitigation measures would be implemented as part of the EIS proposal to minimise these impacts.

### Cumulative impacts to areas of Coastal Wetlands and Proximity Coastal Wetlands (100 metre buffer)

About 7.10 ha of proximity area for coastal wetlands would be directly impacted by the REF proposal, which would include removal of threatened biodiversity. This is assessed in the Biodiversity Assessment Report and the REF in section 6.1.3.

The EIS proposal only contains about 0.28 of Coastal Wetlands and would only have direct impacts to these small areas but has potential to contribute to indirect impacts to these areas. Due to the nature and scale of activities of the EIS proposal, the indirect impacts as outlined in the impact assessment section of this EIS would be comparatively minor compared to the more direct impacts caused by the REF proposal to the proximity area.

## 9.7 Impact summary

An impact summary of the EIS proposal area in Section 9.2 and Section 9.3 of the BAM is provided below.

### 9.7.1 SAI entities

No SAI entities listed under the BC Act were recorded or are considered likely to occur within the EIS proposal area. Therefore, no impacts on SAI entities are predicted to occur because of the EIS proposal and as such have not been considered further.

### 9.7.2 Impacts not requiring offsets

In accordance with subsection 9.2.1 of the BAM, an offset is not required for impacts on PCTs that are associated with a vegetation zone that has a VI score of:

- $\geq 15$ , where the PCT is representative of an EEC or CEEC; or
- $\geq 17$ , where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a VEC; or
- $\geq 20$ , where the PCT does not represent a TEC and is not associated with threatened species habitat.

Biodiversity offsetting for residual impacts that exceed the thresholds above on BC Act biodiversity values is mandatory for developments being assessed under Part 4.1 of the EP&A Act and subsequently assessed under Part 7 of the BC Act and subject to a BDAR.

All vegetation zones recorded within the EIS proposal area exceeded the VI score thresholds listed above, except for VZ2 (PCT 781) and therefore, require biodiversity offsets. The required biodiversity ecosystem and species credit obligations for the EIS proposal are summarised below in Section 9.7.3 and detailed in Chapter 11.

### 9.7.3 Impacts requiring offsets

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the EIS proposal, some residual impacts would occur. The EIS proposal's biodiversity offset obligation for impacts on biodiversity values requiring offsetting in accordance with subsection 9.2.1 of the BAM were determined using the BAM-C. The required ecosystem and species credit obligations are provided in Appendix F and Chapter 11. The areas requiring offsetting in accordance with BAM are illustrated in Figure 9.1.

### 9.7.4 Areas not requiring assessment

In accordance with section 9.3 of the BAM areas within the subject land that do not contain native vegetation do not need to be assessed for ecosystem credits. Despite this, these areas must still be assessed for threatened species habitat associated with species credits in accordance with Chapter 5 of the BAM and prescribed impacts in accordance with Chapter 6 of the BAM.

Non-native vegetation occurs within the species polygon of a single threatened species credit species within the EIS proposal area; being the Southern Myotis. Non-native vegetation is not listed as suitable habitat for the Southern Myotis in the TBDC and therefore does not require further assessment as per subsection 5.2.5 of the BAM. Thus, no species credits would be required to be offset for the non-native vegetation.

Prescribed impacts associated with non-native vegetation within the EIS proposal area are assessed in Section 9.3 of this report in accordance with Chapter 6 of the BAM.





- Watercourse
- Study area
- EIS proposal area
- Areas not requiring offsets
- Areas requiring offsets

**Data source:** - **HEARST**, **UCSA**, **Geospatial Australia**  
**Cor:** **HEARST**, **Geoinf**, **OpenStreetMap** contributors, and the **GIS** user community



## 10 Mitigation and management of impacts

---

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the EIS proposal. Mitigation measures would be undertaken during the construction and operational phases of the EIS proposal.

Mitigation measures for the EIS proposal are provided below in Section 10.1 and Section 10.2.

### 10.1 Terrestrial ecology mitigation measures

The Roads and Maritime (now Transport for NSW) guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a proposal, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

The following mitigation measures as outlined in the Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects (Roads and Traffic Authority, 2011) are recommended for implementation (see Table 10.1). The NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (Department of Primary Industries, 2013) has also been used in the preparation of these mitigation measures.

Transport and the construction contractor will implement the mitigation measures through the detailed design phase and construction. Monitoring and checking compliance to mitigation measures is undertaken throughout both project phases. Section 10.1 of the EIS describes the environmental management plans and the system in which mitigation measures will be implemented. The Construction EMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements, including but not limited to effectiveness of measures in addressing environmental risk, environmental incidents and nonconformities, management reviews and auditing. With these processes in places, management techniques would be 'adaptive'.

**Table 10.1 Mitigation measures**

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Removal of native vegetation and habitat	Native vegetation removal will be minimised through detailed design processes where possible, with consideration to: <ul style="list-style-type: none"> <li>• Placement of embankments and adopting alternative options such as retaining walls to minimise the construction footprint.</li> <li>• Surveying the location of hollow bearing trees and including these on detailed design plans for further investigation in avoiding or minimising direct impacts</li> </ul>	Detailed design	Effective	Loss of native vegetation – predicted residual impact would include the removal of up to 0.25 ha of native vegetation and associated habitats	Construction contractor
	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	Prior to construction	Effective		
	Vegetation removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective		
	Native vegetation will be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) and Landscaping Plans for the proposal. The Landscaping Plans will be prepared with further consideration to the selection of vegetation species that adopts existing communities and landscape character and uses local provenance. Transport will consult with Council during detailed design of the Landscaping Plans.	Detailed design and during construction	Effective		
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (RTA 2011) if TECs, not assessed in the biodiversity assessment, are identified in the EIS proposal area.	During construction	Proven		

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
	Habitat removal will be minimised through detailed design processes where possible, with consideration to: <ul style="list-style-type: none"> <li>Placement of embankments and adopting alternative options such as retaining walls to minimise the construction footprint.</li> <li>Surveying the location of hollow bearing trees and including these on detailed design plans for further investigation in avoiding or minimising direct impacts.</li> </ul>	Detailed design	Effective	Loss of threatened fauna habitat – predicted residual impact would include the removal of up to 0.25 ha of threatened fauna species habitat including the removal of three hollow bearing trees	Transport Proposal Design Engineer
	Fauna will be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective		Construction contractor
	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective		Construction contractor
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) or any updated approaches to tree hollow replacement such as relocated hollows or created hollows.	During construction	Proven		
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the EIS proposal area.	During construction	Proven		
	A targeted microbat survey of structures within the footprint and proposed for removal or modification would be undertaken in accordance with 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH, 2018b), prior to construction or as soon as feasible prior to disturbance.  If threatened microbats are detected, a Microbat Management Plan would be developed as part of the Construction Environment Management Plan (CEMP) and implemented by a suitably qualified bat specialist. The CEMP and Microbat Management Plan (if required) will be submitted to Council for review by the construction contractor.	Prior to construction / During construction  Prior to construction / During construction	Effective		Construction contractor

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Indirect impacts on native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011). This will include excluding portions of the mapped coastal wetlands along sections of the property boundary of EIS Proposal Area 3 to avoid any unnecessary disturbance, except for property site restoration works that may be needed at the end of construction in consultation with Council.	During construction	Effective	Loss of habitat in edge areas	Construction contractor
	Weed species will be managed in accordance with <i>Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	No residual impacts anticipated	Construction contractor
	The Landscaping Plan and the Construction Flora and Fauna Management Plan, the latter comprising a Weed Management Sub-Plan will be prepared in accordance with the DPI Office of Water Guidelines for Vegetation Management Plans on Waterfront Land (2012).	Prior to construction	Effective	No residual impacts anticipated	Construction contractor
	Pest species will be managed within the EIS proposal area.	During construction	Effective	No residual impacts anticipated	Construction contractor
	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	No residual impacts anticipated	Construction contractor
	Shading and artificial light impacts will be minimised where practicable taking into account minimum luminescence requirements for an urban road as outlined in the Australian Standards through detailed design.	Detailed design	Effective	Impacts from noise and light spill would remain	Transport Proposal Design Engineer
Potential removal of threatened plants	Pre-clearing surveys will be undertaken in accordance with <i>Guide 1: Pre-clearing process of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Proven	No residual impacts anticipated	Construction contractor
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the EIS proposal area.	During construction	Proven		Construction contractor



Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Impacts to habitat in human made structures	Implement pre-work microbat inspection procedure for culverts structures or any artificial structures deemed suitable to identify utilisation from microbats. If bats present within structure, procedures for exclusion or removal of individuals from structures will be developed and undertaken by qualified personnel.	During construction	Effective	The mitigation measures should be effective, but injury or death may still occur	Construction contractor
	Develop options for providing microbat roosting habitat during detailed design processes for culvert structures particularly for the Southern Myotis ( <i>Myotis macropus</i> ).	Detailed design	Proven	No residual impacts anticipated	Proposal Design Engineer
	Fauna will be managed in accordance with <i>Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	The mitigation measures should be effective, but injury or death may still occur	Construction contractor
Impacts to habitat in non-native vegetation	Habitat removal will be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	Loss of threatened fauna habitat – predicted residual impacts of 0.25 ha of threatened species habitat	Construction contractor
	Habitat will be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011).	During construction	Effective	Loss of threatened fauna habitat	Construction contractor
Impacts to hydrology	Changes to existing surface water flows will be minimised through detailed design processes. The stormwater design for operational phase would aim to maintain, wherever possible, the existing flood regime and levels as identified by Lyall & Associates (2018).	Detailed design	Effective	No residual impacts anticipated	Proposal Design Engineer

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Vehicle strike	<p>Opportunities to minimise road-kill will be identified in the design process with consideration to:</p> <ul style="list-style-type: none"> <li>• Available space.</li> <li>• Avoid creating features too close to the roadside that would attract fauna to the roadside.</li> <li>• Using landscaping techniques to create suitable buffers and to separate any potential attracting features from the roadside.</li> <li>• A roadside planting palette that does not intentionally attract fauna to the roadside.</li> </ul>	Detailed design	Effective	Minor increase in potential vehicle strike during operation	Proposal Design Engineer
Groundwater dependent ecosystems	Interruptions to groundwater and surface water flows associated with groundwater dependent ecosystems, and impacts to GDEs, will be minimised through detailed design.	Detailed design	Effective	No residual Impacts anticipated	Proposal Design Engineer
	<p>Disturbance of acid sulfate soils to be minimised during construction to prevent leaching into GDEs. Stormwater discharges to be managed to prevent sedimentation of GDE and toxicological impacts from potential contaminants. Sources of existing contaminants will be managed during construction through a Construction Contaminated Land Management Plan and by implementing the water quality strategy for the operational phase.</p> <p>The water quality strategy will be developed in detailed design and in consultation with Canterbury-Bankstown City Council. An Acid sulfate and soil contamination management plan will be implemented to reduce the impact from the EIS proposal.</p>	During Construction	Effective		Construction contractor

## 10.2 Aquatic ecology mitigation measures

Mitigation measures aimed at maintaining riparian habitat and water quality during the EIS proposal construction and operation are outlined below in Table 10.2.

The mitigation measures outlined in Table 10.2, if appropriately implemented, would be adequate to minimise direct and indirect impacts on aquatic biota and habitats.

**Table 10.2 Aquatic mitigation measures**

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
General Guidelines	Aquatic habitat will be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures</i> of the <i>Policy and guidelines for fish habitat conservation and management Update 2013</i> (Department of Primary Industries, 2013).	During construction	Effective	Minor, localised, modification to already highly disturbed habitat – residual impact includes impacts to 0.28 ha of Coastal Wetlands and their buffer area	Construction contractor
Aquatic impacts	Consultation with NSW DPI Fisheries Regional Conservation Manager will be undertaken to discuss the best approach to construction works within aquatic habitats and riparian zones. Consulting before clearing will identify any trees proposed to be removed that could potentially be used for re-snagging of a waterway.	Prior to construction	Effective	Minor, localised, modification to already highly disturbed habitat – residual impact includes impacts to 0.28 ha of Coastal Wetlands and their buffer area	Transport proposal Environment Officer
	Access to the waterway minimises the removal of riparian vegetation and is restricted to the minimum amount of bank length required for the construction activity.	During construction	Effective		
	Riparian exclusion zones are marked out and managed according to Guide 2: Exclusion zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (RTA 2011) to protect aquatic habitats and riparian zones where works are not required.	During construction	Proven		Construction contractor

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Coastal Wetlands and Proximity Areas for Coastal Wetlands	Consider detailed design refinements and constructability options that maintain the undisturbed western boundary of the existing Henry Lawson Drive wherever possible, minimising removal of riparian vegetation or disturbance coastal wetlands and proximity areas for coastal wetlands.	Detailed design	Effective	Reduce the area of impact to coastal wetlands where possible.	Proposal Design Engineer
Contamination to aquatic biodiversity	Operational water quality controls are proposed to be installed for the overall proposal to reduce impacts from potential contaminants that maybe mobilised from the soil and/or groundwater. These will mitigate contaminants reaching the Georges River, including surrounding coastal wetlands.	During Construction and Operation	Effective	No residual Impacts anticipated	Construction contractor
	Management of surface water during construction would be undertaken through the Construction Soil and Water Management Plan (CSWMP). The CSWMP would include the avoidance of water discharge off-site and ensure environmental values are maintained. Where practicable, captured runoff would be reused on-site following the NSW Environmental Protection Authority's waste hierarchy.	During Construction	Effective	No residual Impacts anticipated	Construction contractor
	A stormwater drainage system would divert stormwater runoff along the north-eastern boundary into a vegetated swale. Stormwater drainage systems to divert water along the southern boundary of Milperra Road to discharge points.	Operation	Effective	No residual Impacts anticipated	TfNSW
	During construction, a water quality monitoring program would occur to ensure that site stabilisation techniques are sufficient in avoiding or managing negative impacts to water quality of the sensitive receiving environments.	During Construction	Effective	No residual Impacts anticipated	TfNSW
Acid Sulphate soils	An Acid sulphate soil management plan is to be implemented as part of the CEMP. This plan can be implemented if acid sulfate soils are exposed during the excavation works.	During Construction	Effective	No residual Impacts anticipated	Construction contractor



Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated	Responsibility
Sediment and erosion control	Design and implement site-specific erosion and sediment control plans and soil and water management plans as per Blue Book Vol 1 (Landcom, 2004) to avoid disturbed sediment entering waterways and degrading local and /or downstream water quality, directly or indirectly impacting on aquatic biota and habitats.	Pre-construction	Effective	No residual Impacts anticipated	Construction contractor
	Vegetated swales are proposed to be installed to increase water quality for any runoff from the EIS proposal. Vegetated swales would treat runoff from drainage outlets located along Henry Lawson Drive discharging into the Georges River north of the intersection with Milperra Road, and into Milperra Drain to the south of the intersection.	During construction	Effective	No residual Impacts anticipated	Construction contractor
	A CSWMP or similar as part of a CEMP will be developed and implemented prior to construction to reduce impacts to aquatic biodiversity. The proposal has been divided into 33 control areas (see NGH, 2021).	During Construction	Effective	No residual Impacts anticipated	Construction contractor
	Erosion and sediment (ERSED) controls are to be installed around the ancillary site in EIS proposal area 3 to reduce the risk of sediment runoff to the east into Milperra Drain near the Bankstown Golf Course. These ERSED controls are to be integrated into any exclusion zone or property boundary demarcation..	During Construction	Effective	No residual Impacts anticipated	Construction contractor
	Temporary diversion drains and/or sediment fencing would be provided to collect runoff from the disturbed areas. Runoff would be treated through a series of sediment sumps and/or inline sediment control measures.	During Construction	Effective	No residual Impacts anticipated	Construction contractor
	Depending on the extent of temporary sediment sumps and in-line controls additional erosion controls could be implemented. For example, stabilisation of the fill batter with a cover such as temporary ground cover or spray-on soil binder prior to forecast rainfall.	During Construction	Effective	No residual Impacts anticipated	Construction contractor
	Works within tidal areas of the Georges River would need to include measures to control the dispersion of sediment, such as the provision of turbidity barriers.	During Construction	Effective	No residual Impacts anticipated	Construction contractor

# Biodiversity offsets

## Ecosystem credits

The required ecosystem credit obligation, as determined using the BAM-C for the EIS proposal illustrated in Figure 9.1 and detailed in Table 11.1 and Appendix F.

**Table 11.1 Ecosystem credits required to offset EIS proposal impacts**

PCT	Vegetation zone (BDAR reference)	Vegetation zone (BAM-C reference)	TEC	SAIL	Area impacted (ha)	Biodiversity risk weighting	Current Vegetation VI Score	Vegetation Integrity Loss	Ecosystem credit obligation
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner Bioregion	2	4	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion	No	0.02	2	8.8	-8.8	0
PCT 835 Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin Bioregion	3	2	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion	No	0.02	2	48.4	-48.4	1
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner Bioregion	12	3	Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregion	No	0.01	2	49.4	-49.4	5
PCT 1236 Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	11	1	Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregion	No	0.20	2	34.3	-34.3	1
<b>Total Ecosystem Credits Required</b>									<b>7</b>

## 11.2 Species credits

The required species credit obligation, as determined using the BAM-C for the EIS proposal illustrated Figure 6.4 and detailed in Table 11.2 and Appendix F.

**Table 11.2 Species credits required to offset EIS proposal impacts**

Common Name	Scientific Name	SAII	Biodiversity Risk Weighting	Species Credit Obligation
Southern Myotis	<i>Myotis macropus</i>	No	2	8

## 11.3 Aquatic offsets

The *Policy and guidelines for fish habitat conservation and management – Update 2013* (NSW Department of Primary Industries, 2013) indicates that compensation for disturbances to SEPP 14 coastal wetlands (which may include Type 1 and 2 habitats) requires approval from the Department of Planning, Infrastructure and Environment and a ratio of 10:1 generally applies (NSW Department of Primary Industries, 2013). As SEPP 14 has been repealed by the Coastal Management SEPP, the mapping from the Coastal Management SEPP is relevant.

There will be no impacts to protected marine vegetation such as Mangroves so additional offsets are not required in accordance with NSW DPI *Policy and guidelines for fish habitat conservation and management update 2013* (NSW Department of Primary Industries, 2013).

## 11.4 Preliminary offsetting strategy

It is anticipated that payment for offsets would be paid into the Biodiversity Conservation Fund and/or purchased from existing biodiversity credits available on the open market. Once the detailed design of the disturbance footprint is refined and finalised a detailed Biodiversity Offset Strategy will be developed for the overall proposal (i.e. both REF and EIS components) to identify biodiversity credits and/or supplementary measures for those entities being impacted and requiring offset.

## 12 Conclusion

This report provides an assessment of biodiversity values associated with the EIS proposal to support an Environmental Impact Statement (EIS) subject to assessment as designated development under Division 4.1 of the EP&A Act.

Results of the field surveys and desk based investigations completed identified four PCTs within the EIS proposal area based on floristic composition, geological substrate and landscape position. Table 12.1 below summaries the Plant Community Types (PCTs) recorded and the area of removal of each PCT within the EIS porposla area.

**Table 12.1 Summary of PCTs and impacts**

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Percent cleared in IBRA region	Impact area in EIS Proposal (ha)
PCT 781: Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Moderate condition	E	-	74%	0.02
PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Moderate condition – Forest Red Gum variant	E	CE	93%	0.02
PCT 1236: Swamp Paperbark – Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Poor condition	E	-	32%	0.01
PCT 1234: Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Moderate condition	E	E	90%	0.20
Total area of native vegetation impact					0.25

Within the EIS proposal area one non-native vegetation type was assigned to the miscellaneous ecosystem class, being Weeds / exotics – non-native vegetation.

The EIS proposal is likely to impact upon 0.28 ha of Coastal Wetlands and their buffer areas mapped under the Coastal Management SEPP. A summary of these impacts is provided in Table 12.2 below.

**Table 12.2 Summary of impacts**

Location	Area of Coastal Wetland impacted (ha)	Area of Wetland 100 m buffer zone impacted (ha)
Study area	1.3	19.26
<b>EIS proposal area (development footprint)</b>	<b>0.28</b>	<b>0.00</b>

A total of three threatened ecological communities (TECs) listed under the BC Act were recorded to occur within the EIS proposal area. These are;

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.



Two of these BC Act-listed TECs are also listed under the EPBC Act which include:

- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

A total of 0.25 ha of BC Act listed TECs and 0.22 ha of EPBC Act TECs would require removal by the EIS proposal.

Field surveys completed identified two threatened flora species as occurring in the adjoining REF proposal area, being:

- *Acacia pubescens* (Downy Wattle) (BC Act Vulnerable, EPBC Act Vulnerable)
- *Callistemon linearifolius* (Netted Bottle Brush) (BC Act Vulnerable).

Neither of these two threatened flora species will be directly impacted upon by the EIS proposal portion of the overall proposal.

Field surveys recorded one threatened fauna species within the EIS proposal area 1, being *Myotis macropus* (Southern Myotis) which is listed under as Vulnerable under the BC Act. Two threatened fauna species were recorded within the study area, being the Grey-headed Flying-fox listed as vulnerable under the BC Act and EPBC Act and the White-bellied Sea-eagle which is listed as vulnerable under the BC Act. Both of these species recorded have habitat within the EIS proposal area.

Three hollow-bearing trees located in EIS proposal area 1 may be impacted by the EIS proposal. The exact number of hollow-bearing trees to be removed will be finalised at the final design stage.

Due to the relatively minor extent of excavations and the implementation of environmental groundwater safeguards it is unlikely that interception of groundwater flows would significantly affect groundwater dependent ecosystems within the EIS proposal area. The EIS proposal area is not expected to substantially interfere with subsurface or groundwater flows associated with the Georges River.

The Georges River has a waterway classification of Class 1: Major key fish habitat with habitat sensitivity Type 2: Moderately sensitive key fish habitat as defined in the *Policy and guidelines for fish habitat conservation and management – Update 2013* (Department of Primary Industries, 2013). No habitat for threatened fish or threatened ecological community listed under the FM Act occurs within the EIS proposal area.

Within the study area the banks of the Georges River are lined by seedlings, shrubs and trees of River mangroves (*Aegiceras corniculatum*) and Grey mangroves (*Avicennia marina*) (PCT 920). Mangroves are protected under the FM Act. The mangroves would not be impacted by the EIS proposal.

The estimate of biodiversity credits calculated using the BAM-C are preliminary as the detailed design has yet to be finalised. Detailed design would develop a Biodiversity Offset Strategy and this would be integrated with the Biodiversity Offset requirements for the REF proposal.

Estimate of biodiversity Credit requirements for the EIS proposal are summarised in Table 12.3 below.

**Table 12.3 Summary of Biodiversity credit requirements**

Biodiversity value requiring offsetting in accordance with BAM	Type of credit	Number of credits
PCT 781 - Coastal Freshwater Lagoons of the Sydney Basin and South East Corner	Ecosystem	0
PCT 835 - Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin	Ecosystem	1
PCT 1234 - Swamp Oak Swamp Forest Fringing Estuaries, Sydney Basin and South East Corner	Ecosystem	5

Biodiversity value requiring offsetting in accordance with BAM	Type of credit	Number of credits
1236 - Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin Bioregion and South East Corner Bioregion	Ecosystem	1
Southern Myotis	Species	8
<b>Total number of ecosystem credits</b>		<b>7</b>
<b>Total number of species credits</b>		<b>8</b>

Assessments of impact significance were conducted for all EPBC Act listed threatened species and ecological communities considered likely to be affected by the EIS proposal. These impact assessments determined that the EIS proposal is unlikely to lead to a significant impact on threatened species, populations, ecological communities or their habitats. In respect to Matters of National Environmental Significance (MNES) matters including threatened flora, fauna and communities, a referral of this proposal for consideration as a controlled action under the EPBC Act is not required.

Key recommendations are as follows:

- Limit the removal of native vegetation and threatened ecological communities where practical during detailed design and construction
- Limit removal of coastal wetlands during detailed design and construction
- Implement a Bat Management Plan during construction
- Implement mitigation measures as outlined in Section 10 to limit indirect and direct impacts to biodiversity values.

## 13 References

---

- ATLAS OF LIVING AUSTRALIA. 2021. *Atlas of Living Australia* [Online]. Available: <https://www.ala.org.au/> [Accessed January 2021].
- AURECON AUSTRALASIA PTY LTD *Henry Lawson Drive Upgrade Stage 1A Preliminary Site Investigation*. Transport for NSW
- BUREAU OF METEOROLOGY. 2021. *Groundwater Dependent Ecosystems Atlas* [Online]. Available: <http://www.bom.gov.au/water/groundwater/gde/> [Accessed January 2021].
- BUREAU OF METEOROLOGY. 2021. *Climate Data Online* [Online]. Available: <http://www.bom.gov.au/climate/data/?ref=fttr> [Accessed 2021].
- CHESSMAN, B.C., GROWNS, J.E. and KOTLASH A.R. (1997) *Objective derivation of macro invertebrate family sensitivity grade numbers for the SIGNAL biotic index: application to the Hunter River system*, New South Wales. *Marine and Freshwater Research* 48, 159-172.
- CHURCHILL, S. 2008. *Australian Bats*, Sydney, Allen & Unwin.
- CONTANT, C. K. & WIGGINS, L. L. 1991. Defining and analyzing cumulative environmental impacts. *Environmental Impact Assessment Review*, 11, 297-309.
- COUNCIL ON ENVIRONMENTAL QUALITY 1978. CEQ - Regulations for Implementing National Environmental Policy Act (NEPA) - Sec. 1508.7 Cumulative impact. Washington DC: Council on Environmental Quality (United States of America).
- CROPPER, S. C. 1993. *Management of Endangered Plants*, Melbourne, CSIRO Australia.
- DAVID BAIN, ROD KAVANAGH, KRISTEN HARDY & HOLLY PARSONS 2014. *The Powerful Owl Project: Conserving owls in Sydney's urban landscape*. Melbourne: BirdLife Australia.
- DEBUS, S. J. S. 1994. The Sooty Owl *Tyto tenebricosa* in NSW. *Australian Birds*, 28, S4-S19.
- DEBUS, S. J. S. & CHAFER, C. J. 1994. The Powerful Owl *Ninox strenua* in NSW. *Australian Birds*, 28, 41-57.
- DEBUS, S. J. S. & ROSE, A. B. 1994. The Masked Owl *Tyto novaehollandiae* in NSW. *Australian Birds*, 28, 21-39.
- DEPARTMENT OF AGRICULTURE WATER AND THE ENERGY. 2021a. *Australian Faunal Directory* [Online]. Available: <https://biodiversity.org.au/afd/home> [Accessed January 2021].
- DEPARTMENT OF AGRICULTURE WATER AND THE ENERGY. 2021b. *Directory of Important Wetlands in Australia* [Online]. Available: <https://www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands> [Accessed January 2021].
- DEPARTMENT OF AGRICULTURE WATER AND THE ENERGY. 2021c. *Protected Matters Search Tool* [Online]. Available: <https://www.environment.gov.au/epbc/protected-matters-search-tool> [Accessed January 2021].
- DEPARTMENT OF AGRICULTURE WATER AND THE ENERGY. 2021d. *Register of Critical Habitat* [Online]. Available: <https://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl> [Accessed January 2021].
- DEPARTMENT OF AGRICULTURE WATER AND THE ENERGY. 2021e. *Species Profile and Threats Database* [Online]. Available: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> [Accessed January 2021].
- DEPARTMENT OF AGRICULTURE, WATER AND THE ENVIRONMENT (2020). *Conservation Advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*. Canberra: Department of Agriculture, Water and the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/154-conservation-advice.pdf>. In effect under the EPBC Act from 15-Dec-2020.

DEPARTMENT OF ENVIRONMENT (2015). Approved Conservation Advice (including listing advice) for Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/129-conservation-advice.pdf>. In effect under the EPBC Act from 17-Mar-2015.

DEPARTMENT OF ENVIRONMENT 2013. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. In: ENVIRONMENT, D. O. (ed.). Canberra, ACT: Commonwealth of Australia.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. The Green and Golden Bell Frog Key Population of the Georges River Management Plan. Sydney: Catchment Management Authorities NSW,.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2009. Threatened species survey and assessment guidelines: field survey methods for fauna - Amphibians. Department of Environment and Climate Change.

DEPARTMENT OF ENVIRONMENT AND CONSERVATION 2004. Natural Resources Management Advisory Series Note 7- bat roosts Coffs Harbour: North East Branch, Department of Environment and Conservation.

DEPARTMENT OF ENVIRONMENT AND ENERGY. 2018. *Species Profile and Threats Database (SPRAT) for Green and Golden Bell Frog (Litoria aurea)* [Online]. Canberra: Department of Environment and Energy,. Available: [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=1870](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1870) [Accessed].

DEPARTMENT OF ENVIRONMENT AND ENERGY (2018). *Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community*. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/141-conservation-advice.pdf>. In effect under the EPBC Act from 20-Mar-2018.

DEPARTMENT OF ENVIRONMENT WATER HERITAGE AND THE ARTS 2010a. Survey guidelines for Australia's threatened bats - Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF ENVIRONMENT WATER HERITAGE AND THE ARTS 2010b. Survey guidelines for Australia's threatened birds - Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF ENVIRONMENT WATER HERITAGE AND THE ARTS 2011. Survey guidelines for Australia's threatened mammals - Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF LAND AND WATER CONSERVATION 2002. The NSW State Groundwater Dependent Ecosystem Policy. Sydney: Department of Land and Water Conservation.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2019. Guidance to assist a decisionmaker to determine a serious and irreversible impact. Goulburn Street, Sydney NSW 2000: Environment, Energy and Science Group.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020a. Biodiversity Assessment Method.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020b. Biodiversity Assessment Method 2020 Operational Manual - Stage 1. Parramatta: Environment, Energy and Science.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020c. Biodiversity Assessment Method Operational Manual - Stage 2. Sydney: Environment, Energy and Science.

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2020d. Surveying threatened plants and their habitat - NSW survey guide for the Biodiversity Assessment Method. Parramatta: Environment, Energy and Science.



DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT. 2021a. *Area of Outstanding Biodiversity Value register* [Online]. Available: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register> [Accessed January 2021].

DEPARTMENT OF PLANNING INDUSTRY AND ENVIRONMENT 2021b. NSW (Mitchell) Landscapes - Version 3.1. Version 3.1 ed.

DEPARTMENT OF PRIMARY INDUSTRIES 1999. Policy and guidelines : aquatic habitat management and fish conservation. *In*: SMITH, A. A. P., D. (ed.). Taylors Beach.

DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). Wollongbar: NSW Department of Primary Industries,.

DEPARTMENT OF PRIMARY INDUSTRIES. 2021. *Fisheries Spatial Data Portal* [Online]. Available: <https://www.dpi.nsw.gov.au/about-us/science-and-research/spatial-data-portal> [Accessed January 2021].

DEPARTMENT OF THE ENVIRONMENT 2013a. Matters of National Environmental Significance - Significant impact guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999.

DEPARTMENT OF THE ENVIRONMENT 2013b. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. *In*: ENVIRONMENT, D. O. (ed.). Canberra, ACT: Commonwealth of Australia.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY 2016. An Interim Biogeographic Regionalisation of Australia (IBRA) - Version 7. Canberra: Department of the Environment and Energy.

DEPARTMENT OF THE ENVIRONMENT WATER HERITAGE AND THE ARTS 2009. EPBC Act Policy Statement 1.1 Matters of National Environmental Significance, Significant Impact Guidelines. Canberra: Department of the Environment Water Heritage and the Arts.

DEPARTMENT OF THE ENVIRONMENT WATER HERITAGE AND THE ARTS 2010. Survey guidelines for Australia's threatened frogs - guidelines for detecting frogs listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*. *In*: DEPARTMENT OF THE ENVIRONMENT, W., HERITAGE AND THE ARTS (ed.). Department of the Environment, Water, Heritage and the Arts.

EAMUS, D., FROEND, R., LOOMES, R., HOSE, G. & MURRAY, B. 2006. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. *Australian Journal of Botany*, 24, 97–114.

ENVIRONMENT ENERGY AND SCIENCE. 2021a. *Biodiversity Assessment Method Calculator (BAM-C)* [Online]. [Accessed 2021].

ENVIRONMENT ENERGY AND SCIENCE. 2021b. *BioNet Atlas of NSW Wildlife* [Online]. Available: [https://www.environment.nsw.gov.au/atlaspublicapp/UI\\_Modules/ATLAS/AtlasSearch.aspx](https://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS/AtlasSearch.aspx) [Accessed January 2021].

ENVIRONMENT ENERGY AND SCIENCE. 2021c. *BioNet Vegetation Classification* [Online]. Available: <https://www.environment.nsw.gov.au/research/Visclassification.htm> [Accessed January 2021].

ENVIRONMENT ENERGY AND SCIENCE. 2021d. *NSW BioNet Threatened Biodiversity Data Collection* [Online]. Available: <http://www.bionet.nsw.gov.au/> [Accessed January 2021].

FAHRIG, L. 2002. Effect of habitat fragmentation on the extinction threshold: a synthesis. *Ecological Applications*, 12, 346-351.

FAIRFULL, S., WITHERIDGE, G. & FISHERIES, N. 2003. *Why Do Fish Need to Cross the Road: Fish Passage Requirements for Waterway Crossings*, NSW Fisheries.

- HATTON, T. & EVANS, R. 1998. Dependence of ecosystems on groundwater and its significance to Australia. Canberra: Land and Water Resources Research and Development Corporation.
- LANDCOM 2004. Soils and construction: managing urban stormwater.
- LINCOLN-SMITH, M. P. 2003. Aquatic Ecology in Environmental Impact Assessment. Sydney: NSW Department of Planning.
- LYALL & ASSOCIATES 2021. *Henry Lawson Drive Upgrade Stage 1A Review of Environmental Factors and Environmental Impact Statements, Flooding Assessment Report*
- LONGCORE, T. & RICH, C. 2004. Ecological Light Pollution. *Frontiers in Ecology and the Environment*, 2, 191-198.
- NATIONAL PARKS AND WILDLIFE SERVICE 2000. Cumberland Plain Land Snail (*Meridolum corneovirens* Pfeiffer, 1851) Environmental Impact Assessment Guidelines. Hurstville: National Parks and Wildlife Service,.
- NGH PTY LTD 2021. Henry Lawson Drive Stage 1A Construction and Operation Surface Water Assessment.
- NSW DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 update). *In*: INDUSTRIES, N. D. O. P. (ed.).
- NSW OFFICE OF ENVIRONMENT AND HERITAGE 2018. Threatened species profile search.
- OFFICE OF ENVIRONMENT & HERITAGE 2016. NSW Guide to Surveying Threatened Plants. Sydney: Office of Environment and Heritage.
- OFFICE OF ENVIRONMENT & HERITAGE 2017. Biodiversity Assessment Method.
- OFFICE OF ENVIRONMENT & HERITAGE. 2018. *Bionet Atlas of NSW Wildlife* [Online]. Available: [http://www.environment.nsw.gov.au/atlaspublicapp/UI\\_Modules/ATLAS\\_/AtlasSearch.aspx](http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx) [Accessed 2018].
- OFFICE OF ENVIRONMENT AND HERITAGE 2016. The Native Vegetation of the Sydney Metropolitan Area. Version 3.0. Sydney: Office of Environment and Heritage, Department of Premier and Cabinet.
- PENNAY, M., LAW, B. & REINHOLD, L. 2004. Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats. Sydney: New South Wales Department of Environment and Conservation and State Forests of New South Wales.
- PHILLIPS, S. & CALLAGHAN, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist*, 35, 774-780.
- ROADS AND TRAFFIC AUTHORITY 2011. Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects.
- ROYAL BOTANIC GARDENS. 2021. *Plantnet - The Plant Information Network System of Botanic Gardens Trust Version 2.0* [Online]. Available: <https://plantnet.rbgsyd.nsw.gov.au/> [Accessed].
- STEWART, D. 1998. *Nocturnal bird and mammal calls of north-east New South Wales* [Online]. Mullumbimby: Nature Sound. [Accessed].
- TOZER, M., TURNER, K., KEITH, D., TINDALL, D., PENNAY, C., SIMPSON, C., MACKENZIE, B., BEUKERS, P. & COX, S. 2010. Native Vegetation of southeast NSW: a revised classification and map for the coast and tablelands. *Cunninghami*, 11.
- VAN DYCK, S. & STRAHAN, R. 2008. *Mammals of Australia*, Sydney, Reed New Holland.
- WSP 2019. Henry Lawson Drive Upgrade (M5 to Hume Highway) Biodiversity Development Assessment Report. Sydney: Prepared on behalf of Roads and Maritime Services.

## Appendix A – Threatened species habitat suitability tables

### Likelihood of occurrence criteria

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

## A1 – Habitat suitability assessment – threatened flora

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Acacia bynoeana</i> (Bynoes Wattle)	E1	V	No	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with <i>Corymbia gummifera</i> , <i>Eucalyptus haemastoma</i> , <i>E. gummifera</i> , <i>E. parramattensis</i> , <i>E. sclerophylla</i> , <i>Banksia serrata</i> and <i>Angophora bakeri</i> .	BioNet, PMST	Low – Although there are a few records within the locality and an associated vegetation type (PCT 725) was recorded in the EIS proposal area, suitable and preferred habitat (i.e. PCT 725 and sandy soils) was not recorded within the EIS proposal area. Furthermore, this species was not identified during targeted surveys.	Not a candidate species credit species and not considered further
<i>Acacia prominens</i> (Gosford Wattle)	E2	-	No	Occurs on clay, loam or sand soils, often requiring a moist, protected habitat in wet sclerophyll forest. The Endangered population is restricted to the Hurstville and Kogarah LGAs and consist of isolated trees from a few sites at Penshurst and Oatley.	BioNet	Low – Few records within the locality, preferred habitat is not recorded within the EIS proposal area. EIS proposal area is not located within the Hurstville or Kogarah LGAs.	Not a candidate species credit species and not considered further
<i>Acacia pubescens</i> (Downy Wattle)	V	V	No	Restricted to the Sydney Region from Bilpin to the Georges River and also at Woodford where it usually grows in open sclerophyll forest and woodland on clay soils. Typically it occurs at the intergrade between shales and sandstones in gravelly soils often with ironstones.	BioNet, PMST	Low – Although recorded in the EIS proposal area suitable habitat for the species does not occur within the EIS proposal area and the species was recorded during field surveys. This species is considered further within the body of the report.	Not a candidate species credit species and not considered further
<i>Allocasuarina diminuta</i> subsp. <i>mimica</i>	E2	-	No	The endangered population occurs along sandstone ridges and upper hillsides in the region northwest from Heathcote, towards Menai and Holsworthy, in heathy and low open woodland communities. Occurs in heathy woodlands, heathlands and low open woodlands.	BioNet	Low – Known population further south. Species is likely to occur in heathy and low open woodland communities. This preferred habitat does not occur within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Allocasuarina glaireicola</i>	E1	E	Yes	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows on lateritic soil in open forest.	PMST	Low – Known distribution primarily restricted to Richmond. No suitable habitat recorded within the EIS proposal area. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further
<i>Caesia parviflora</i> var. <i>minor</i> (Small Pale Grass-lily)	E1	-	No	Occurs south from Corindi area where it grows in heath woodland and dry sclerophyll forest on sandstone derived soils. Found in damp places in open forest.	BioNet	Low – This species has a low likelihood of occurring within the EIS proposal area. EIS proposal area not within known distribution.	Not a candidate species credit species and not considered further



Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Caladenia tessellata</i> (Thick Lip Spider Orchid)	E1	V	oYes	Occurs south of Swansea where it grows on clay loam or sandy soils. Prefers low open forest with a heathy or sometimes grassy understorey. Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Previously known also from Sydney and South Coast areas.	PMST, BioNet	Low – No records within the locality. Although an associated vegetation type occurs within the EIS proposal area (i.e. PCT 725) it did not occur within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Callistemon linearifolius</i> (Netted Bottle Brush)	V	-	No	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies. Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River.	BioNet, BAM-C	Recorded – <i>Callistemon linearifolius</i> was recorded during field surveys within the EIS proposal area. Material was collected to confirm identification. Previously recorded within the locality. Closest record near the intersection of Milperra Rd and Henry Lawson Drive. This species is considered further within the body of the report.	Considered further as a candidate species credit
<i>Cryptostylis hunteriana</i> (Leafless Tongue Orchid)	V	V	No	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats.	PMST	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	E1	E	No	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes. This species typically occurs at the ecotone between dry subtropical forest/woodland communities.	PMST, BAM-C	Low – This species is known to prefer rainforest gullies, scrub and scree slope habitats at ecotones between sub dry subtropical forest/woodland. Although its preferred microhabitats did not occur within the EIS proposal area an associated PCT was recorded (i.e. PCT 835) as such was considered further as a candidate species.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 835.

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Darwinia biflora</i>	V	V	No	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively. Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include <i>Eucalyptus haemastoma</i> , <i>Corymbia gummifera</i> and/or <i>E. squamosa</i> . The vegetation structure is usually woodland, open forest or scrub-heath.	PMST	Low – Not recorded in the locality and preferred habitat not recorded within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Deyeuxia appressa</i>	E1	E	Yes	Highly restricted, known only from two pre-1942 records in the Sydney area; in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown and in 1941 from Killara, near Hornsby. It has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas. Flowers spring to summer and is mesophytic (grows in moist conditions). But, given that it hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology.	PMST	Low – Highly restricted, known only from two pre-1942 records. Species has not been recorded for 60 years.	Not a candidate species credit species and not considered further
<i>Diuris aequalis</i> (Buttercup Doubletail)	E1	V	No	Occurs chiefly in the ranges and tablelands from Braidwood to Kanangra and Liverpool where it grows among grass in sclerophyll forest. It typically occurs on gentle slopes, in gravely clay-loam soil within montane eucalypt forest with a grass or heath understorey. Three small populations are known to occur within Kanangra Boyd National Park, other populations are restricted to remnant vegetation within roadsides and agricultural lands.	BioNet	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further
<i>Eucalyptus benthami</i> (Camden White Gum)	V	V	No	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty, with a further stand at Werriberri (Monkey) Creek in The Oaks. At least five trees occur on the Nattai River in Nattai National Park. Large areas of habitat were inundated by the formation of Warragamba Dam in 1933.	BAM-C	Low – although marginal quality habitat occurs (i.e. PCT 835) preferred habitat not recorded in the EIS proposal area. EIS proposal area is also outside the species known distribution. Species not recorded during surveys completed.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 835.

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Eucalyptus camfieldii</i> (Heart-leaved Stringybark)	V	V	No	Occurs in scattered locations within a restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Grows in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone, in coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include Brown Stringybark ( <i>E. capitellata</i> ), Scribbly Gum ( <i>E. haemastoma</i> ), Narrow-leaved Stringybark ( <i>E. oblonga</i> ), Silvertop Ash ( <i>E. sieberi</i> ), Smooth-barked Apple ( <i>Angophora costata</i> ), Dwarf Apple ( <i>A. hispida</i> ), Red Bloodwood ( <i>Corymbia gummifera</i> ), Scrub She-oak ( <i>Allocasuarina distyla</i> ), Slender Tea Tree ( <i>Leptospermum trinervium</i> ), and Fern-leaved Banksia ( <i>Banksia oblongifolia</i> ).	BioNet, PMST	Low – This species is known to occur within coastal heath and low open woodland on exposed sandy ridges of which no similar habitats were recorded within the EIS proposal area. There are no records within the locality.	Not a candidate species credit species and not considered further
<i>Eucalyptus nicholii</i> (Narrow-leaved Black Peppermint)	V	V	Nuo	Occurs from Niangala to Glenn Innes where it grows in grassy sclerophyll woodland on shallow relatively infertile soils on shales and slates, mainly on granite. Endemic on the NSW Northern Tablelands, of limited occurrence, particularly in the area from Walcha to Glen Innes; often on porphyry or granite.	BioNet	Low – Few records within the locality. No preferred habitat within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Eucalyptus scoparia</i>	E1	V	Yes	Occurs in Queensland and reaches its southern limit in NSW. In NSW it is known from three locations all near Tenterfield in the far northern New England Tableland Bioregion where it grows on well drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	BioNet	Low – Few records within the locality, possibly as street plantings. No preferred habitat within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Genoplesium baueri</i> (Bauers Midge Orchid)	E	E	Yes	Grows in dry sclerophyll forest and moss gardens over sandstone. The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from northern Sydney suburbs. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	PMST	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Grevillea beadleana</i>	E1	E	No	Found on sheer granite scarps, confined to Guy Fawkes R. catchment and possibly Apsley R. catchment.	BioNet	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	V	V	No	Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales.	BioNet, PMST	Low – Although potential habitat within the EIS proposal area not suitable habitat within the EIS proposal area. Records within the locality, at Lieutenant Cantello Reserve. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further
<i>Haloragis exalata</i> subsp. <i>exalata</i> (Square Raspwort)	V	V	Now	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	BAM-C	Low – Low quality habitat on site. Has not been recoded within locality with the closest record in 1892 recorded at Coalcliff.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 1236 and PCT 1234.



Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Hibbertia fumana</i>	CE	-	Yes	Currently only known from a single population at Moorebank but potentially elsewhere in greater Sydney. Generally found in areas of woodland with a more open understorey, in a long intergrade between Castlereagh Scribbly Gum Woodland and Castlereagh Ironbark Forest at the Moorebank Site.	Professional opinion	Low – <i>Hibbertia fumana</i> has recently been identified within the Bankstown Airport site adjoining the EIS proposal area (pers. com. Andrew Orme RBG). Detailed targeted surveys were conducted for this species during the known flowering period of between August and December (19 September & 15 November 2018). A single species of <i>Hibbertia</i> was recorded to occur within Stage 1A of the EIS proposal area. Parallel traverse identified a population extent of 5 individuals within a patch of PCT 725 vegetation. Fertile flowering material was collected from these individuals and forwarded to the National Herbarium of NSW for positive identification. The species was identified to be the non-threatened <i>Hibbertia pedunculata</i> based on the stamen arrangement around the carpel and the length of the flowering peduncle (pers. com. Andrew Orme, National Herbarium of NSW). No specimens of this species were recorded during targeted surveys and based on completed detailed field surveys it is reconsidered to have a low likelihood of occurrence within the EIS proposal area. No suitable habitat present within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Hibbertia puberula</i>	E1	-	No	Recent work on this species and its relatives have shown it to be widespread, but never common. It extends from Wollemi National Park south to Morton National Park and the south coast near Nowra. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. It favours low heath on sandy soils or rarely in clay, with or without rocks.	PMST	Low – see discussion for <i>Hibbertia fumana</i>	Not a candidate species credit species and not considered further

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Hibbertia</i> sp. <i>Bankstown</i>	CE	CE	Yes	Endemic to New South Wales and is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown local government area. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. The species is not known from any conservation reserves. The population comprises fewer than 50 individuals.	BAM-C	Moderate – see discussion for <i>Hibbertia fumana</i> . Furthermore, an associated vegetation type was recorded within the EIS proposal area; being PCT 835.	Considered further as a candidate species credit
<i>Leucopogon exolasius</i> (Woronora Beard-heath)	V	V	No	Restricted chiefly to the Woronora and Grose Rivers and Stokes Creek, Sydney catchments and the Royal National Park. One old record from the Grose River. Grows in woodland on sandstone.	BioNet, PMST	Low – few records within the locality, outside known distribution, preferred habitat does not occur.	Not a candidate species credit species and not considered further
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (Native Pear)	E2	-	No	Occurs in subcoastal and southern Queensland but rarely in NSW with a disjunct occurrence near Sydney. It occurs as scattered plants in remnant woodland and scrub <i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	BioNet, BAM-C	Moderate - Known populations occur in the locality. Not recorded during targeted surveys.	Considered further as a candidate species credit
<i>Maudia triglochinosides</i>	V	-	No	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct. Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients.	BAM-C	Low – Species is assumed extinct in the Sydney region and the EIS proposal area occurs outside the species current known distribution. Associated vegetation type recorded within the EIS proposal area; being PCT 1234.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 1234.
<i>Melaleuca biconvexa</i> (Biconvex Paperbark)	V	V	No	Occurs as disjunct populations in coastal New South Wales from Jervis Bay to Port Macquarie, with the main concentration of records is in the Gosford/Wyong area. Grows in damp places, often near streams, or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST, BAM-C	Low – Outside known distribution. No preferred habitat within the EIS proposal area however an associated vegetation does occur within the EIS proposal area; being PCT 1234.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 1234.

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Melaleuca deanei</i> (Deanes Paperbark)	V	V	Yes	Occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone.	BioNet, PMST	Low – No preferred habitat within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Pelargonium</i> sp. <i>Striatellum</i> (G. W. Carr 10345), syn. <i>Pelargonium</i> sp., <i>Pelargonium</i> sp. 1 (Omeo Stork's-bill)	E1	E	Yes	Known from only 4 locations in NSW, with three on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It occurs with Serrated Tussock ( <i>Nassella trichotoma</i> ) and Curly Sedge ( <i>Carex bichenoviana</i> ), and less commonly with Creeping Hopbush ( <i>Dodonaea procumbens</i> ) and a bog-sedge ( <i>Schoenus nitens</i> ) on sandy soils or gravelly soils or amongst rocks.	PMST	Low – No records within the locality. Preferred habitat does not occur within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Persicaria elatior</i> (Tall Knotweed)	V	V	No	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). The species also occurs in Queensland. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	BAM-C, PMST	Low – Targeted surveyed completed and species not identified and microhabitats highly disturbed. EIS proposal area is outside of species known distribution. Previously recorded in Picton in 1949. Associated vegetation types within the EIS proposal area all in a modified state including PCT 781 and PCT 835.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 781 and PCT 835.

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Persoonia hirsuta</i> (Hairy Geebung)	E1	E	Yes	The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. It has a large area of occurrence, but occurs in small populations. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone or very rarely on shale. Often occurs in areas with clay influence, in the ecotone between shale and sandstone.	BioNet, PMST, BAM-C	Low – Few records within the locality. No preferred habitat within the EIS proposal area. Associated vegetation recorded within the EIS proposal area; being PCT 835.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 835.
<i>Persoonia nutans</i> (Nodding Geebung)	E1	E	No	Confined to the Cumberland Plain where it grows in Castlereagh Scribbly Gum Woodlands and Agnes Banks Woodlands.	BioNet, PMST	Low – Although preferred habitat recorded within the EIS proposal area no suitable habitat was recorded in the EIS proposal area. Records within the locality, at Lieutenant Cantello Reserve. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further
<i>Pilularia novae-hollandiae</i> (Austral Pillwort)	E	-	Yes	Austral Pillwort is a semi-aquatic fern, resembling a small fine grass. Its thread-like fronds, to 8 cm long, arise in tufts from a creeping underground stem (rhizome). The fruiting capsules are small, spherical hairy pills that form at the base of fronds. In NSW, Austral Pillwort has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong), Oolambeyan National Park near Carathool and at Lake Cowal near West Wyalong.	BAM-C	Low – Preferred habitat includes shallow swamps and waterways which are limited and highly disturbed on site. The species has not been recorded within locality with nearest record near Doonside in 1966. Despite this a vegetation association was recorded in the EIS proposal area; being PCT 835.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 835.
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	No	Confined to coastal areas around Sydney where it grows on sandstone and laterite soils. It is found between South Maroota, Cowan, Narrabeen, Allambie Heights, Northmead and Kellyville, but its former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Usually occurs in woodland in the transition between shale and sandstone, often on Lucas Heights soil landscape.	PMST	Low – No records within the locality. No suitable habitat recorded within the EIS proposal area. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further



Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Pimelea spicata</i> (Spiked Rice-flower)	E1	E	No	This species occurs in two disjunct areas: in coastal districts from Lansdowne to Shellharbour, and in Cumberland Plain Woodland inland to Penrith. In western Sydney it grows on Wianamatta Shales in Greybox - Ironbark Woodland with <i>Bursaria spinosa</i> and <i>Themeda australis</i> . In the Illawarra, it occurs on well structured clay soils in grassland or open woodland.	BioNet, PMST	Low – Species is known to occur in the locality (GHD, 2014 and WSP, 2019). No suitable habitat for the species was recorded within the EIS proposal area. Furthermore, species was not recorded during surveys completed.	Not a candidate species credit species and not considered further
<i>Pomaderris brunnea</i>	E	V	No	Confined to the Colo and Upper Nepean Rivers where it grows in open forest; in western Sydney (Camden to Picton area) known from sandy alluvium on levee and creek banks.	PMST, BAM-C, BioNet	Moderate - Outside known distribution. No records within the locality. Included as a candidate species based on the presence of PCT 835. Not recorded during targeted surveys.	Considered further as a candidate species credit
<i>Pomaderris prunifolia</i> (Plum-leaf Pomaderris)	E2	-	No	Occurs on rocky slopes, often along creeks. The population in Paramatta, Auburn, Strathfield and Bankstown LGAs is listed as Endangered under the BC Act. Within the Endangered population, the only recent record of this species is from Rydalmere, where only 3 plants occur.	BioNet	Low – Records within the locality at The Crest reserve. Few records within the locality. No preferred habitat within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Prostanthera saxicola</i>	E2	-	No	This population is restricted to the named local government areas (Liverpool and Sutherland). Recorded occurrences are mainly between Holsworthy station and Sutherland station, north from Lucas Heights and south of the Georges River. Habitat includes: Eucalypt forest and heath in association with <i>Hakea dactyloides</i> , <i>Brachyloma daphnoides</i> , <i>Banksia spinulosa</i> , <i>Baeckea brevifolia</i> , <i>Epacris pulchella</i> , <i>Acacia myrtifolia</i> and <i>Acacia ulicifolia</i> ; Closed heath in association with <i>Allocasuarina nana</i> and <i>Lepidosperma viscidum</i> . Heathy woodland of <i>Angophora hispida</i> , <i>Eucalyptus squamosa</i> and <i>Corymbia gummifera</i> , as a 'major component of the ground flora'; and rocky ridges and areas of outcrop.	BioNet	Low – Not previously recorded within locality, limited suitable habitat within EIS proposal area.	Not a candidate species credit species and not considered further
<i>Pterostylis gibbosa</i>	E1	E	No	Occurs in the southern part of the Central Coast region with a disjunct population in the Hunter Valley. Grows among grass in sclerophyll forest. In the Illawarra it grows in Coastal Grassy Red Gum Forest and in Lowland Woollybutt-Melaleuca forest.	PMST	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Pterostylis saxicola</i> (Sydney Plains Greenhood)	E1	E	No	Known now only from Freemans Reach to Picton district. Grows in Sydney Sandstone Gully Forest in shallow or skeletal soils over sandstone shelves, often near streams.	BioNet, PMST	Low – No records within the locality and no suitable habitat present within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Pultenaea aristata</i>	V	V	No	Occurs from Helensburgh to Mt Keira where it grows in moist, dry sclerophyll woodland to heath on sandstone. Also grows within upland swamps on the Illawarra Plateau (pers obs).	BioNet	Low – Outside known distribution.	Not a candidate species credit species and not considered further
<i>Pultenaea pedunculata</i> (Matted Bush-pea)	E1	-	No	Restricted to Wianamatta Shales of the Cumberland Plain from Bankstown to Liverpool and on the South Coast in the Southeast Corner Bioregion at Bournda. If grows on a variety of soils in dry sclerophyll forest and disturbed sites. It is largely confined to loamy soils in dry gullies in populations in the Windellama area.	BioNet	Low – Preferred habitat within the EIS proposal area but not within the EIS proposal area. Existing records within locality. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further
<i>Rhizanthella slateri</i> (Eastern Underground Orchid)	V	E	Yes	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	PMST	Low – no preferred habitat recorded within the EIS proposal area and EIS proposal area is outside the species known distribution. No records within the locality.	Not a candidate species credit species and not considered further
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	CE	CE	Yes	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	PMST, BioNet	Low – although recorded in the locality no preferred habitat identified in the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Rhodomyrtus psidioides</i> (Native Guava)	CE	CE	Yes	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	PMST	Low – although recorded in the locality no preferred habitat identified in the EIS proposal area.	Not a candidate species credit species and not considered further

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAIL <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Syzygium paniculatum</i> (Magenta Lilly Pilly)	E1	V	No	Occurs between Bulahdelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	BioNet, PMST	Low – Preferred habitat is not recorded within the EIS proposal area.	Not a candidate species credit species and not considered further
<i>Thelymitra kangaloonica</i>	CE	CE	Yes	It is found in swamps in sedgeland over grey silty grey loam soils. Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at three swamps that are above the Kangaloon Aquifer.	PMST	Low – Preferred habitat is not recorded within the EIS proposal area. No records within the locality.	Not a candidate species credit species and not considered further
<i>Thesium australe</i> (Austral Toadflax)	V	V	No	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be Themeda australis and Poa spp..	PMST	Low – The species has no recent records within the locality. No preferred habitat recorded within the EIS proposal area. Not recorded during targeted surveys.	Not a candidate species credit species and not considered further
<i>Wahlenbergia multicaulis</i> (Tadgells Bluebell)	E2	-	No	Occurs in coastal and tableland districts south from Sydney and the Blue Mountains west along the Murray River to Mathoura where it grows in a variety of habitats including forest, woodland, grassland, forest, scrub and the edges of watercourses and wetlands. It is a coloniser and typically occurs in damp, disturbed sites. Population in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas listed as Endangered under the BC Act.	BioNet, BAM-C	Moderate - Possible habitat within the EIS proposal area and there are also species records nearby the intersection of the M5 motorway. Not recorded during targeted surveys.	Considered further as a candidate species credit
<i>Wilsonia backhousei</i> (Narrow-leafed Wilsonia)	V	-	No	Occurs chiefly in the Sydney district but also common at Jervis Bay. A salt tolerant species, it is found in intertidal saltmarshes and sometimes on seacliffs.	BioNet, BAM-C	Moderate - The EIS proposal area is outside the species known distribution range. Included as a candidate species based on the presence of PCT 1234. Not recorded during targeted surveys.	Considered further as a candidate species credit

Species name (Common name)	BC Act <sup>1</sup>	EPBC Act <sup>1</sup>	SAII <sup>3</sup>	Habitat	Data Source <sup>4</sup>	Likelihood of occurrence within the EIS proposal area <sup>4</sup>	Outcome
<i>Zannichellia palustris</i>	E	-	No	In NSW, known from the lower Hunter and in Sydney Olympic Park. Grows in fresh or slightly saline stationary or slowly flowing water. Flowers during warmer months.	BAM-C	Low – Preferred habitat not recorded within the EIS proposal area and not previously recorded within locality. Associated vegetation type however was recorded in the EIS proposal area; being PCT 781.	Although low likelihood considered further as a candidate species due to BAM-C output and presence of PCT 781.

1. Listed under the NSW *Biodiversity Conservation Act 2016* – E4 = Presumed extinct, CE = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable
2. SAII = Serious and Irreversible Impact entity under BAM
3. Listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory
4. Bionet = OEH Bionet Atlas of NSW Wildlife, PMST = EPBC Act Protected Matters Search Tool, PlantNet = Royal Botanic Gardens PlantNet Spatial Search and BAM-C = Biodiversity Assessment Method Calculator output based on vegetation within the EIS proposal area.



## A2 – Habitat suitability assessment – threatened fauna

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
<b>Amphibians</b>								
Giant Burrowing Frog ( <i>Heleioporus australiacus</i> )	V	V	No	Species credit	Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Breeding habitat of this species is generally soaks or pools within first or second order streams. Species is dependent on hanging swamps on the top of sandstone plateaus and deeply dissected gullies that occur as erosion features in the Sydney Basin.	PMST	Low – confined to sandstone ridgetop habitat and upland valleys where it is associated with small headwater and slow flowing/intermittent creek lines. Such habitat does not occur in the EIS proposal areas. This species has not been recorded within the locality.	Not a candidate species credit species Not considered further
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	E1	V	No	Species credit	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes ( <i>Typha</i> spp.) or spikerushes ( <i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow ( <i>Gambusia holbrooki</i> ), have a grassy area nearby and diurnal sheltering sites available.	BAM-C, BioNet, PMST	Low – Potential marginal habitat within the EIS proposal area. Possible utilisation by the frogs, however there has been little records within the locality in the last 30 years. Detailed targeted surveys did not record this species.	Considered further as a candidate species credit

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Red-crowned Toadlet ( <i>Pseudophryne australis</i> )	V	-	No	Species credit	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5. Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites.	BioNet	Low – localised species that is largely restricted to the immediate vicinity of ephemeral creeks and gutters below sandstone ridges. Such habitat does not occur in the EIS proposal area.	Not a candidate species credit species  Not considered further
Southern Bell Frog ( <i>Litoria raniformis</i> )	E1	V	No	Species credit	In NSW the species was once distributed along the Murray and Murrumbidgee Rivers and their tributaries, the southern slopes of the Monaro district and the central southern tablelands as far north as Tarana, near Bathurst. Currently, the species is 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. 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.	PMST	Low – The known habitat of this species is not present within the EIS proposal area. The EIS proposal area is outside the known distribution for this species, and it has not been recorded within the locality.	Not a candidate species credit species  Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAII <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Stuttering Frog ( <i>Mixophyes balbus</i> )	E1	V	Yes	Species credit	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Considered to have disappeared from Victoria and to have undergone considerable range contraction in NSW, particularly in south-east NSW. It is the only <i>Mixophyes</i> species that occurs in south-east NSW and in recent surveys it has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	PMST	Low – occupies streams in rainforest or tall open wet forest in foothills and escarpment on the eastern side of the Great Dividing Range. Such habitat does not occur in the EIS proposal area. This species has not been recorded within the locality.	Not a candidate species credit species  Not considered further
<b>Birds</b>								
Australasian Bittern ( <i>Botaurus poiciloptilus</i> )	E1	E	No	Ecosystem credit	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes ( <i>Typha</i> spp.) and spikerushes ( <i>Eleocharis</i> spp.). Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	BAM-C, BioNet, PMST	Low – a wetland bird that frequents freshwater and brackish swamps, in which it forages and breeds. Marginal habitat occurs within the vicinity of the EIS proposal area; majority of artificial wetlands lack dense aquatic vegetation which is preferred by the species. Closest records at Deepwater Park.	Predicted ecosystem credit species in BAM-C

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Australian Painted Snipe ( <i>Rostratula australis</i> )	E1	E; Ma	No	Ecosystem credit	The Australian Painted Snipe is restricted to Australia. Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. In NSW many records are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	BAM-C, PMST	Low – a wetland bird that prefers marshes where bank side vegetation provides cover. Artificial wetlands lack sufficient aquatic vegetation that is preferred by the species. No records within the locality.	Predicted ecosystem credit species in BAM-C
Barking Owl ( <i>Ninox connivens</i> )	V	-	No	Ecosystem credit / Species credit Species credit: hollow-bearing trees that provide active nesting habitat Ecosystem credit: all 'other habitat'	The Barking Owl is found throughout continental Australia except for the central arid regions. Although common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. Many populations crashed as woodland on fertile soils was cleared over the past century, leaving linear riparian strips of remnant trees as the last inhabitable areas. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils.	BAM-C	Low – prefers drier intact woodlands and forests compared to other owl species. Intermittent occurrences within the study may occur, however, more known to occur in woodlands to the west of the divide.	Predicted ecosystem credit species in BAM-C. Considered further as candidate species credit species.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Bar-tailed Godwit ( <i>Limosa lapponica baueri</i> )	-	V; M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The Bar-tailed Godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (western Alaskan) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST, BAM-C	Low – marginal habitat near mangroves along Georges River. Preferred habitat of large intertidal mudflats not within the EIS proposal area. No records within the locality.	Predicted ecosystem credit species in BAM-C. Not considered further as candidate species credit species as no important habitat mapped within the study area.
Black Bittern ( <i>Ixobrychus flavicollis</i> )	V	-	No	Ecosystem credit	The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds.	BAM-C, BioNet	Low – uses the lower reaches of coastal creeks and rivers within rainforest habitat. There is marginal habitat within the EIS proposal area (associated with artificial wetlands) and intermittent occurrences within the EIS proposal area cannot be discounted.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Black-chinned Honeyeater ( <i>Melithreptus gularis gularis</i> )	V	-	No	Ecosystem credit	The eastern subspecies extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark ( <i>Eucalyptus sideroxylon</i> ), White Box ( <i>E. albens</i> ), Inland Grey Box ( <i>E. microcarpa</i> ), Yellow Box ( <i>E. melliodora</i> ), Blakely's Red Gum ( <i>E. blakelyi</i> ) and Forest Red Gum ( <i>E. tereticornis</i> ). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	BAM-C, BioNet	Low – The Black-chinned Honeyeater is a western woodlands species that only rarely occurs in near coastal locations. Closest record along the Georges River at Liverpool. Rare or intermittent occurrences cannot be discounted.	Predicted ecosystem credit species in BAM-C.
Black-faced Monarch ( <i>Monarcha melanopsis</i> )	-	M; Ma	N/A	Not listed on the BC Act	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	PMST	Low – preferred habitat not within EIS proposal area. Rare and intermittent occurrences cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )	E1	-	No	Ecosystem credit	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Inhabits floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	BAM-C, BioNet	Low – forages in freshwater and estuarine wetlands and lakes. They breed in floodplain habitats in northern Australia south to the northern Hunter Region. Suitable breeding habitats do not occur within the EIS proposal area. Marginal foraging habitat occurs within the vicinity of the EIS proposal area, rare seasonal occurrences cannot be dismissed. Closest records at Deepwater Park.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Black-tailed Godwit ( <i>Limosa limosa</i> )	V	M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. The species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state. Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.	BAM-C, PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of large intertidal mudflats not within the EIS proposal area. No records within the locality.	Predicted ecosystem credit species in BAM-C. Not considered further as candidate species credit species as no important habitat mapped within the study area.
Broad-billed Sandpiper ( <i>Limicola falcinellus</i> )	V	M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW. Favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	BAM-C	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the EIS proposal area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	Predicted ecosystem credit species in BAM-C. Not considered further as candidate species credit species as no important habitat mapped within the study area.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Brown Treecreeper ( <i>Climacteris picumnus victoriae</i> )	V	-	No	Ecosystem credit	The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum ( <i>Eucalyptus camaldulensis</i> ), forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding.	BAM-C	Low – prefers intact woodlands and forest of inland slopes and plains. Important habitat components limited. Rare occurrences within intact woodland may occur.	Predicted ecosystem credit species in BAM-C.
Bush-stone Curlew ( <i>Burhinus grallarius</i> )	E1	-	No	Species credit: fallen/standing dead timber including logs required	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	BAM-C, BioNet	Low – This species is unlikely to occur within the locality, thought to be extinct from the locality. Micro habitat for this species occurs within the EIS proposal area.	Considered further as a candidate species credit species

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Cattle Egret ( <i>Ardea bulbulcus</i> ) <i>ibis</i> )	-	Ma	N/A	Not listed on the BC Act	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands and very rarely in arid and semi-arid regions. High numbers may occur in moist, poorly drained pastures with high grass; it avoids low grass pastures but has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. It is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora.	PMST	Moderate – May occur within artificial wetland areas during seasonal movements.	Considered further in MNES section
Comb-crested Jacana ( <i>Irediparra gallinacea</i> )	V	-	No	Ecosystem credit	The Comb-crested Jacana occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW, with stragglers recorded in south-eastern. Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.	BAM-C	Low – preferred habitat of large amounts of floating aquatic vegetation within artificial wetlands not present	Predicted ecosystem credit species in BAM-C.
Common Greenshank ( <i>Tringa nebularia</i> )	-	M; Ma	N/A	Not listed on the BC Act	Occurs in a range of inland and coastal environments. Inland, it occurs in both permanent and temporary wetlands, billabongs, swamps, lakes floodplains, sewage farms, saltworks ponds, flooded irrigated crops. On the coast, it occurs in sheltered estuaries and bays with extensive mudflats, mangrove swamps, muddy shallows of harbours and lagoons, occasionally rocky tidal ledges. It generally prefers wet and flooded mud and clay rather than sand.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or swamps. Rare and intermittent occurrences during seasonal movements cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Common Sandpiper ( <i>Actitis hypoleucos</i> )	-	M, Ma	N/A	Not listed on the BC Act	The Common Sandpiper frequents a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity. It is mostly encountered along muddy margins or rocky shores and rarely on mudflats. It has been recorded in estuaries and deltas of streams, banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	Not considered further
Curlew Sandpiper ( <i>Calidris ferruginea</i> )	E1	CE, M, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	BAM-C, PMST	Low – This species is unlikely to occur within the locality. However, there is marginal habitat available in the vicinity of the EIS proposal area, and accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	Predicted ecosystem credit species in BAM-C. Not considered further as candidate species credit species as no important habitat mapped within the study area.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Diamond Firetail ( <i>Stagonopleura guttate</i> )	V	-	No	Ecosystem credit	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum ( <i>Eucalyptus pauciflora</i> ) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	BAM-C	Low – marginal habitat within EIS proposal area, uncommon in coastal areas. Rare occurrences within the locality cannot be discounted.	Predicted ecosystem credit species in BAM-C.
Dusky Woodswallow ( <i>Artamus cyanopterus cyanopterus</i> )	V	-	No	Ecosystem credit	Dusky woodswallows are widespread in eastern, southern and south-western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland.	BAM-C, BioNet	Moderate - potential foraging habitat available. This species has been recorded within the locality.	Predicted ecosystem credit species in BAM-C.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Eastern Bristlebird ( <i>Dasyornis brachypterus</i> )	E	E	No	Species credit	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species.	PMST	Low – No preferred habitat within the EIS proposal area. No records within the locality.	Not considered further
Eastern Curlew ( <i>Numenius madagascariensis</i> )	-	CE, M, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Inhabits coastal estuaries, mangroves, mud flats and sand pits. It is a migratory shorebird which generally inhabits sea and lake shore mudflats, deltas and similar areas, where it forages for crabs and other crustaceans, clam worms and other annelids, molluscs, insects and other invertebrates. Its migration route ranges from its wintering grounds in Australia to its breeding grounds in northern China, Korea and Russia.	PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the EIS proposal area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Eastern Osprey ( <i>Pandion cristatus</i> )	V	-	No	Ecosystem credit / Species credit: presence of active stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting  Ecosystem credit: all 'other habitat'	Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	BAM-C, BioNet, PMST	Moderate - The species is a specialised fish hunting species generally using shallow estuary or coastal embayments. They nest in the top of a prominent tree or man-made structure. There is potential for the species to forage along the Georges River. Despite target surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.  Considered further as a candidate species credit species.
Flame Robin ( <i>Petroica phoenicea</i> )	V	-	No	Ecosystem credit	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	BAM-C, BioNet	Low – breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They also disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. Marginal habitat available. Closest record at Voyager Point.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Fork-tailed Swift ( <i>Apus pacificus</i> )	-	M; Ma	N/A	Not listed on the BC Act	Breeds in the northern hemisphere, wintering south to Australia. It is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially, but has occasionally been observed to land	PMST	Low – May occur over the EIS proposal area intermittently during seasonal migration movements but unlikely to use terrestrial habitats.	Considered further in MNES section
Freckled Duck ( <i>Stictonetta naevosa</i> )	V	-	No	Ecosystem credit	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	BAM-C	Low – prefers large swamps often with dense aquatic vegetation. Limited available habitat in EIS proposal area.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAII <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Gang-gang Cockatoo ( <i>Callocephalon fimbriatum</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of Eucalypt tree species with hollows greater than 9 cm diameter actively being used Ecosystem credit: all 'other habitat'	The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum ( <i>Eucalyptus pauciflora</i> ) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	BAM-C	Low – Preferred habitat of mature/old growth eucalypt forest not within study. Intermittent and rare seasonal occurrences during seasonal movements cannot be discounted.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Glossy Black-cockatoo ( <i>Calyptorhynchus lathamii</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground actively being used Ecosystem credit: all 'other habitat'	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak ( <i>Allocasuarina littoralis</i> ) and Forest Sheoak ( <i>A. torulosa</i> ) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak ( <i>Allocasuarina diminuta</i> ). Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah ( <i>Casuarina cristata</i> ). Feeds almost exclusively on the seeds of several species of she-oak ( <i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	BioNet	Low – Potential foraging habitat available in EIS proposal area (presence of <i>Allocasuarina</i> sp.) however none recorded during targeted surveys and native nest trees identified.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Great Egret ( <i>Ardea alba</i> (syn. <i>Ardea modesta</i> ))	-	Ma	N/A	Not listed on the BC Act	Eastern Great Egrets are widespread in Australia. They occur in all states/territories of mainland Australia and in Tasmania. In Australia, the largest breeding colonies, and greatest concentrations of breeding colonies, are located in near-coastal regions of the Top End of the Northern Territory. The Channel Country of south-western Queensland and north-eastern South Australia have at least 12 breeding colonies, and colonies are also known in the Darling Riverine Plains region of NSW and the Riverina region of NSW and Victoria. Minor breeding sites are widely scattered across the species' distribution and include sites in western Cape York Peninsula, the central coast of Queensland, north and north-eastern NSW, south-eastern South Australia, south-western Western Australia, the Kimberley region of Western Australia and the Barkly Tablelands in the Northern Territory. Non-breeding birds have been recorded across much of Australia, but avoid the driest regions of the western and central deserts. The Eastern Great Egret inhabits a wide range of wetland habitats which include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs.	PMST	Moderate – May occur within artificial wetland areas during seasonal movements.	Considered further in MNES section
Grey Falcon ( <i>Falco hypoleucos</i> )	E	V	No	Ecosystem credit	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.	PMST	Low – preferred habitat not recorded within the EIS proposal area.	Not considered further.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Hooded Robin ( <i>Melanodryas cucullata cucullata</i> )	V	-	No	Ecosystem credit	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies <i>cucullata</i> ) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies <i>picata</i> . Two other subspecies occur outside NSW. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	BAM-C	Low – rarely found on the coast. Preferred habitat not within EIS proposal area.	Predicted ecosystem credit species in BAM-C.
Hooded Plover ( <i>Thinornis rubricollis</i> )	CE	V, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Hooded Plovers occur on beaches with large amounts of beach-washed seaweed. Densities are lowest on narrow, steep beaches, where there are few or no dunes, and where human activities are most intensive. In the south-west, they also occur on inland salt lakes.	PMST	Low – No beach habitat occurs within the EIS proposal area.	Not considered further.
Latham's Snipe ( <i>Gallinago hardwickii</i> )	-	M, Ma	N/A	Not listed on the BC Act	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	PMST	Low – wetlands and artificial wetlands provide marginal habitat. Prefers wetlands with abundant aquatic vegetation for protection, this is limited within EIS proposal area.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Little Eagle ( <i>Hieraaetus morphnoides</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of nest trees - live (occasionally dead) large old trees within vegetation actively being used Ecosystem credit: all 'other habitat'	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.	BAM-C, BioNet	Moderate – may occur in the EIS proposal area locality and known to move widely within its home range. Open and managed habitats within the EIS proposal area may represent part of the foraging habitat of local individuals, so its potential intermittent occurrence within the EIS proposal area cannot be discounted. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Little Lorikeet ( <i>Glossopsitta pusilla</i> )	V	-	No	Ecosystem credit	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards.	BAM-C, BioNet	Moderate - Potential foraging habitat in EIS proposal area associated with blossoming eucalypts. Recorded within the locality. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.
Masked Owl ( <i>Tyto novaehollandiae</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares.	BAM-C BioNet	Moderate – marginal habitat in association with intact eucalypt woodlands of Landsdowne. Records within the locality and to the south in larger intact remnants. May intermittently forage within study as part of a larger home range. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Northern Siberian Bar-tailed Godwit ( <i>Limosa lapponica menzbieri</i> )	-	CE	N/A	Not listed on the BC Act	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria. The migratory Bar-tailed Godwit (northern Siberian) does not breed in Australia. Occurs mainly in coastal habitats in coastal habitats which include large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It also has been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms and coral reef-flats.	PMST	Low – marginal habitat near mangroves along Georges River. Preferred habitat of intertidal mudflats limited within the EIS proposal area. Rare occurrences during seasonal movements cannot be discounted. No records within the locality.	Not considered further
Orange-bellied Parrot ( <i>Neophema chrysogaster</i> )	CE	CE, Ma	Yes	Species credit	The Orange-bellied Parrot breeds in the south-west of Tasmania and migrates in autumn to spend the winter on the mainland coast of south-eastern South Australia and southern Victoria. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. It is expected that NSW habitats may be being more frequently utilised than observations suggest. Typical winter habitat is saltmarsh and strandline/foredune vegetation communities either on coastlines or coastal lagoons. Spits and islands are favoured but they will turn up anywhere within these coastal regions. The species can be found foraging in weedy areas associated with these coastal habitats or even in totally modified landscapes such as pastures, seed crops and golf courses.	PMST	Low – Considered locally extinct. No preferred habitat within the EIS proposal area. No records within the locality.	Not considered further
Oriental Cuckoo ( <i>Cuculus opatus</i> (syn. <i>Cuculus saturatus</i> ))	-	M, Ma	N/A	Not listed on the BC Act	A non-breeding migrant to Australia, it often inhabits rainforest, vine thickets, wet sclerophyll forest and open woodland and sometimes occurs in mangroves, wooded swamps and as vagrants in gardens. The population trend appears to be stable.	PMST	Low – preferred habitat not within EIS proposal area. Rare and intermittent occurrences cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Painted Honeyeater ( <i>Grantiella picta</i> )	V	V	No	Ecosystem credit	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree/ Weeping Myall ( <i>Acacia pendula</i> ), Brigalow ( <i>A. harpophylla</i> ) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	BAM-C, PMST	Low – No preferred habitat within the EIS proposal area. No records within the locality.	Predicted ecosystem credit species in BAM-C.
Pectoral Sandpiper ( <i>Calidris melanotos</i> )	-	M, Ma	N/A	Not listed on the BC Act	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is usually found in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	Not considered further
Pink Robin ( <i>Petroica rodinogaster</i> )	V	-	No	Species credit	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	BioNet	Low – Very marginal habitat, on the edge of range. Irregular occurrences cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Powerful Owl ( <i>Ninox strenua</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations. It inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine <i>Syncarpia glomulifera</i> , Black She-oak <i>Allocasuarina littoralis</i> , Blackwood <i>Acacia melanoxylon</i> , Rough-barked Apple <i>Angophora floribunda</i> , Cherry Ballart <i>Exocarpus cupressiformis</i> and a number of eucalypt species. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider.	BAM-C, BioNet	Moderate - Potential foraging habitat available. There are records within the locality, the closets record is at Deepwater Park. No large hollow bearing trees within EIS proposal area, however some may occur within Landsdowne. Likely to forage within EIS proposal area as part of a larger home range. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.
Rainbow Bee-eater ( <i>Merops ornatus</i> )	-	Ma	N/A	Not listed on the BC Act	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings.	PMST	Low – prefer habitat limited within EIS proposal area. Irregular and intermittent occurrences during seasonal movements cannot be discounted.	Not considered further



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Red Knot ( <i>Calidris canutus</i> )	-	E, M, Ma	No	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps.	PMST	Low – This species is unlikely to occur within the locality. However, there is marginal habitat available in the vicinity of the EIS proposal area, and accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	Not considered further
Regent Honeyeater ( <i>Anthochaera phrygia</i> )	CE	CE	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. It inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. It feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany.	BAM-C, BioNet, PMST	Low – Marginal foraging habitat available. Rare occurrences under suitable seasonal conditions cannot be discounted. The last record within the locality is over 25 years old.	Predicted ecosystem credit species in BAM-C. No important areas mapped within the study area and therefore not considered further as a candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Rufous Fantail ( <i>Rhipidura rufifrons</i> )	-	M, Ma	N/A	Not listed on the BC Act	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range.	PMST	Moderate – potential habitat within EIS proposal area associated with intact native vegetation.	Considered further in MNES section
Satin Flycatcher ( <i>Myiagra cyanoleuca</i> )	-	M, Ma	N/A	Not listed on the BC Act	Widespread in eastern Australia. In Queensland, it is widespread but scattered in the east. In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. In Victoria, the species is widespread in the south and east, in the area south of a line joining Numurkah, Maldon, the northern Grampians, Balmoral and Nelson. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests, often occurring in gullies. They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest. In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline.	PMST	Low – preferred habitat within EIS proposal area limited. Rare and intermittent occurrences cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAII <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Scarlet Robin ( <i>Petroica boodang</i> )	V	-	No	Ecosystem credit	The Scarlet Robin is found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude.	BAM-C, BioNet	Low – The Scarlet Robin breeds in elevated woodland habitats of the Great Dividing Range and its foothills. They disperse from breeding habitats during the cooler months to lowland woodland habitats on valley floors below their breeding grounds. Marginal habitat available. Closest record at Voyager Point.	Predicted ecosystem credit species in BAM-C.
Sharp-tailed Sandpiper ( <i>Calidris acuminata</i> )	-	M, Ma	N/A	Not listed on the BC Act	Occurs in a variety of habitats: tidal mudflat, mangrove swamps, saltmarshes, shallow fresh, brackish, salt inland swamps and lakes; flooded and irrigated paddocks, sewage farms and commercial saltfields.	PMST	Low – marginal habitat in association with mangroves. Prefers larger areas of intertidal mudflats or floodplains. Rare and intermittent occurrences during seasonal movements cannot be discounted.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Sooty Owl ( <i>Tyto tenebricosa</i> )	V	-	No	Ecosystem credit / Species credit Species: presence of caves/clifflines/ledges and/or living or dead trees with hollows greater than 20cm diameter actively being used Ecosystem credit: all 'other habitat'	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum ( <i>Pseudocheirus peregrinus</i> ) or Sugar Glider ( <i>Petaurus breviceps</i> ). Nests in very large tree-hollows.	BioNet	Low – This species prefers rainforest type habitats, of which do not occur within in EIS proposal area. No records within close proximity.	Not considered further
Speckled Warbler ( <i>Chthonicola sagittata</i> )	V	-	No	Ecosystem credit	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. Lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	BAM-C	Low – marginal habitat in association with Landsdowne. Typically occurs on hills and tablelands of Dividing Range. Often require large remnant patches of habitat to persist. Rare or intermittent occurrences cannot be discounted.	Predicted ecosystem credit species in BAM-C.
Spectacled Monarch ( <i>Monarcha trivirgatus</i> )	-	M, Ma	N/A	Not listed on the BC Act	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed.	PMST	Low – preferred habitat not within EIS proposal area. Rare and intermittent occurrences cannot be discounted.	Not considered further



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Spotted Harrier ( <i>Circus assimilis</i> )	V	-	No	Ecosystem credit	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Preys on terrestrial mammals (e.g. bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	BAM-C, BioNet	Low – a western plains species that sometimes extends its range to near coastal locations. However, there is marginal habitat available in the vicinity of the EIS proposal area, and intermittent or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	Predicted ecosystem credit species in BAM-C.
Square-tailed Kite ( <i>Lophoictinia isura</i> )	V	-	No	Ecosystem credit / Species credit Species: actively used nest trees Ecosystem credit: all 'other habitat'	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.	BAM-C, BioNet	Low – Marginal foraging habitat available in the vicinity of the EIS proposal area. Intermittent or rare occurrences under suitable conditions cannot be entirely discounted.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Superb Fruit-dove ( <i>Ptilinopus superbus</i> )	V	-	No	Ecosystem credit	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic.	BAM-C	Low – There is no suitable habitat within the EIS proposal area (rainforest habitats), however rare occurrences within the EIS proposal area cannot be discounted.	Predicted ecosystem credit species in BAM-C.
Swift Parrot ( <i>Lathamus discolor</i> )	E1	CE, Ma	Yes	Ecosystem credit / Species credit Species credit: as per mapped important areas Ecosystem credit: all 'other habitat'	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ). Commonly used lerp infested trees include Inland Grey Box ( <i>E. macrocarpa</i> ), Grey Box ( <i>E. moluccana</i> ) and Blackbutt ( <i>E. pilularis</i> ).	BAM-C, BioNet, PMST	Moderate – potential habitat within the EIS proposal area. May occur within study during seasonal movements when blossom resources are in abundance.	Predicted ecosystem credit species in BAM-C.  No important areas mapped within the study area and therefore not considered further as a candidate species credit species.
Turquoise Parrot ( <i>Neophema pulchella</i> )	V	-	No	Ecosystem credit	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	BAM-C, BioNet	Low – It is unlikely to occur with the EIS proposal area due to a lack of local records, suitable habitat, and it is outside the species normal distribution.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Varied Sittella ( <i>Daphoenositta chrysoptera</i> )	V	-	No	Ecosystem credit	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	BAM-C, BioNet	Moderate - Potential habitat available in EIS proposal area. Recorded within the greater locality.	Predicted ecosystem credit species in BAM-C.
White-bellied Sea-eagle ( <i>Haliaeetus leucogaster</i> )	V	Ma	No	Ecosystem credit / Species credit Species: presence of living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines actively being used Ecosystem credit: all 'other habitat'	The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. In New South Wales it is widespread along the east coast, and along all major inland rivers and waterways. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion.	BAM-C, BioNet	High – Potential habitat nesting and foraging habitat within the EIS proposal area. Records for this species in the REF proposal area. No nesting was observed or potential nesting trees observed within EIS proposal area. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
White-fronted Chat ( <i>Epthianura albifrons</i> )	E2, V	-	No	E2: Species credit V: Ecosystem credit	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly. The nearest extant populations outside Sydney Metropolitan CMA are at Ash Island north of Newcastle and Lake Illawarra, south of Wollongong. White-fronted Chats were previously recorded at Penrith Lakes (2001), Hawkesbury Swamps (2002), Tuggerah Lake (1997) and Lake Macquarie (1998).	BAM-C	Low – This species is unlikely to occur within the EIS proposal area as there is no suitable habitat. Known to occur within the Sydney Metropolitan Catchment, accidental or rare occurrences under suitable seasonal conditions cannot be entirely discounted.	Predicted ecosystem credit species in BAM-C. Not considered further as a candidate species credit species as considered unlikely to occur. Not considered further
White-throated Needletail ( <i>Hirundapus caudacutus</i> )	-	V, M, Ma	No	Species credit	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April.	PMST, BioNet	Low – May occur over the EIS proposal area on a seasonal basis, but unlikely to use terrestrial habitats in the EIS proposal area.	Not considered further



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Yellow Wagtail ( <i>Motacilla flava</i> )	-	M, Ma	N/A	Not listed on the BC Act	This species occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. This species also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. This species migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA.	PMST	Low – preferred habitat within EIS proposal area limited. Rare and intermittent occurrences cannot be discounted. Despite targeted surveys this species was not recorded.	Not considered further
<b>Mammals</b>								
Brush-tailed Rock-wallaby ( <i>Petrogale penicillata</i> )	E1	V	Yes	Species credit: presence of land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines	The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However, the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.	PMST	Low – Suitable habitat not available within the EIS proposal area. This species has not been previously recorded within locality. The EIS proposal area is outside its normal distribution which tends to be associated with the Great Dividing Range.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Large Bent-winged Bat ( <i>Miniopterus orianae oceanensis</i> )	V	-	Yes	Ecosystem credit / Species credit Species: presence of cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding Ecosystem credit: all 'other habitat'	This species is found along the east coast of Australia from Cape York in Queensland to Castlemaine in Victoria. Habitat includes rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forests and open grasslands. Roosts in caves, old mines, stormwater channels and sometimes buildings with populations centred on maternity caves that are used annually for the birth and development of young.	BAM-C, BioNet	Moderate (Ecosystem credit) - potential foraging available within the vicinity of the EIS proposal area. Recorded within the wider locality. Species not recorded during targeted surveys. Low (Species credit) - No roosting or breeding habitat recorded. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as candidate species credit species.
Eastern False Pipistrelle ( <i>Falsistrellus tasmaniensis</i> )	V	-	No	Ecosystem credit	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	BAM-C, BioNet	Moderate – This species prefers moist habitats, with trees taller than 20m. Some marginal habitat within the EIS proposal area, potential to forage as part of greater home range. Records within the wider locality. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Eastern Coastal Free-tailed bat ( <i>Mormopterus norfolkensis</i> )	V	-	No	Ecosystem credit	The Eastern Freetail-bat is found along the east coast from south Queensland 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.	BAM-C, BioNet	Moderate - potential foraging available within the vicinity of the EIS proposal area. Recorded within the wider locality. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.
Eastern Pygmy-possum ( <i>Cercartetus nanus</i> )	V	-	No	Species credit	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	BAM-C, BioNet	Low – preferred habitat not recorded within the EIS proposal area. EIS proposal area is highly fragmented and isolated from remnant intact forests/woodland.	Predicted ecosystem credit species in BAM-C. Considered further as candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )	V	-	No	Ecosystem credit	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however, does not occur at altitudes above 500m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3-6m.	BAM-C, BioNet	Moderate – more commonly found in tall wet forest which are not available within the EIS proposal area. However, the species may forage within the vicinity of the EIS proposal area, i.e. Georges River. Despite targeted surveys this species was not recorded.	Predicted Ecosystem Credit Species in BAM-C.
Greater Glider ( <i>Petauroides volans</i> )	-	V	No	Species credit	The Greater Glider has a restricted distribution in eastern Australia, from the Windsor Tableland in north Queensland to central Victoria, with an elevated range from sea level to 1200m above sea level. The species is largely restricted to eucalypt forests and woodlands, feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. It is found in abundance in montane eucalypt forest with relatively old trees and an abundance of hollows. It also favours forests with a diversity of eucalypts to cater for seasonal variation in food abundance.	PMST	Low – This species has not been previously recorded within locality. EIS proposal area is majority disturbed, and disjunct from major patches of intact vegetation. This species unlikely to occur as the EIS proposal area is too isolated from known populations to the south.	Not considered further



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	V	V	No	Ecosystem credit / Species credit Species: breeding camps Ecosystem credit: all 'other habitat'	Grey-headed Flying-foxes are generally found within 200km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Can travel up to 50km from the camp to forage; commuting distances are more often <20km. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	BAM-C, BioNet, PMST	High - Foraging habitat occurs within the EIS proposal area. No known roost sites or established camps within the EIS proposal area. The closest known GHFF camp is at Cabramatta. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.  Not considered further as candidate species credit species as no breeding camps occur within the EIS proposal area.
Koala ( <i>Phascolarctos cinereus</i> )	V	V	No	Ecosystem credit / Species credit Species: areas identified via survey as important habitat Ecosystem credit: all 'other habitat'	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. It was briefly historically abundant in the 1890s in the Bega District on the south coast of NSW, although not elsewhere, but it now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Some preferred species include Forest Red Gum, Grey Gum. In coastal areas, Tallowwood and Swamp Mahogany are important food species, while in inland areas White Box, Bimble Box and River Red Gum are favoured. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	BAM-C, BioNet, PMST	Low – This species has not been previously recorded within locality. EIS proposal area is fairly disturbed, and disjunct from major patches of intact vegetation. Closest records are at Sandy Point on the other side of the Georges River in association with Campbelltown LGA population. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.  Considered further as candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Large-eared Pied Bat ( <i>Chalinolobus dwyeri</i> )	V	V	Yes	Species credit: areas within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin ( <i>Petrochelidon ariel</i> ), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.	BAM-C, BioNet, PMST	Low – No roosting habitat (i.e. cliffs and sandstone rocky outcrops/caves) recorded within EIS proposal area. Potential foraging available within the of the EIS proposal area. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Not considered further as candidate species credit species due to no cliffs occurring within the EIS proposal area and the study area not occurring within 2 km of rocky areas containing appropriate habitat.
Little Bent-winged Bat ( <i>Miniopterus australis</i> )	V	-	Yes	Ecosystem credit / Species credit Species: presence of cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding Ecosystem credit: all 'other habitat'	Found along east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. Only five nursery sites /maternity colonies are known in Australia.	BAM-C, BioNet	Moderate (Ecosystem credit) - potential marginal foraging available within the vicinity of the EIS proposal area. Species not recorded during targeted surveys. Low (Species credit) - No roosting or breeding habitat recorded. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C. Considered further as candidate species credit species.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Long-nosed Potaroo (SE Mainland) ( <i>Potorous tridactylus</i> )	V	V	No	Species credit	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	PMST	Low – no suitable habitat within the EIS proposal area	No considered further
New Holland Mouse ( <i>Pseudomys novaehollandiae</i> )	-	V	No	Ecosystem credit	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Genetic evidence indicates that the New Holland Mouse once formed a single continuous population on mainland Australia and the distribution of recent subfossils further suggest that the species has undergone a large range contraction since European settlement. Total population size of mature individuals is now estimated to be less than 10,000 individuals although, given the number of sites from which the species is known to have disappeared between 1999 and 2009, it is likely that the species' distribution is actually smaller than current estimates. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes.	PMST	Low – marginal habitat, preferred habitat of heathy understorey limited. No records within the locality. This species unlikely to occur as the EIS proposal area is too isolated from known populations and records to the south in Royal National Park.	Not considered further
Southern Brown Bandicoot ( <i>Isodon obesulus</i> )	E1	E	No	Species credit: requires dense ground cover in a variety of habitats.	The Southern Brown Bandicoot has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruited) fungi. Their searches for food often create distinctive conical holes in the soil. Males have a home range of approximately 5-20 hectares whilst females forage over smaller areas of about 2-3 hectares.	PMST	Low – not suitable habitat within the EIS proposal area.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Southern Myotis ( <i>Myotis macropus</i> )	V	-	No	Species credit: areas within 200 m of riparian zone; bridges, caves or artificial structures within 200 m of riparian zone; riparian zones include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	BAM-C, BioNet	Recorded - An individual was identified utilising one culvert along the Georges River in EIS proposal area 1. It is also likely that the species may be utilising native vegetation and waterbodies surrounding these potential artificial roosting sites within the EIS proposal area.	Candidate species credit species
Spotted-tailed Quoll ( <i>Dasyurus maculatus</i> )	V	E	No	Ecosystem credit	Found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines.	BAM-C, PMST	Low – No records within the locality. EIS proposal area disturbed and isolated from major patches of intact vegetation.	Predicted ecosystem credit species in BAM-C.



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Squirrel Glider ( <i>Petaurus norfolcensis</i> )	V	-	No	Species credit: presence of hollow-bearing trees	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	BAM-C	Low – Despite targeted surveys the species has not been previously recorded within locality. EIS proposal area is fairly disturbed, and disjunct from major patches of intact vegetation.	Predicted ecosystem credit species in BAM-C. Considered further as a candidate species credit species.
Yellow-bellied Glider ( <i>Petaurus australis</i> )	V	-	No	Ecosystem credit	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources.	BAM-C	Low – This species has not been previously recorded within locality. EIS proposal area is majority disturbed, and disjunct from major patches of intact vegetation. This species unlikely to occur as the EIS proposal area is too isolated from known populations to the south.	Predicted ecosystem credit species in BAM-C.

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Yellow-bellied Sheathtail Bat ( <i>Saccolaimus flaviventris</i> )	V	-	No	Ecosystem credit	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	BAM-C, BioNet	Moderate - Potential foraging habitat available within the vicinity of the study area. Records within the locality to the south of Holsworthy military base. Despite targeted surveys this species was not recorded.	Predicted ecosystem credit species in BAM-C.
<b>Fish</b>								
Black Cod ( <i>Epinephelus daemeli</i> )	V (FM Act)	V	N/A	Not listed on the BC Act	Adult Black Rockcod are known to occur in caves, gutters and on rocky reefs from near shore environments to depths of at least 50 m. Recently settled small juveniles are occasionally found in intertidal rock pools along the NSW coastline and larger juveniles are generally captured by anglers on rocky reefs in estuary systems.	PMST	Low – No suitable habitat within the EIS proposal area	Not considered further
Macquarie Perch ( <i>Macquaria australasica</i> )	V (FM Act)	E	N/A	Not listed on the BC Act	Riverine fish most abundant in reaches > 200m altitude. The species is heavily dependent on the availability of flowing mesohabitats (runs and/or riffles) and small complex rock piles (aggregations of 0.5–1 m diameter boulders) to provide cover. <input type="checkbox"/> Preferred juvenile habitat in rivers is not well documented.	PMST	Low – No suitable habitat within the EIS proposal area	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
<b>Insects</b>								
Golden Sun Moth ( <i>Synemon plana</i> )	E	CE	Yes	Species Credit	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses <i>Austrodanthonia</i> spp.	PMST	Low – No suitable habitat within the EIS proposal area	Not considered further
<b>Invertebrates</b>								
Cumberland Plain Land Snail ( <i>Meridolum corneovirens</i> )	E1	-	No	Species credit	Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. known from over 100 different locations, but not all are currently occupied, and they are usually isolated from each other as a result of land use patterns. Primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed communities. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	BAM-C, BioNet	Moderate – although preferred habitat does not occur within the EIS proposal area it does occur within the study area	Predicted ecosystem credit species in BAM-C. Considered further as candidate species credit species.

Common Name ( <i>Scientific Name</i> )	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Dural Woodland Snail ( <i>Pommerhelix duralensis</i> )	E1	E	No	Species credit	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species is definitely found within the Local Government Areas of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris. Migration and dispersal is limited, with overnight straight-line distances of under 1 metre identified in the literature and studies. The main food sources are hyphae and fruiting bodies of native fungi. It is possible other detritus may be consumed.	PMST	Low – Outside known species distribution and it has not been recorded within the locality.	Not considered further



Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
<b>Reptiles</b>								
Broad-headed Snake ( <i>Hoplocephalus bungaroides</i> )	E1	V	Yes	Ecosystem credit / Species credit Species: areas including escapements, outcrops and pogodas within the Sydney Sandstone geologies Ecosystem credit: all 'other habitat'	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250km of Sydney. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in cervices or hollows in large trees within 500m of escarpments in summer.	PMST	Low – associated with exposed cliff edges and sandstone rock outcropping, where it shelters in rock crevices and under flat sandstone rocks during autumn, winter and spring. During summer, this species seeks shelter in hollows of large trees within 500 m of their escarpment habitat. The EIS proposal area did not comprise habitat suitable for this species.	Not considered further

Common Name (Scientific Name)	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	SAIL <sup>3</sup>	Ecosystem or species credit species?	Habitat requirements	Data source <sup>4</sup>	Likelihood of occurrence	Outcome
Rosenberg's Goanna ( <i>Varanus rosenbergi</i> )	V	-	No	Ecosystem credit	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	BAM-C	Low – Critical habitat components include termite mounds, within which this species nests. The EIS proposal area does not comprise appropriate habitat for this species.	Predicted ecosystem credit species in BAM-C.

1. Listed under the NSW *Biodiversity Conservation Act 2016* – E4 = Presumed extinct, CE = Critically Endangered, E1 = Endangered Species, E2 = Endangered Population, V = Vulnerable
2. SAIL = Serious and Irreversible Impact entity under BAM
3. Listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – X = Extinct, CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Ma = Marine
4. Bionet = OEH Bionet Atlas of NSW Wildlife, PMST = EPBC Act Protected Matters Search Tool, PlantNet = Royal Botanic Gardens PlantNet Spatial Search and BAM-C = Biodiversity Assessment Method Calculator output based on vegetation within the study area.

## Appendix B – Flora survey data

### B1 – BAM vegetation integrity plot data

#### Q1

##### Q1

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open forest  
on clay soils of the Cumberland Plain,  
Sydney Basin Bioregion – Good  
condition

Species	Cover	Abundance	Covers # spp	Native Count	Trees Count	Shrubs Count	Grass Count	Forb Count	Fern Count	Other Count	Exotic Count	HighThreat Count	Easting 313855 Orientation	Northing 6243825 260	Zone 56
			45	38	6	12	8	6	1	5	7	2			
			Sum cover 93	Sum 88.8	Sum 16.8	Sum 42.6	Sum 19.4	Sum 4.3	Sum 1	Sum 4.7	Sum 4.2	Sum 2.1			
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0.1	1	SG			0.1									
<i>Acacia parramattensis</i>	0.8	4	TG		0.8										
<i>Acacia pubescens</i>	0.5	12	SG			0.5									
<i>Allocasuarina littoralis</i>	0.5	2	TG		0.5										
<i>Angophora bakeri</i>	0.5	1	TG		0.5										
<i>Angophora floribunda</i>	6	4	TG		6										
<i>Aristida vagans</i>	2	40	GG				2								
<i>Asparagus asparagoides</i> *	2	30	HT									2			
<i>Astroloma humifusum</i>	0.1	2	SG			0.1									
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	2	20	SG			2									
<i>Cassythra glabella</i> f. <i>glabella</i>	0.6	10	OG							0.6					
<i>Cestrum parqui</i> *	0.1	1	HT									0.1			
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	1	100	EG						1						
<i>Clematis glycinoides</i> var. <i>glycinoides</i>	3	50	OG							3					
<i>Desmodium varians</i>	0.1	2	OG							0.1					
<i>Dianella longifolia</i> var. <i>longifolia</i>	0.3	10	FG					0.3							
<i>Dichondra repens</i>	1	80	FG					1							
<i>Entolasia stricta</i>	5	200	GG				5								
<i>Eriochloa pseudoacrotricha</i>	0.8	30	GG				0.8								
<i>Eucalyptus fibrosa</i>	1	1	TG		1										
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	8	2	TG		8										
<i>Freesia hybrid</i> *	0.4	20	EX								0.4				
<i>Glycine clandestina</i>	0.4	20	OG							0.4					
<i>Hakea sericea</i>	0.5	3	SG			0.5									
<i>Hardenbergia violacea</i>	0.6	10	OG							0.6					
<i>Hibbertia aspera</i>	0.1	3	SG			0.1									
<i>Imperata cylindrica</i> var. <i>major</i>	0.5	30	GG				0.5								
<i>Kunzea ambigua</i>	4	20	SG			4									
<i>Laxmannia gracilis</i>	0.1	5	FG					0.1							
<i>Leucopogon juniperinus</i>	5	20	SG			5									
<i>Lobelia purpurascens</i>	2	100	FG					2							
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.1	5	GG				0.1								
<i>Lomandra longifolia</i>	4	100	GG				4								

BAM Attributes  
20x50m plot  
Stem classes

80+ 0  
50-79 0  
30-49 Yes  
20-29 Yes  
10-19 Yes  
5-9 Yes  
<5 Yes

Hollows 0  
Lenth of logs  
(m) 16.5

BAM Attributes  
1x1m plot

Litter cover 58

**Q1**

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open forest  
on clay soils of the Cumberland Plain,  
Sydney Basin Bioregion – Good  
condition

Species	Cover	Abundance
<i>Melaleuca nodosa</i>	30	80
<i>Melaleuca sieberi</i>	0.1	1
<i>Microlaena stipoides</i> var. <i>stipoides</i>	6	150
<i>Opercularia varia</i>	0.5	30
<i>Ozothamnus diosmifolius</i>	0.1	1
<i>Paspalidium distans</i>	1	40
<i>Passiflora subpeltata</i> *	0.8	40
<i>Pavonia hastata</i> *	0.4	10
<i>Pellaea viridis</i> *	0.1	2
<i>Pultenaea villosa</i>	0.1	2
<i>Setaria parviflora</i> *	0.4	20
<i>Veronica plebeia</i>	0.4	30

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
45	38	6	12	8	6	1	5	7	2
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
93	88.8	16.8	42.6	19.4	4.3	1	4.7	4.2	2.1
SG			30						
SG			0.1						
GG				6					
FG					0.5				
SG			0.1						
GG				1					
EX								0.8	
EX								0.4	
EX								0.1	
SG			0.1						
EX								0.4	
FG					0.4				

Easting 313855  
Orientation  
Northing 6243825  
260  
Zone 56

BAM Attributes  
20x50m plot  
Stem classes

## Q2

### Q2

PCT 1236: Swamp Paperbark -  
Swamp Oak tall shrubland on  
estuarine flats, Sydney Basin  
Bioregion and South East Corner  
Bioregion - Poor condition

Species	Cover	Abundance	Covers # spp 16	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Easting 313573 Orientation	Northing 6243803 270	Zone 56
				Count	Count	Count	Count	Count	Count	Count	Count	Count			
				8	0	2	3	3	0	0	8	8			
			Sum cover 130.3	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum			
				119.5	0	33	74	12.5	0	0	10.8	10.8			
<i>Alternanthera philoxeroides</i> *	5	100	HT									5	80+	0	
<i>Carex appressa</i>	4	50	GG				4						50-79	0	
<i>Cestrum parqui</i> *	0.8	3	HT									0.8	30-49	No	
<i>Commelina cyanea</i>	0.5	30	FG					0.5					20-29	No	
<i>Cyperus eragrostis</i> *	0.1	2	HT									0.1	10-19	No	
<i>Erythrina crista-galli</i> *	1	1	HT									1	5-9	Yes	
<i>Lantana camara</i> *	0.4	5	HT									0.4	<5	Yes	
<i>Ligustrum sinense</i> *	0.1	1	HT									0.1			
<i>Melaleuca ericifolia</i>	30	12	SG			30							Hollows	0	
<i>Melaleuca linariifolia</i>	3	3	SG			3							Lenth of logs (m)	3	
<i>Persicaria hydropiper</i>	2	100	FG					2							
<i>Persicaria lapathifolia</i>	10	500	FG					10							
													BAM Attributes 1x1m plot		
<i>Phragmites australis</i>	65	500	GG				65								
<i>Senna pendula</i> var. <i>glabrata</i> *	0.4	2	HT									0.4	Litter cover	10	
<i>Tradescantia fluminensis</i> *	3	100	HT									3			
<i>Typha orientalis</i>	5	100	GG				5								



### Q3

#### Q3

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open  
forest on clay soils of the  
Cumberland Plain, Sydney Basin  
Bioregion – Good condition

Species	Cover	Abundance	Covers # spp 55	Native Count 33	Trees Count 4	Shrubs Count 6	Grass Count 9	Forb Count 8	Fern Count 1	Other Count 5	Exotic Count 22	HighThreat Count 8	Easting 313716 Orientation	Northing 6243827 280	Zone 56
			Sum cover 125.5	Sum 115.5	Sum 27.8	Sum 40.9	Sum 22.4	Sum 20.1	Sum 0.5	Sum 3.8	Sum 10	Sum 6			
<i>Acacia falcata</i>	0.1	1	SG			0.1							80+	0	
<i>Acacia longifolia</i> subsp. <i>longifolia</i>	0.1	1	SG			0.1							50-79	0	
<i>Acetosa sagittata</i> *	0.1	5	HT									0.1	30-49	Yes	
<i>Adiantum aethiopicum</i>	0.5	20	EG						0.5				20-29	Yes	
<i>Asparagus asparagoides</i> *	5	100	HT									5	Oct-19	Yes	
<i>Bidens pilosa</i> *	0.4	20	EX								0.4		5-9	Yes	
<i>Brunoniella australis</i>	0.1	5	FG					0.1					<5	Yes	
<i>Cestrum parqui</i> *	0.1	1	HT									0.1			
<i>Cinnamomum camphora</i> *	0.1	1	HT									0.1	Hollows	0	
<i>Cirsium vulgare</i> *	0.1	5	EX								0.1		Lenth of logs (m)	8.5	
<i>Clematis glycinoides</i> var. <i>glycinoides</i>	2	50	OG							2					
<i>Commelina cyanea</i>	10	100	FG					10							
<i>Conyza</i> sp.*	0.4	10	EX								0.4				
<i>Cyperus eragrostis</i> *	0.1	3	HT									0.1	Litter cover	79	
<i>Desmodium varians</i>	0.1	2	OG							0.1					
<i>Dianella longifolia</i> var. <i>longifolia</i>	0.2	10	FG					0.2							
<i>Dichondra repens</i>	4	200	FG					4							
<i>Einadia polygonoides</i>	0.1	2	FG					0.1							
<i>Entolasia marginata</i>	10	300	GG				10								
<i>Entolasia stricta</i>	0.5	10	GG				0.5								
<i>Eriochloa pseudoacrotricha</i>	1	80	GG				1								
<i>Erythrina crista-galli</i> *	0.1	1	HT									0.1			
<i>Eucalyptus fibrosa</i>	12	9	TG		12										
<i>Eucalyptus longifolia</i>	15	11	TG		15										
<i>Glycine clandestina</i>	1	80	OG							1					
<i>Glycine tabacina</i>	0.6	50	OG							0.6					
<i>Guioa semiglauc</i>	0.4	10	TG		0.4										
<i>Lepidosperma gunnii</i>	0.2	10	GG				0.2								
<i>Leucopogon juniperinus</i>	0.6	10	SG			0.6									
<i>Ligustrum sinense</i> *	0.4	10	HT									0.4			
<i>Lobelia purpurascens</i>	5	200	FG					5							
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0.1	1	GG				0.1								
<i>Lomandra longifolia</i>	2	50	GG				2								
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	0.6	40	GG				0.6								
<i>Melaleuca decora</i>	15	40	SG			15									
<i>Melaleuca nodosa</i>	25	200	SG			25									
<i>Microlaena stipoides</i> var. <i>stipoides</i>	5	100	GG				5								
<i>Modiola caroliniana</i> *	0.1	3	EX								0.1				
<i>Morus</i> sp.*	0.1	1	EX								0.1				
<i>Notelaea longifolia</i> f. <i>longifolia</i>	0.4	1	TG		0.4										

### Q3

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open  
forest on clay soils of the  
Cumberland Plain, Sydney Basin  
Bioregion – Good condition

Species	Cover	Abundance
<i>Oplismenus aemulus</i>	3	100
<i>Oxalis perennans</i>	0.5	30
<i>Oxalis purpurea</i> *	0.1	2
<i>Ozothamnus diosmifolius</i>	0.1	1
<i>Passiflora subpeltata</i> *	0.8	50
<i>Pellaea viridis</i> *	0.1	5
<i>Phytolacca octandra</i> *	0.2	5
<i>Senecio madagascariensis</i> *	0.1	1
<i>Setaria parviflora</i> *	1	80
<i>Sida rhombifolia</i> *	0.3	20
<i>Solanum nigrum</i> *	0.1	3
<i>Solanum pseudocapsicum</i> *	0.1	3
<i>Sonchus oleraceus</i> *	0.2	10
<i>Tylophora barbata</i>	0.1	1
<i>Veronica plebeia</i>	0.2	10

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
55	33	4	6	9	8	1	5	22	8
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
125.5	115.5	27.8	40.9	22.4	20.1	0.5	3.8	10	6

Easting 313716  
Orientation  
Northing 6243827  
280  
Zone 56

BAM Attributes  
20x50m plot  
Stem classes

# Q4

## Q4

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open forest  
on clay soils of the Cumberland Plain,  
Sydney Basin Bioregion – Moderate  
condition (regrowth)

Species	Cover	Abundance	Covers # spp 47	Native Count 35	Trees Count 3	Shrubs Count 12	Grass Count 12	Forb Count 5	Fern Count 2	Other Count 1	Exotic Count 12	HighThreat Count 6	Easting 313645	Northing 6243901	Zone 56
			Sum cover 89.7	Sum 43.4	Sum 3.8	Sum 22.4	Sum 14	Sum 1.2	Sum 1.2	Sum 0.8	Sum 46.3	Sum 41.6			
<i>Acacia decurrens</i>	2	10	TG		2								80+	0	
<i>Acacia falcata</i>	0.4	5	SG			0.4							50-79	0	
<i>Angophora floribunda</i>	1	3	TG		1								30-49	No	
<i>Aristida vagans</i>	2	80	GG				2						20-29	No	
<i>Aristida warburgii</i>	0.1	5	GG				0.1						10-19	No	
<i>Asparagus asparagoides*</i>	0.4	10	HT									0.4	5-9	Yes	
<i>Brunoniella australis</i>	0.1	2	FG					0.1					<5	Yes	
<i>Bursaria spinosa subsp. spinosa</i>	10	60	SG			10									
<i>Callistemon linearis</i>	0.3	7	SG			0.3							Hollows	0	
<i>Cassytha glabella f. glabella</i>	0.8	10	OG							0.8			Lenth of logs (m)	4	
<i>Casuarina glauca</i>	0.8	3	TG		0.8										
<i>Cheilanthes distans</i>	0.2	10	EG						0.2						
<i>Cheilanthes sieberi subsp. sieberi</i>	1	100	EG						1						
<i>Conyza bonariensis*</i>	0.2	10	EX								0.2		Litter cover	37	
<i>Cynodon dactylon</i>	0.6	30	GG				0.6								
<i>Daviesia genistifolia</i>	0.1	1	SG			0.1									
<i>Dianella longifolia var. longifolia</i>	0.2	10	FG					0.2							
<i>Dichelachne crinita</i>	0.4	10	GG				0.4								
<i>Echinopogon caespitosus var. caespitosus</i>	0.6	20	GG				0.6								
<i>Eragrostis brownii</i>	0.4	30	GG				0.4								
<i>Eragrostis curvula*</i>	40	1000	HT									40			
<i>Eragrostis leptostachya</i>	8	200	GG				8								
<i>Fimbristylis dichotoma</i>	0.2	20	GG				0.2								
<i>Freesia hybrid*</i>	1	70	EX								1				
<i>Goodenia hederacea subsp. hederacea</i>	0.6	40	FG					0.6							
<i>Hakea sericea</i>	0.2	3	SG			0.2									
<i>Kunzea ambigua</i>	0.8	40	SG			0.8									
<i>Lantana camara*</i>	0.4	5	HT									0.4			
<i>Lepidosperma laterale</i>	0.4	20	GG				0.4								
<i>Leucopogon juniperinus</i>	3	30	SG			3									
<i>Ligustrum sinense*</i>	0.5	10	HT									0.5			
<i>Lomandra longifolia</i>	1	20	GG				1								
<i>Lomandra multiflora subsp. multiflora</i>	0.1	5	GG				0.1								
<i>Melaleuca nodosa</i>	5	50	SG			5									
<i>Melaleuca sieberi</i>	2	1	SG			2									
<i>Melaleuca thymifolia</i>	0.1	1	SG			0.1									
<i>Microlaena stipoides var. stipoides</i>	0.2	10	GG				0.2								
<i>Olea europaea*</i>	0.2	1	HT									0.2			

#### Q4

PCT 725: Broad-leaved Ironbark -  
Melaleuca decora shrubby open forest  
on clay soils of the Cumberland Plain,  
Sydney Basin Bioregion – Moderate  
condition (regrowth)

Species	Cover	Abundance	Covers								Easting 313645 Orientation	Northing 6243901 280	Zone 56
			# spp	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	
			47	Count	Count	Count	Count	Count	Count	Count	Count	Count	
			47	35	3	12	12	5	2	1	12	6	
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot Stem classes
			89.7	43.4	3.8	22.4	14	1.2	1.2	0.8	46.3	41.6	
<i>Opercularia varia</i>	0.2	10	FG					0.2					
<i>Ozothamnus diosmifolius</i>	0.1	1	SG			0.1							
<i>Passiflora subpeltata</i> *	0.1	1	EX								0.1		
<i>Pellaea viridis</i> *	0.1	5	EX								0.1		
<i>Pimelea linifolia</i>	0.4	5	SG			0.4							
<i>Senna pendula</i> var. <i>glabrata</i> *	0.1	1	HT									0.1	
<i>Setaria parviflora</i> *	3	100	EX								3		
<i>Sida rhombifolia</i> *	0.3	20	EX								0.3		
<i>Wahlenbergia gracilis</i>	0.1	1	FG					0.1					

## Q7

### Q7

VZ4 – PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Blue Box variant)

#### Species

<i>Acacia decurrens</i>	0.4	2	TG	0.4									80+	1
<i>Acacia parramattensis</i>	10	12	TG	10									50-79	6
<i>Bidens pilosa</i> *	0.3	20	EX								0.3		30-49	No
<i>Casuarina glauca</i>	3	5	TG	3									20-29	No
<i>Cayratia clematidea</i>	3	40	OG						3				10-19	No
<i>Conyza bonariensis</i> *	0.2	10	EX							0.2			5-9	Yes
<i>Cynodon dactylon</i>	3	80	GG			3							<5	Yes
<i>Cyperus gracilis</i>	0.1	5	GG			0.1								
<i>Ehrharta erecta</i> *	8	100	HT									8	Hollows	5
<i>Einadia hastata</i>	0.6	10	FG				0.6						Lenth of logs (m)	0
<i>Eucalyptus baueriana</i>	38	16	TG	38										
<i>Fumaria muralis</i> *	0.1	1	EX							0.1			BAM Attributes	
													1x1m plot	
<i>Melaleuca decora</i>	1	1	SG			1								
<i>Melaleuca styphelioides</i>	20	30	SG			20							Litter cover	62
<i>Microlaena stipoides</i> var. <i>stipoides</i>	0.8	40	GG				0.8							
<i>Modiola caroliniana</i> *	0.1	5	EX								0.1			
<i>Sida rhombifolia</i> *	0.2	20	EX								0.2			
<i>Solanum nigrum</i> *	0.1	1	EX								0.1			
<i>Sonchus oleraceus</i> *	0.1	2	EX								0.1			
<i>Stellaria media</i> *	0.1	5	EX								0.1			
<i>Tetragonia tetragonioides</i>	10	50	FG				10							
<i>Tradescantia fluminensis</i> *	2	40	HT									2		



## Q12

### Q12

PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Q12			PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)								Easting	Northing	Zone	
Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	Orientation BAM Attributes 20x50m plot Stem classes	90
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count		
			31	13	4	4	1	3	0	1	18	7		
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum		
			122.5	50.3	19.4	29.4	0.2	1.2	0	0.1	72.2	61.3		
Acacia decurrens	4	10	TG	4								80+	0	
Acetosa sagittata*	0.1	5	HT									0.1	50-79	2
Araujia sericifera*	0.2	5	HT									0.2	30-49	No
Asparagus asparagoides*	0.5	20	HT									0.5	20-29	Yes
Bidens pilosa*	3	100	EX									3	10-19	Yes
Bursaria spinosa subsp. spinosa	0.3	2	SG	0.3									5-9	Yes
Cardiospermum grandiflorum*	15	50	HT									15	<5	Yes
Carex appressa	0.2	10	GG	0.2										
Cassytha glabella	0.1	1	OG									0.1	Hollows	0
Casuarina glauca	0.4	1	TG	0.4									Lenth of logs (m)	0
Cestrum parqui*	0.5	5	HT									0.5		
Cirsium vulgare*	0.4	10	EX									0.4	BAM Attributes 1x1m plot	
Conyza sumatrensis*	0.8	30	EX									0.8		
Ehrharta erecta*	35	500	HT									35	Litter cover	57
Einadia hastata	0.5	10	FG											
Eucalyptus fibrosa	3	3	TG	3										
Eucalyptus tereticornis	12	10	TG	12										
Euphorbia peplus*	0.8	80	EX									0.8		
Jacaranda mimosifolia*	0.4	1	EX									0.4		
Melaleuca ericifolia	0.1	1	SG	0.1										
Melaleuca linariifolia	7	4	SG	7										
Melaleuca styphelioides	22	15	SG	22										
Oxalis perennans	0.1	2	FG									0.1		
Plantago lanceolata*	0.1	5	EX									0.1		
Sida rhombifolia*	3	80	EX									3		
Solanum americanum	0.6	20	FG	0.6										
Solanum nigrum*	1	50	EX									1		
Sonchus oleraceus*	0.6	20	EX									0.6		
Taraxacum officinale*	0.4	20	EX									0.4		
Tradescantia fluminensis*	10	15	HT									10		
Trifolium repens*	0.4	10	EX									0.4		

## Q18

### Q18

PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Species	Cover	Abundance	Covers								Easting 313306 Orientation	Northing 6243717 320	Zone 56
			# spp	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	
			37	12	4	1	2	4	0	1	25	8	
			Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	
			116.2	52.2	40	0.7	2.3	8.8	0	0.4	64	47	
<i>Acacia decurrens</i>	1	2	TG		1								
<i>Acetosa sagittata</i> *	0.2	5	HT									0.2	
<i>Amaranthus viridis</i> *	0.2	5	EX								0.2		
<i>Anagallis arvensis</i> *	0.1	5	EX								0.1		
<i>Araujia sericifera</i> *	0.4	10	HT									0.4	
<i>Asphodelus fistulosus</i> *	0.2	10	EX								0.2		
<i>Bidens pilosa</i> *	4	100	EX								4		
<i>Bromus catharticus</i> *	0.6	30	EX								0.6		
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	0.7	1	SG			0.7							
<i>Carex appressa</i>	0.3	10	GG				0.3						
<i>Casuarina glauca</i>	4	2	TG		4								
<i>Cenchrus clandestinus</i> *	3	60	EX								3		
<i>Centella asiatica</i>	1	80	FG					1					
<i>Cinnamomum camphora</i> *	1	1	HT									1	
<i>Cirsium vulgare</i> *	0.1	1	EX								0.1		
<i>Commelina cyanea</i>	5	100	FG					5					
<i>Cynodon dactylon</i>	2	50	GG				2						
<i>Dichondra repens</i>	2	100	FG					2					
<i>Ehrharta erecta</i> *	5	100	HT									5	
<i>Einadia hastata</i>	0.8	20	FG					0.8					
<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>	10	4	TG		10								
<i>Eucalyptus tereticornis</i>	25	28	TG		25								
<i>Glycine clandestina</i>	0.4	15	OG							0.4			
<i>Hydrocotyle bonariensis</i> *	0.2	5	EX								0.2		
<i>Ligustrum sinense</i> *	0.2	1	HT									0.2	
<i>Modiola caroliniana</i> *	0.4	10	EX								0.4		
<i>Olea europaea</i> *	0.1	1	HT									0.1	
<i>Oxalis purpurea</i> *	0.2	10	EX								0.2		
<i>Panicum maximum</i> var. <i>maximum</i> *	40	500	HT									40	
<i>Passiflora subpeltata</i> *	0.5	10	EX								0.5		
<i>Plantago lanceolata</i> *	0.4	20	EX								0.4		
<i>Senecio madagascariensis</i> *	0.1	1	HT									0.1	
<i>Senna septemtrionalis</i> *	0.1	1	EX								0.1		
<i>Sida rhombifolia</i> *	5	100	EX								5		
<i>Solanum nigrum</i> *	0.6	10	EX								0.6		
<i>Solanum pseudocapsicum</i> *	1	50	EX								1		
<i>Sonchus oleraceus</i> *	0.4	20	EX								0.4		

BAM Attributes  
20x50m plot  
Stem classes

80+ 1  
50-79 6  
30-49 Yes  
20-29 Yes  
10-19 Yes  
5-9 Yes  
<5 Yes

Hollows 5  
Lenth of logs (m) 10

BAM Attributes  
1x1m plot

Litter cover 74

## Q19

### Q19

Miscellaneous ecosystem -

Weeds / exotics – non-native vegetation

#### Species

Cover Abundance

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
32	3	0	0	2	1	0	0	29	6
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
95.9	10.3	0	0	10.2	0.1	0	0	85.6	48.3
<i>Acetosa sagittata</i> *	0.4	5	HT						0.4
<i>Anagallis arvensis</i> *	0.2	10	EX					0.2	
<i>Asphodelus fistulosus</i> *	0.1	5	EX					0.1	
<i>Axonopus fissifolius</i> *	2	80	HT						2
<i>Bidens pilosa</i> *	0.8	40	EX					0.8	
<i>Bidens subalternans</i> *	0.3	20	EX					0.3	
<i>Bromus catharticus</i> *	0.1	5	EX					0.1	
<i>Carex inversa</i>	0.2	10	GG	0.2					
<i>Cenchrus clandestinus</i> *	10	80	EX					10	
<i>Cestrum parqui</i> *	0.4	2	HT						0.4
<i>Cichorium intybus</i> *	0.1	1	EX					0.1	
<i>Cirsium vulgare</i> *	0.1	2	EX					0.1	
<i>Conyza bonariensis</i> *	0.6	30	EX					0.6	
<i>Cynodon dactylon</i>	10	100	GG	10					
<i>Digitaria sanguinalis</i> *	2	30	EX					2	
<i>Eleusine tristachya</i> *	0.2	10	EX					0.2	
<i>Eragrostis curvula</i> *	10	100	HT						10
<i>Euphorbia peplus</i> *	0.1	10	EX					0.1	
<i>Fumaria muralis</i> *	0.4	10	EX					0.4	
<i>Hypochaeris radicata</i> *	3	100	EX					3	
<i>Lonicera japonica</i> *	0.5	5	HT						0.5
<i>Oxalis corniculata</i> *	0.1	5	EX					0.1	
<i>Paspalum dilatatum</i> *	35	500	HT						35
<i>Plantago lanceolata</i> *	0.6	30	EX					0.6	
<i>Rumex crispus</i> *	0.1	1	EX					0.1	
<i>Setaria parviflora</i> *	15	200	EX					15	
<i>Sida rhombifolia</i> *	0.6	20	EX					0.6	
<i>Solanum americanum</i>	0.1	1	FG		0.1				
<i>Sonchus oleraceus</i> *	0.5	30	EX					0.5	
<i>Taraxacum officinale</i> *	1	80	EX					1	
<i>Verbena bonariensis</i> *	1	40	EX					1	
<i>Vicia sativa subsp. sativa</i> *	0.4	80	EX					0.4	

Easting 313174  
Northing 6243566  
Zone 56  
Orientation 70

BAM Attributes  
20x50m plot  
Stem classes

80+ 0  
50-79 0  
30-49 No  
20-29 No  
10-19 No  
5-9 No  
<5 No

Hollows 0  
Lenth of logs (m) 0

BAM Attributes  
1x1m plot

Litter cover 10

## Q20

### Q20

PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition

Q20			Covers								Easting	Northing	Zone			
PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley – Poor condition			# spp	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat	313095	6243534	56	
			20	Count	Count	Count	Count	Count	Count	Count	Count	Count	Count	Orientation	250	
			2	1	0	1	0	0	0	0	18	11				
Species	Cover	Abundance	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	BAM Attributes 20x50m plot Stem classes			
			144	35.2	35	0	0.2	0	0	0	108.8	92.2				
<i>Araujia sericifera</i> *	0.3	10	HT	35								0.3	80+	0		
<i>Arundo donax</i> *	10	20	HT										10	50-79	0	
<i>Asparagus aethiopicus</i> *	0.1	1	HT										0.1	30-49	No	
<i>Asparagus asparagoides</i> *	0.8	10	HT										0.8	20-29	Yes	
<i>Bidens pilosa</i> *	0.3	20	EX									0.3		10-19	Yes	
<i>Bidens subalternans</i> *	0.1	5	EX									0.1		5-9	Yes	
<i>Bryophyllum delagoense</i> *	0.3	5	HT										0.3	<5	Yes	
<i>Cardiospermum grandiflorum</i> *	55	100	HT										55			
<i>Casuarina glauca</i>	35	50	TG											Hollows	0	
<i>Conyza bonariensis</i> *	0.1	1	EX									0.1		Lenth of logs (m)	5	
<i>Ehrharta erecta</i> *	15	100	HT										15			
<i>Lantana camara</i> *	0.1	5	HT										0.1	BAM Attributes 1x1m plot		
<i>Ligustrum sinense</i> *	0.1	1	HT										0.1			
<i>Microlaena stipoides</i> var. <i>stipoides</i>	0.2	20	GG				0.2							Litter cover	70	
<i>Oxalis purpurea</i> *	0.1	2	EX									0.1				
<i>Rubus fruticosus</i> agg.*	0.5	5	HT									0.5				
<i>Sida rhombifolia</i> *	0.4	20	EX								0.4					
<i>Syagrus romanzoffiana</i> *	0.6	1	EX								0.6					
<i>Tradescantia fluminensis</i> *	10	100	HT									10				
<i>Yucca sp.</i> *	15	30	EX								15					

## Q21

### Q21

PCT 1234: Swamp Oak  
Swamp Forest Fringing  
Estuaries, Sydney Basin and  
South East Corner – Moderate  
condition

Species	Cover	Abundance	Covers								Easting 313235 Orientation	Northing 6244032 20	Zone 56
			Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic			
			# spp 27	Count 11	Count 3	Count 3	Count 1	Count 4	Count 0	Count 0	Count 16	Count 7	
Sum cover 129	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
				86.6	65	12	5	4.6	0	0	42.4	38.3	
<i>Acacia binervia</i>	10	3	TG		10								
<i>Acacia parramattensis</i>	15	30	TG		15								
<i>Alternanthera philoxeroides*</i>	0.1	2	HT								0.1		
<i>Bidens pilosa*</i>	0.8	20	EX							0.8			
<i>Bidens subalternans*</i>	0.4	10	EX							0.4			
<i>Bursaria spinosa subsp. spinosa</i>	1	4	SG			1							
<i>Cardiospermum grandiflorum*</i>	0.4	5	HT										
<i>Casuarina glauca</i>	40	60	TG		40								
<i>Dichondra repens</i>	0.4	50	FG					0.4					
<i>Ehrharta erecta*</i>	25	500	HT								25		
<i>Einadia hastata</i>	3	20	FG					3					
<i>Hypochaeris radicata*</i>	0.4	10	EX							0.4			
<i>Jacaranda mimosifolia*</i>	0.1	1	EX							0.1			
<i>Ligustrum lucidum*</i>	1	1	HT								1		
<i>Malva parviflora*</i>	0.5	10	EX							0.5			
<i>Melaleuca decora</i>	10	8	SG			10							
<i>Melaleuca styphelioides</i>	1	2	SG			1							
<i>Microlaena stipoides var. stipoides</i>	5	100	GG				5						
<i>Olea europaea*</i>	0.8	1	HT								0.8		
<i>Oxalis corniculata*</i>	0.8	50	EX							0.8			
<i>Panicum maximum var. maximum*</i>	1	30	HT								1		
<i>Sida rhombifolia*</i>	0.4	10	EX							0.4			
<i>Solanum americanum</i>	0.6	15	FG					0.6					
<i>Soliva sessilis*</i>	0.1	5	EX							0.1			
<i>Sonchus oleraceus*</i>	0.6	20	EX							0.6			
<i>Tetragonia tetragonoides</i>	0.6	4	FG					0.6					
<i>Tradescantia fluminensis*</i>	10	150	HT								10		

BAM Attributes  
20x50m plot  
Stem classes

80+ 0  
50-79 1  
30-49 Yes  
20-29 Yes  
10-19 Yes  
5-9 Yes

<5 Yes

Hollows 0  
Lenth of logs (m) 21

BAM Attributes  
1x1m plot

Litter cover 47



## Q23

### Q23

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

Species	Cover	Abundance	Covers # spp	Covers							Easting 313565 Orientation	Northing 6243824 0	Zone 56
				Native Count	Trees Count	Shrubs Count	Grass Count	Forb Count	Fern Count	Other Count			
			16	4	1	1	1	0	0	1	12	9	
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	
			94.6	32.8	1	1	30	0	0	0.8	61.8	42.4	
<i>Acetosa sagittata</i> *	5	50	HT								5	80+	0
<i>Ageratina adenophora</i> *	0.2	10	HT								0.2	50-79	0
<i>Anredera cordifolia</i> *	10	100	HT								10	30-49	No
<i>Araujia sericifera</i> *	0.2	5	HT								0.2	20-29	No
<i>Cassytha glabella f. glabella</i>	0.8	30	OG							0.8		10-19	No
<i>Cestrum parqui</i> *	20	100	HT								20	5-9	No
<i>Erythrina crista-galli</i> *	1	2	HT								1	<5	No
<i>Grevillea robusta</i>	1	1	TG		1								
<i>Lantana camara</i> *	0.5	5	HT								0.5	Hollows	0
<i>Melaleuca ericifolia</i>	1	2	SG			1						Lenth of logs (m)	0
<i>Morus sp.</i> *	1	2	EX								1		
<i>Passiflora subpeltata</i> *	18	90	EX								18		
												BAM Attributes 1x1m plot	
<i>Phragmites australis</i>	30	500	GG				30						
<i>Rubus fruticosus agg.</i> *	5	200	HT								5	Litter cover	0
<i>Senna septemtrionalis</i> *	0.4	5	EX								0.4		
<i>Tradescantia fluminensis</i> *	0.5	20	HT								0.5		

## Q24

### Q24

PCT 835: Forest Red Gum-Rough-barked Apple Grassy Woodland on Alluvial Flats of the Cumberland Plain, Sydney Basin – Moderate condition (Forest Red Gum variant)

Species	Cover	Abundance	Covers # spp 22	Covers							Easting 313291 Orientation	Northing 6243933 315	Zone 56
				Native Count	Trees Count	Shrubs Count	Grass Count	Forb Count	Fern Count	Other Count	Exotic Count	HighThreat Count	
				13	8	4	1	0	0	0	9	6	
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	
			137.4	49.7	48	1.1	0.6	0	0	0	87.7	86.9	
<i>Acacia binervia</i>	2	4	TG		2								
<i>Acacia decurrens</i>	0.6	3	TG		0.6								
<i>Angophora floribunda</i>	12	5	TG		12								
<i>Asparagus aethiopicus</i> *	0.1	2	HT										
<i>Bidens pilosa</i> *	0.3	20	EX								0.3	0.1	
<i>Bidens subalternans</i> *	0.1	3	EX								0.1		
<i>Bursaria spinosa subsp. spinosa</i>	0.5	3	SG			0.5							
<i>Casuarina glauca</i>	0.4	10	TG		0.4								
<i>Corymbia maculata</i>	15	5	TG		15								
<i>Ehrharta erecta</i> *	0.5	20	HT									0.5	
<i>Eragrostis curvula</i> *	85	500	HT									85	
<i>Eucalyptus resinifera subsp. resinifera</i>	7	1	TG		7								
<i>Eucalyptus robusta</i>	8	3	TG		8								
<i>Eucalyptus tereticornis</i>	3	1	TG		3								
<i>Ligustrum lucidum</i> *	1	2	HT									1	
<i>Ligustrum sinense</i> *	0.2	1	HT									0.2	
<i>Melaleuca decora</i>	0.4	3	SG			0.4							
<i>Melaleuca ericifolia</i>	0.1	1	SG			0.1							
<i>Melaleuca styphelioides</i>	0.1	1	SG			0.1							
<i>Microlaena stipoides var. stipoides</i>	0.6	20	GG				0.6						
<i>Ochna serrulata</i> *	0.1	1	HT									0.1	
<i>Passiflora subpeltata</i> *	0.4	10	EX								0.4		

BAM Attributes  
20x50m plot  
Stem classes

80+ 0  
50-79 5  
30-49 Yes  
20-29 Yes  
10-19 Yes  
5-9 Yes  
<5 Yes

Hollows 0  
Lenth of logs (m) 0

BAM Attributes  
1x1m plot

Litter cover 60

## Q25

### Q25

PCT 920: Mangrove Forest in  
Estuaries of the Sydney Basin  
and South East Corner – Good  
condition

Species	Cover	Abundance	Covers # spp	Covers							Easting 313217 Orientation	Northing 6244086 310	Zone 56
				Native Count	Trees Count	Shrubs Count	Grass Count	Forb Count	Fern Count	Other Count			
			5	4	2	1	0	1	0	0	1	0	
			Sum cover 108.1	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	
				107.8	62	45	0	0.8	0	0	0.3	0	
<i>Aegiceras corniculatum</i>	45	30	SG			45							
<i>Atriplex prostrata*</i>	0.3	5	EX								0.3		
<i>Avicennia marina subsp. australasica</i>	60	50	TG		60								
<i>Casuarina glauca</i>	2	3	TG		2								
<i>Tetragonia tetragonioides</i>	0.8	20	FG					0.8					
BAM Attributes 20x50m plot													
Stem classes													
												80+	0
												50-79	0
												30-49	No
												20-29	No
												10-19	No
												5-9	No
												<5	No
												Hollows	2
												Lenth of logs (m)	11
BAM Attributes 1x1m plot													
												Litter cover	1.6

## Q26

### Q26

PCT 1800: Swamp Oak  
open forest on riverflats of  
the Cumberland Plain and  
Hunter valley – Poor  
condition

#### Species

*Acetosa sagittata*\*  
*Aegiceras corniculatum*  
*Bidens pilosa*\*  
*Cardiospermum*  
*grandiflorum*\*  
*Casuarina glauca*  
*Cestrum parqui*\*  
*Chenopodium album*\*  
*Conyza bonariensis*\*  
*Ehrharta erecta*\*  
*Ehrharta longiflora*\*  
*Lolium perenne*\*  
*Melaleuca ericifolia*  
  
*Parietaria judaica*\*  
*Phragmites australis*  
*Solanum linnaeanum*\*  
*Solanum nigrum*\*  
*Sonchus oleraceus*\*  
*Tetragonia tetragonioides*  
*Tradescantia fluminensis*\*

Cover Abundance

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
19	5	1	2	1	1	0	0	14	6
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
143.7	81	40	0.9	0.1	40	0	0	62.7	60.9
HT									0.1
SG			0.5						
EX								0.2	
HT									0.1
TG		40							
HT									0.5
EX								0.1	
EX								0.1	
HT									30
EX								0.1	
EX								0.1	
SG			0.4						
HT									0.2
GG				0.1					
EX								0.5	
EX								0.5	
EX								0.2	
FG					40				
HT									30

Easting 313011  
Northing 6244397  
Zone 56  
Orientation 139

BAM Attributes  
20x50m plot  
Stem classes

80+ 0  
50-79 3  
30-49 Yes  
20-29 Yes  
  
10-19 Yes  
5-9 Yes  
<5 Yes  
  
Hollows 1  
Lenth of logs (m) 0

BAM Attributes  
1x1m plot

Litter cover 40

## B2 – Flora species recorded

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Acanthaceae	<i>Avicennia marina</i> subsp. <i>australasica</i>	Grey Mangrove															x		
Acanthaceae	<i>Brunoniella australis</i>	Blue Trumpet					x	x											
Adiantaceae	<i>Adiantum aethiopicum</i>	Common Maidenhair					x												
Adiantaceae	<i>Cheilanthes distans</i>	Bristly cloak fern						x											
Adiantaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Mulga fern			x			x											
Adiantaceae	<i>Pellaea viridis</i> *	Green Cliff Brake			x		x	x											
Agavaceae	<i>Yucca sp.</i> *	-											x						
Aizoaceae	<i>Tetragonia tetragonioides</i>	New Zealand Spinach							x					x			x	x	
Amaranthaceae	<i>Alternanthera philoxeroides</i> *	Alligator Weed				x								x					
Amaranthaceae	<i>Amaranthus viridis</i> *	Green Amaranth									x								
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily			x														
Apiaceae	<i>Centella asiatica</i>	Pennywort									x								
Apiaceae	<i>Hydrocotyle bonariensis</i> *	A Pennywort									x								
Apocynaceae	<i>Araujia sericifera</i> *	Moth Vine								x	x		x		x				
Apocynaceae	<i>Tylophora barbata</i>	Bearded Tylophora					x												
Arecaceae	<i>Syagrus romanzoffiana</i> *	Cocos palm											x						
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern											x			x			
Asparagaceae	<i>Asparagus asparagoides</i> *	Bridal Creeper			x		x	x		x			x						



Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Asphodelaceae	<i>Asphodelus fistulosus</i> *	Onion Weed									x	x							
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed													x				
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs					x		x	x	x	x	x	x		x		x	
Asteraceae	<i>Bidens subalternans</i> *	Greater Beggar's Ticks										x	x	x		x			
Asteraceae	<i>Cichorium intybus</i> *	Chicory										x							
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle					x			x	x	x							
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane						x	x			x	x					x	
Asteraceae	<i>Conyza sp.</i> *	A Fleabane					x												
Asteraceae	<i>Conyza sumatrensis</i> *	Tall fleabane								x									
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear										x		x					
Asteraceae	<i>Olearia microphylla</i>	Bridal Daisy Bush																	x
Asteraceae	<i>Ozothamnus diosmifolius</i>	Everlasting			x		x	x											
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed					x				x								
Asteraceae	<i>Soliva sessilis</i> *	Bindii												x					
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle					x		x	x	x	x		x				x	
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion								x		x							
Basellaceae	<i>Anredera cordifolia</i> *	Madeira Vine													x				
Bignoniaceae	<i>Jacaranda mimosifolia</i> *	Jacaranda								x				x					
Campanulaceae	<i>Lobelia purpurascens</i>	Whiteroot			x		x												
Campanulaceae	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell						x											

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Caprifoliaceae	<i>Lonicera japonica</i> *	Japanese Honeysuckle										x							
Caryophyllaceae	<i>Stellaria media</i> *	Common Chickweed							x										
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black Sheoak			x														
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak						x	x	x	x		x	x		x	x	x	
Chenopodiaceae	<i>Atriplex prostrata</i> *																x		
Chenopodiaceae	<i>Chenopodium album</i> *	Fat Hen																x	
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush							x	x	x			x					
Chenopodiaceae	<i>Einadia polygonoides</i>	-					x												
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew				x	x				x								
Commelinaceae	<i>Tradescantia fluminensis</i> *	Wandering Jew				x			x	x			x	x	x			x	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed			x		x				x			x					x
Crassulaceae	<i>Bryophyllum delagoense</i> *	Mother of millions											x						
Cyperaceae	<i>Carex appressa</i>	Tall Sedge				x				x	x								
Cyperaceae	<i>Carex inversa</i>	Knob Sedge										x							
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge				x	x												
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge							x										
Cyperaceae	<i>Fimbristylis dichotoma</i>	Common Fringe-sedge						x											
Cyperaceae	<i>Gahnia aspera</i>	Rough Saw-sedge																	x
Cyperaceae	<i>Lepidosperma gunnii</i>	-					x												
Cyperaceae	<i>Lepidosperma laterale</i>	Variable Sword-sedge						x											

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Dilleniaceae	<i>Hibbertia aspera</i>	Rough Guinea Flower			x														
Epacridaceae	<i>Astroloma humifusum</i>	Native Cranberry			x														
Epacridaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath			x		x	x											
Euphorbiaceae	<i>Euphorbia peplus</i> *	Petty Spurge								x		x							
Fabaceae (Caesalpinioideae)	<i>Senna pendula</i> var. <i>glabrata</i> *	Easter Cassia				x		x											
Fabaceae (Caesalpinioideae)	<i>Senna septemtrionalis</i> *	-									x				x				
Fabaceae (Faboideae)	<i>Daviesia genistifolia</i>	Broom Bitter Pea						x											
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender tick trefoil			x		x												
Fabaceae (Faboideae)	<i>Erythrina crista-galli</i> *	Cockspur Coral Tree				x	x								x				
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-			x		x				x								
Fabaceae (Faboideae)	<i>Glycine tabacina</i>	-					x												
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>	False Sarsaparilla			x														
Fabaceae (Faboideae)	<i>Pultenaea villosa</i>	-			x														
Fabaceae (Faboideae)	<i>Trifolium repens</i> *	White Clover								x									
Fabaceae (Faboideae)	<i>Vicia sativa</i> subsp. <i>sativa</i> *	Common Vetch										x							
Fabaceae (Mimosoideae)	<i>Acacia binervia</i>	Coast Myall												x		x			
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>	Green Wattle						x	x	x	x					x			

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Fabaceae (Mimosoideae)	<i>Acacia falcata</i>	-					x	x											
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> subsp. <i>longifolia</i>	Sydney Golden Wattle			x		x												
Fabaceae (Mimosoideae)	<i>Acacia parramattensis</i>	Parramatta Wattle			x				x					x					
Fabaceae (Mimosoideae)	<i>Acacia pubescens</i>	Downy wattle	V	V	x														
Fumariaceae	<i>Fumaria muralis</i> *								x			x							
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy Goodenia						x											
Iridaceae	<i>Freesia hybrid</i> *	Freesia			x			x											
Lauraceae	<i>Cassytha glabella</i>	Slender Devil's Twine								x									
Lauraceae	<i>Cassytha glabella</i> f. <i>glabella</i>	Slender Devil's Twine			x			x							x				
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel					x				x								
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	-			x		x												
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			x		x	x											
Lomandraceae	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush					x	x											
Malvaceae	<i>Malva parviflora</i> *	Small-flowered Mallow												x					
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow					x		x		x								
Malvaceae	<i>Pavonia hastata</i> *	-			x														
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne					x	x	x	x	x	x	x	x					
Moraceae	<i>Morus sp.</i> *	Mulberry					x								x				

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Myrsinaceae	<i>Anagallis arvensis</i> *	Scarlet/Blue Pimpernel									x	x							
Myrtaceae	<i>Angophora bakeri</i>	Narrow-leaved Apple			x														
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple			x			x								x			
Myrtaceae	<i>Callistemon linearis</i>	Narrow-leaved Bottlebrush	V	-				x											
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum														x			
Myrtaceae	<i>Eucalyptus amplifolia</i> subsp. <i>amplifolia</i>	Cabbage Gum									x								
Myrtaceae	<i>Eucalyptus baueriana</i>	Blue Box							x										
Myrtaceae	<i>Eucalyptus fibrosa</i>	Red Ironbark			x		x			x									
Myrtaceae	<i>Eucalyptus longifolia</i>	Woollybutt					x												
Myrtaceae	<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Parramatta Red Gum			x														
Myrtaceae	<i>Eucalyptus resinifera</i> subsp. <i>resinifera</i>	Red Mahogany														x			
Myrtaceae	<i>Eucalyptus robusta</i>	Swamp Mahogany														x			
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum								x	x					x			
Myrtaceae	<i>Kunzea ambigua</i>	Tick Bush			x			x											
Myrtaceae	<i>Melaleuca decora</i>	White Feather Myrtle					x		x					x		x			
Myrtaceae	<i>Melaleuca ericifolia</i>	Swamp Paperbark				x				x					x	x		x	x
Myrtaceae	<i>Melaleuca linariifolia</i>	Snow-in-Summer				x				x									x
Myrtaceae	<i>Melaleuca nodosa</i>	Ball Honeymyrtle			x		x	x											
Myrtaceae	<i>Melaleuca sieberi</i>	-			x			x											



Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree							x	x				x		x			x
Myrtaceae	<i>Melaleuca thymifolia</i>	-						x											x
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant														x			
Oleaceae	<i>Ligustrum lucidum</i> *	Large-leaved Privet												x		x			
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet				x	x	x			x		x			x			
Oleaceae	<i>Notelaea longifolia</i> f. <i>longifolia</i>	Mock Olive					x												
Oleaceae	<i>Olea europaea</i> *	Common Olive						x			x			x					
Oxalidaceae	<i>Oxalis corniculata</i> *	Creeping Oxalis										x		x					
Oxalidaceae	<i>Oxalis perennans</i>	-					x			x									
Oxalidaceae	<i>Oxalis purpurea</i> *	Large-flowered Wood Sorrel					x				x		x						
Passifloraceae	<i>Passiflora subpeltata</i> *	White Passionflower			x		x	x			x				x	x			
Phormiaceae	<i>Dianella longifolia</i> var. <i>longifolia</i>	-			x		x	x											
Phytolaccaceae	<i>Phytolacca octandra</i> *	Inkweed					x												
Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Native Blackthorn			x			x		x	x			x		x			
Plantaginaceae	<i>Plantago lanceolata</i> *	Lamb's Tongues								x	x	x							
Poaceae	<i>Aristida vagans</i>	Threeawn Speargrass			x			x											
Poaceae	<i>Aristida warburgii</i>	-						x											
Poaceae	<i>Arundo donax</i> *	Giant Reed											x						

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leaved Carpet Grass										x							
Poaceae	<i>Bromus catharticus</i> *	Prairie Grass									x	x							
Poaceae	<i>Cenchrus clandestinus</i> *	Kikuyu Grass									x	x							
Poaceae	<i>Cynodon dactylon</i>	Common Couch						x	x		x	x							
Poaceae	<i>Dichelachne crinita</i>	Longhair Plumegrass						x											
Poaceae	<i>Digitaria sanguinalis</i> *	Summer Grass, Crab Grass										x							
Poaceae	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	Tufted Hedgehog Grass						x											
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass							x	x	x		x	x		x		x	
Poaceae	<i>Ehrharta longiflora</i> *	Annual Veldtgrass																x	
Poaceae	<i>Eleusine tristachya</i> *	Goose Grass										x							
Poaceae	<i>Entolasia marginata</i>	Bordered Panic					x												
Poaceae	<i>Entolasia stricta</i>	Wiry Panic			x		x												
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass						x											x
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass						x				x				x			x
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass						x											x
Poaceae	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass			x		x												
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass			x														

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Poaceae	<i>Lolium perenne</i> *	Perennial Ryegrass																x	
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	-			x		x	x	x				x	x		x			
Poaceae	<i>Oplismenus aemulus</i>	-					x												
Poaceae	<i>Panicum maximum</i> var. <i>maximum</i> *	Guinea Grass									x			x					
Poaceae	<i>Paspalidium distans</i>	-			x														
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum										x							
Poaceae	<i>Phragmites australis</i>	Common Reed				x									x			x	
Poaceae	<i>Setaria parviflora</i> *	Slender Pigeon Grass			x		x	x				x							
Polygonaceae	<i>Acetosa sagittata</i> *	Turkey Rhubarb					x			x	x	x			x			x	
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper				x													
Polygonaceae	<i>Persicaria lapathifolia</i>	Pale Knotweed				x													
Polygonaceae	<i>Rumex crispus</i> *	Curled Dock										x							
Primulaceae	<i>Aegiceras corniculatum</i>	River Mangrove															x	x	
Proteaceae	<i>Grevillea robusta</i>	Silky Oak													x				
Proteaceae	<i>Hakea sericea</i>	Needlebush			x			x											
Ranunculaceae	<i>Clematis glycinoides</i> var. <i>glycinoides</i>	Headache Vine			x		x												
Rosaceae	<i>Rubus fruticosus</i> agg.*	Blackberry											x		x				
Rubiaceae	<i>Opercularia varia</i>	Variable Stinkweed			x			x											
Sapindaceae	<i>Cardiospermum grandiflorum</i> *	Balloon Vine								x			x	x				x	
Sapindaceae	<i>Guioa semiglauca</i>	-					x												

Family Name	Scientific Name <sup>1</sup>	Common Name	BC Act <sup>2</sup>	EPBC Act <sup>3</sup>	Q1	Q2	Q3	Q4	Q7	Q12	Q18	Q19	Q20	Q21	Q23	Q24	Q25	Q26	RM
Scrophulariaceae	<i>Veronica plebeia</i>	Trailing Speedwell			x		x												
Solanaceae	<i>Cestrum parqui</i> *	Green Cestrum			x	x	x			x		x			x			x	
Solanaceae	<i>Solanum americanum</i>	Glossy Nightshade								x		x		x					
Solanaceae	<i>Solanum linnaeanum</i> *	Apple of Sodom																x	
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade					x		x	x	x							x	
Solanaceae	<i>Solanum pseudocapsicum</i> *	Madeira Winter Cherry					x				x								
Thymelaeaceae	<i>Pimelea linifolia</i>	Slender Rice-flower						x											
Typhaceae	<i>Typha orientalis</i>	Broad-leaved Cumbungi				x													
Urticaceae	<i>Parietaria judaica</i> *	Asthma Weed																x	
Verbenaceae	<i>Lantana camara</i> *	Lantana				x		x					x		x				
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop										x							
Vitaceae	<i>Cayratia clematidea</i>	Slender Grape							x										

1. \* denotes an exotic species

2. BC Act status: threatened species status under the *Biodiversity Conservation Act 2016*; V = Vulnerable and E = Endangered

3. EPBC Act status: threatened species status under the *Environment Protection and Biodiversity Conservation Act 1999*; V = Vulnerable and Ma = Marine.

**B3 – RBG herbarium identification confirmation letter**





*National Herbarium of New South Wales*

Mr Mark STABLES  
WSP Australia Pty Ltd  
Level 27 Ernst & Young Centre  
680 George Street  
Sydney, NSW 2001

Enquiry No: 20657  
Botanical.Is@rbgsyd.nsw.gov.au  
Fax No: (02) 9251 1952  
Ph. No: (02) 9231 8111  
Date: 6 July 2018

Dear Mark,

**Re: Callistemon specimens from Milperra Rd, Ashford Reserve, Milperra**

Your two *Callistemon* specimens have been determined as:

- broad leaf - *Callistemon linearifolius* - det. Peter G. Wilson, 2<sup>nd</sup> July 2018 – retained
- narrow leaf - *Callistemon linearis* - det. Peter G. Wilson, 2<sup>nd</sup> July 2018 – retained

There has been no charge for these identifications. Both specimens have been retained for the herbarium collection. Please send us the GPS coordinates for these two collections at your earliest convenience.

Thank you for your enquiry.

Yours sincerely

Andrew Orme  
Identification Technical Officer  
Botanical Information Service



Go to our online Botanical Information Services at [plantnet.rbgsyd.nsw.gov.au](http://plantnet.rbgsyd.nsw.gov.au) to find out more about plants of New South Wales



Office of  
Environment  
& Heritage

The Botanical Information Email address is [Botanical.Is@rbgsyd.nsw.gov.au](mailto:Botanical.Is@rbgsyd.nsw.gov.au)  
Mrs Macquaries Road Sydney NSW 2000 Australia • Telephone (02) 9231 8111 • Fax (02) 9251 1952

## Appendix C – Fauna survey data

### C1 – Fauna species recorded

Scientific Name	Common Name <sup>1</sup>	BC Act Status <sup>2</sup>	EPBC Act Status <sup>3</sup>	Ecosystem or species credit species?
<b>Amphibians</b>				
<i>Crinia signifera</i>	Common Eastern Froglet	-	-	-
<i>Limnodynastes peronii</i>	Striped Marsh frog	-	-	-
<i>Litoria dentata</i>	Bleating Tree frog	-	-	-
<i>Litoria fallax</i>	Eastern Dwarf Tree frog	-	-	-
<i>Litoria peronii</i>	Peron's Tree Frog	-	-	-
<i>Litoria tylerii</i>	Tyler's Tree frog	-	-	-
<b>Birds</b>				
<i>Acanthiza pusilla</i>	Brown Thornbill	-	-	-
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	-	-	-
<i>Acridotheres tristis</i>	Common Myna*	-	-	-
<i>Anas superciliosa</i>	Pacific Black Duck	-	-	-
<i>Anser anser domesticus</i>	Goose	-	-	-
<i>Anthochaera carunculata</i>	Red Wattlebird	-	-	-
<i>Aythya australis</i>	Hardhead	-	-	-
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	-	-	-
<i>Cacatua sanguinea</i>	Little Corella	-	-	-
<i>Chenonetta jubata</i>	Australian Wood Duck	-	-	-
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	-	-
<i>Columba livia</i>	Rock Dove*	-	-	-
<i>Corvus coronoides</i>	Australian Raven	-	-	-
<i>Cracticus torquatus</i>	Grey Butcherbird	-	-	-
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	-	-	-
<i>Egretta novaehollandiae</i>	White-faced Heron	-	-	-
<i>Eolophus roseicapilla</i>	Galah	-	-	-
<i>Eopsaltria australis</i>	Eastern Yellow Robin	-	-	-
<i>Fulica atra</i>	Eurasian Coot	-	-	-
<i>Gallinula tenebrosa</i>	Dusky Moorhen	-	-	-
<i>Glossopsitta concinna</i>	Musk Lorikeet	-	-	-
<i>Grallina cyanoleuca</i>	Magpie-lark	-	-	-
<i>Gymnorhina tibicen</i>	Australian Magpie	-	-	-
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	Ma	Dual Ecosystem/ species credit species – only ecosystem credit identified within study area
<i>Hirundo neoxena</i>	Welcome Swallow	-	-	-
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	-	-	-
<i>Lichenostomus leucotis</i>	White-eared Honeyeater	-	-	-
<i>Malurus cyaneus</i>	Superb Fairy-wren	-	-	-
<i>Manorina melanocephala</i>	Noisy Miner	-	-	-
<i>Manorina melanophrys</i>	Bell Miner	-	-	-

Scientific Name	Common Name <sup>1</sup>	BC Act Status <sup>2</sup>	EPBC Act Status <sup>3</sup>	Ecosystem or species credit species?
<i>Mesophoyx intermedia</i>	Intermediate Egret	-	-	-
<i>Neochmia temporalis</i>	Red-browed Finch	-	-	-
<i>Ocyphaps lophotes</i>	Crested Pigeon	-	-	-
<i>Pachycephala pectoralis</i>	Golden Whistler	-	-	-
<i>Pachycephala rufiventris</i>	Rufous Whistler	-	-	-
<i>Pardalotus punctatus</i>	Spotted Pardalote	-	-	-
<i>Pelecanus conspicillatus</i>	Australian Pelican	-	-	-
<i>Phalacrocorax carbo</i>	Great Cormorant	-	-	-
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	-	-	-
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	-	-	-
<i>Platycercus eximius</i>	Eastern Rosella	-	-	-
<i>Porphyrio porphyrio</i>	Purple Swamphe	-	-	-
<i>Psephotus haematonotus</i>	Red-rumped Parrot	-	-	-
<i>Psophodes olivaceus</i>	Eastern Whipbird	-	-	-
<i>Pycnonotus jocosus</i> *	Red-whiskered Bulbul*	-	-	-
<i>Rhipidura albiscapa</i>	Grey Fantail	-	-	-
<i>Rhipidura leucophrys</i>	Willie Wagtail	-	-	-
<i>Sericornis frontalis</i>	White-browed Scrubwren	-	-	-
<i>Strepera graculina</i>	Pied Currawong	-	-	-
<i>Streptopelia chinensis</i> *	Spotted Dove*	-	-	-
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	-	-	-
<i>Threskiornis molucca</i>	Australian White Ibis	-	-	-
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	-	-	-
<i>Vanellus miles</i>	Masked Lapwing	-	-	-
<i>Zosterops lateralis</i>	Silvereye	-	-	-
<b>Mammals</b>				
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	-	-
<i>Myotis macropus</i>	Southern Myotis	V	-	Species credit species
<i>Pseudocheirus peregrinus</i>	Ring-tail Possum	-	-	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Dual Ecosystem/ species credit species – only ecosystem credit identified within study area
<i>Rattus rattus</i> *	Black Rat*	-	-	-
<i>Tadarida australis</i>	White-striped free-tailed Bat	-	-	-
<i>Trichosurus vulpecula</i>	Brush-tail Possum	-	-	-
<i>Vulpes Vulpes</i> *	Fox	-	-	-
<b>Reptiles</b>				
<i>Lampropholis delicata</i>	Delicate Skink	-	-	-
<i>Physignathus lesueurii</i>	Eastern Water-dragon	-	-	-

1. \* denotes an exotic species

2. BC Act status: threatened species status under the Biodiversity Conservation Act 2016; V = Vulnerable and E = Endangered

3. EPBC Act status: threatened species status under the Environment Protection and Biodiversity Conservation Act 1999; V = Vulnerable and Ma = Marine.

## Appendix D – Aquatic habitat assessments results

### D1 – Waterway descriptors, associated categories and values used in the modified riparian, channel and environmental inventory (RCE)

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		

## D2 – RCE score for Aquatic Site 1

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>37</b>	



### D3 – RCE score for Aquatic Site 2

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1	<b>34</b>	

## D4 – RCE score for Aquatic Site 3

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>32</b>	

## D5 – RCE score for Aquatic Site 4

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>34</b>	

## D6 – RCE score for Aquatic Site 5

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b>	
Deep: width / depth ratio < 7:1	4	<b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	<b>37</b>
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		

## D7 – RCE score for Aquatic Site 6

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1	<b>33</b>	



## D8 – RCE score for Aquatic Site 7

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1	<b>33</b>	

## D9 – RCE score for Aquatic Site 8

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1	<b>33</b>	

## D10 – RCE score for Aquatic Site 9

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>29</b>	

## D11 – RCE score for Aquatic Site 10

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>30</b>	

## D12 – RCE score for Aquatic Site 11

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>38</b>	



## D13 – RCE score for Aquatic Site 12

Descriptor and category	Score	Descriptor and category	Score
<b>1. Land use pattern beyond the immediate riparian zone</b>		<b>8. Riffle / pool sequence</b>	
Undisturbed native vegetation	4	Frequent alternation of riffles and pools	4
Mixed native vegetation and pasture/exotics	3	Long pools with infrequent short riffles	3
Mainly pasture, crops or pine plantation	2	Natural channel without riffle / pool sequence	2
Urban	1	Artificial channel; no riffle / pool sequence	1
<b>2. Width of riparian strip of woody vegetation</b>		<b>9. Retention devices in stream</b>	
More than 30 m	4	Many large boulders and/or debris dams	4
Between 5 and 30 m	3	Rocks / logs present; limited damming effect	3
Less than 5 m	2	Rocks / logs present, but unstable, no damming	2
No woody vegetation	1	Stream with few or no rocks / logs	1
<b>3. Completeness of riparian strip of woody vegetation</b>		<b>10. Channel sediment accumulations</b>	
Riparian strip without breaks in vegetation	4	Little or no accumulation of loose sediments	4
Breaks at intervals of more than 50 m	3	Some gravel bars but little sand or silt	3
Breaks at intervals of 10 - 50 m	2	Bars of sand and silt common	2
Breaks at intervals of less than 10 m	1	Braiding by loose sediment	1
<b>4. Vegetation of riparian zone within 10 m of channel</b>		<b>11. Stream bottom</b>	
Native tree and shrub species	4	Mainly clean stones with obvious interstices	4
Mixed native and exotic trees and shrubs	3	Mainly stones with some cover of algae / silt	3
Exotic trees and shrubs	2	Bottom heavily silted but stable	2
Exotic grasses / weeds only	1	Bottom mainly loose and mobile sediment	1
<b>5. Stream bank structure</b>		<b>12. Stream detritus</b>	
Banks fully stabilised by trees, shrubs etc.	4	Mainly un-silted wood, bark, leaves	4
Banks firm but held mainly by grass and herbs	3	Some wood, leaves etc. with much fine detritus	3
Banks loose, partly held by sparse grass etc.	2	Mainly fine detritus mixed with sediment	2
Banks unstable, mainly loose sand or soil	1	Little or no organic detritus	1
<b>6. Bank undercutting</b>		<b>13. Aquatic vegetation</b>	
None, or restricted by tree roots	4	Little or no macrophyte or algal growth	4
Only on curves and at constrictions	3	Substantial algal growth; few macrophytes	3
Frequent along all parts of stream	2	Substantial macrophyte growth; little algae	2
Severe, bank collapses common	1	Substantial macrophyte and algal growth	1
<b>7. Channel form</b>		<b>Total RCE score (sum of scores for each descriptor)</b> <b>Poor condition = 13-25</b> <b>Moderate condition = 26-39</b> <b>Good condition = 39-52</b>	
Deep: width / depth ratio < 7:1	4		
Medium: width / depth ratio 8:1 to 15:1	3		
Shallow: width / depth ratio > 15:1	2		
Artificial: concrete or excavated channel	1		
		<b>35</b>	

## Appendix E – EPBC Act Assessments of Significance

---

For threatened biodiversity listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) significance assessments have been completed in accordance with the *Matters of National Environmental Significance, Significant Impact Guidelines 1.1* (Department of Environment, 2013).

The following assessments were undertaken to consider impacts of works associated with the EIS proposal upon threatened species or communities with a moderate or greater likelihood of occurring within the EIS proposal area.

# Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland

## Status

Coastal Swamp Oak (*Casuarina glauca*) Forest (CSOF) of New South Wales and South East Queensland is listed as a threatened ecological community under the EPBC Act, with a status of Endangered.

## Specific impacts

The EIS proposal may require the removal of up to 0.20 ha of CSOF.

The field surveys recorded PCTs 1234 within the EIS proposal area 1 which was assessed in Section 7.2.1 as meeting the criteria for the EPBC Act listing of CSOF. The CSOF in EIS proposal area 1 was assessed as being in moderate quality – Category C condition of the criteria for COSF listed as endangered under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

**An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:**

### **Reduce the extent of an ecological community**

#### **Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The EIS proposal might impact 0.20 ha of CSOF protected under the EPBC Act. The potential impacted area is restricted EIS proposal area 1. The impact is small and will involve widening of Henry Lawson Drive. Following construction, vegetation connectivity would be maintained, including opportunities to rehabilitate CSOF. Fragmentation of this TEC is unlikely as the impact is linear in nature and will involve the widening of Henry Lawson Drive. The final extent and level of impact will be confirmed once a final design has been selected with the aim of reducing potential impacts through recommended mitigation measures. Therefore, the EIS proposal is unlikely to increase fragmentation of the patch and it unlikely to have a significant impact on CSOF.

### **Adversely affect habitat critical to the survival of an ecological community**

The Approved Conservation Advice for CSOF states that the habitat most critical to the survival of the ecological community consists of those patches that are of a reasonable size and in the best condition. These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function (Department of the Environment and Energy, 2018).

The PCT associated with COSF (PCT 1234) was assessed as being in moderate condition as it meet some of the structure and function benchmarks (Table 5.16). The area to be remove is minor (0.20 ha) and therefore the COSF that might be impacted is unlikely to be critical to the survival of COSF.

#### **Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

Though the EIS proposal is likely to involve subsurface construction work due to the installation of a culvert under Henry Lawson Drive within CSOF. The subsurface works are shallow in nature and are likely to intersect with the groundwater (Aurecon, 2021). These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the EIS proposal. Whilst the EIS proposal may increase water surface drainage and has the potential to mobilise containments to the CSOF within the EIS proposal

area, these would be reduced and managed through recommended mitigation measures. These impacts are unlikely to significantly modify abiotic factors such as the soil profile, groundwater levels of surface water drainage patterns necessary to the survival of vegetation within and surrounding the EIS proposal area 1.

**Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

CSOF within EIS proposal area 1 is located on the edge of Henry Lawson Drive. As such, the CSOF is currently subject to edge effects from Henry Lawson Drive. Whilst the EIS proposal may have the potential to introduce edge effects, these would be reduced and managed through recommended mitigation measures.

The EIS proposal does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting. The EIS proposal is considered unlikely to cause a substantial change in the species composition of CSOF.

**Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

**Assisting invasive species, that are harmful to the listed ecological community, to become established**

**Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The EIS proposal has the potential to result in minor increases in the establishment, density or diversity of weed species. The EIS proposal area containing COSF occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species. Recommended mitigation measures are to be implemented to mitigate any impact of invasive species to the CSOF. As such, the EIS proposal is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence.

The EIS proposal is likely to involve subsurface construction work due to the installation of a culvert under Henry Lawson Drive within the CSOF. These excavations could mobilise potential contaminants that may be present within the subsurface soils. The Georges River Golf Course occurs on the western side of Henry Lawson Drive opposite the CSOF. This golf course could be a source of fertilisers and herbicides. If so, then this is already occurring and the EIS proposal is unlikely to result in any increase of these chemicals than is already occurring. Recommended mitigation measures are to be implemented to reduce the any impacts from contaminants. The EIS proposal is unlikely to kill or inhibit the growth of species within the CSOF such that it would substantially reduce the quality or integrity of the community's occurrence.

The EIS proposal does not involve other processes that are likely to reduce the quality or integrity of COSF other than those described above.

**Interfere with the recovery of an ecological community**

Currently there is no recovery plan for COSF. The Approved Conservation Advice outlined four priority conservation actions (Section 6.2, Department of the Environment and Energy, 2018). The EIS proposal is likely to interfere with one priority conservation action being *conserve remaining patches*.

**Conclusion**

The EIS proposal may require the removal of up to 0.20 ha of CSOF consistent with the EPBC Act listing. The ecological community is unlikely to be significantly impacted by the EIS proposal. The final impact will be confirmed once a final design has been selected with the aim of reducing the design would avoid areas of high biodiversity value as far as possible.

# River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria

## Status

River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria (RFEF) is listed as a threatened ecological community under the EPBC Act, with a status of Critically Endangered.

## Specific impacts

The EIS proposal may require the removal of up to 0.02 ha of RFEF.

The field surveys recorded PCT 835 within the EIS proposal area 1 which was assessed in Section 7.2.1 (Patch 1) as meeting the criteria for the EPBC Act listing of RFEF. The RFEF in EIS proposal area 1 was assessed as being in moderate condition – Class C2 of the criteria for RFEF. However, no data for this patch 1 was collected at the time of the survey (this TEC wasn't listed at the time of the survey) therefore, a precautionary measure was undertaken and it has been assessed as being commensurate with the EPBC Act listing. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, Water, Heritage and the Arts, 2013).

**An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:**

### **Reduce the extent of an ecological community**

#### **Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The EIS proposal is likely to impact 0.02 ha of RFEF listed under the EPBC Act. The potential impacted area is restricted EIS proposal area 1. The impact is small, linear and will involve widening of Henry Lawson Drive. Following construction, vegetation connectivity would be maintained, including opportunities to rehabilitate RFEF. Fragmentation of this TEC is unlikely as the impact is linear in nature and will involve the widening of Henry Lawson Drive. The final extent and level of impact will be confirmed once a final design has been selected with the aim of reducing potential impacts through recommended mitigation measures. Therefore, the EIS proposal is unlikely to increase fragmentation of the patch and it unlikely to have a significant impact on RFEF.

### **Adversely affect habitat critical to the survival of an ecological community**

The Approved Conservation Advice for RFEF states that the habitat most critical to the survival of the ecological community consists of those patches that are of a reasonable size and in the best condition. These represent those parts of the ecological community closest to the benchmark or reference state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function (Department of Agriculture, Water, and the Environment, 2020).

The PCT associated with RFEF (PCT 835) was assessed as being in moderate condition as it meets the majority of the state benchmarks (Table 5.10). The area to be remove is minor (0.02 ha) and therefore the RFEF that is likely to be impacted is unlikely to be critical to the survival of RFEF.

### **Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The EIS proposal is likely to involve subsurface construction work due to the installation of a drainage infrastructure under Henry Lawson Drive within the adjoining TEC of CSOF. The subsurface works are unlikely to intersect the groundwater due to the shallow nature of the excavations (Aurecon, 2021). These excavations could mobilise potential contaminants that



may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the EIS proposal. Whilst the EIS proposal may increase water surface drainage and has the potential to mobilise containments to the RFEF within the EIS proposal area 1, these would be reduced and managed through recommended mitigation measures. These impacts are unlikely to significantly modify abiotic factors such as the soil profile, and surface water drainage patterns necessary to the survival of vegetation within and surrounding the EIS proposal area 1.

**Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

RFEF within EIS proposal area 1 is located on the edge of Henry Lawson Drive. As such, the RFEF is currently subject to edge effects from Henry Lawson Drive. Whilst the EIS proposal may have the potential to introduce edge effects, these would be reduced and managed through recommended mitigation measures.

The EIS proposal does not involve actions that would significantly change the existing disturbance regime such as the intensity or frequency of fires, the intensity or frequency of floods or flora/fauna harvesting.

The EIS proposal is considered unlikely to cause a substantial change in the species composition of RFEF.

**Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

**Assisting invasive species, that are harmful to the listed ecological community, to become established**

**Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community**

The EIS proposal has the potential to result in minor increases in the establishment, density or diversity of weed species. The EIS proposal area containing RFEF occurs within a broader study area which is surrounded by urban development and roads and is subject to edge effects resulting in invasive species. Recommended mitigation measures are to be implemented to mitigate any impact of invasive species to the RFEF. As such, the EIS proposal is unlikely to exacerbate invasive species such that it would substantially reduce the quality or integrity of the community's occurrence.

The EIS proposal is likely to involve subsurface construction work due to the installation of a culvert under Henry Lawson Drive within the adjoining CSOF. These excavations could mobilise potential contaminants that may be present within the subsurface soils. The Georges River Golf Course occurs on the western side of Henry Lawson Drive opposite the RFEF. This golf course could be a source of fertilisers and herbicides. If so, then this is already occurring and the EIS proposal is unlikely to result in any increase of these chemicals than is already occurring. Recommended mitigation measures are to be implemented to reduce the any impacts from contaminants. The EIS proposal is unlikely to kill or inhibit the growth of species within the RFEF such that it would substantially reduce the quality or integrity of the community's occurrence.

The EIS proposal does not involve other processes that are likely to reduce the quality or integrity of RFEF other than those described above.

**Interfere with the recovery of an ecological community**

Currently there is no recovery plan for RFEF. The Approved Conservation Advice outlined four priority conservation actions (Section 5.4, Department of the Agriculture, Water and the Environment, 2020). The EIS proposal is likely to interfere with one priority conservation action being *Protect the ecological community from further losses*.

## **Conclusion**

The EIS proposal may require the removal of up to 0.02 ha of RFEF consistent with the EPBC Act listing. The ecological community is unlikely to be significantly impacted by the EIS proposal. The final impact will be confirmed once a final design has been selected with the aim of reducing the design would avoid areas of high biodiversity value as far as possible.

## Grey-headed flying-fox

### Status

The Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as Vulnerable under both the BC Act and EPBC Act. This species was recorded during the survey. The Grey-headed Flying-fox has been assessed due to the species widespread occurrence locally, its high mobility and the occurrence of native tree species that are known to be used by this species for the purpose of foraging.

### Specific Impacts

The EIS proposal has the potential to remove 0.25 ha of potential foraging habitat for the Grey-Headed Flying-fox.

The Grey-headed Flying-fox is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of the Environment, 2013). Under the Act, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

#### Is this part of an important population?

Grey-headed Flying-foxes occur across a range of habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered as an important population.

**An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:**

#### Lead to a long-term decrease in the size of an important population of a species

A minor area of habitat being, 0.25 ha and as such is unlikely to lead to a long-term decrease in size in the Grey-headed Flying-Fox populations

#### Reduce the area of occupancy of an important population

No Grey-headed Flying-fox camps occur within the EIS proposal and the habitat to be impacted upon is minor. Therefore, the EIS proposal is unlikely to reduce the area of occupancy.

#### Fragment an existing important population into two or more populations

No Grey-headed Flying-fox camps occur within the EIS proposal and the habitat to be impacted upon is minor. Therefore, the EIS proposal is unlikely to fragment the population into two or more populations.

#### Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act. Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or

- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment Water Heritage and the Arts, 2009).

The EIS proposal will remove a small area 0.25 ha of habitat, which represent potential foraging habitat for this species. As this species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed widely throughout the locality and beyond. Therefore, this would not meet the above criteria.

#### **Disrupt the breeding cycle of an important population**

No Grey headed Flying-fox camps occur within the EIS proposal and the habitat to be impacted upon is minor. Therefore, the EIS proposal is unlikely to disrupt the breeding cycle of the Grey-headed Flying-fox.

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

The EIS proposal is likely to involve subsurface construction work due to the installation of drainage infrastructure. These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the EIS proposal. Whilst the EIS proposal may increase water surface drainage and has the potential to mobilise containments to the Grey-headed Fly-fox habitat within the EIS proposal area, these would be reduced and managed through recommended mitigation measures. These impacts are unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

#### **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the EIS proposal.

#### **Introduce disease that may cause the species to decline**

No. There are no known diseases that are likely to increase in the area as a result of the EIS proposal.

#### **Interfere substantially with the recovery of the species**

Due to the limited foraging habitat likely to be affect by the proposed works (0.25 ha) and as no roost camps are located in the vicinity of the EIS proposal area, the proposed works are not likely to interfere with the recovery of this species.

#### **Conclusion**

The extent of native vegetation clearing and habitat removal associated with the EIS proposal is small (0.25 ha) in terms of the available habitat for these species within the surrounding landscape. Although the loss of foraging habitat for Grey-headed Flying-fox is considered to be an incremental loss of suitable habitat locally, the EIS proposal is not likely to have a significant impact upon Grey-headed Flying-fox.

## Swift Parrot

### Status

The Swift Parrot (*Lathamus discolor*) is listed as Endangered under the BC Act and Critically Endangered under the EPBC Act.

The Swift Parrot is a migratory species, which only breeds in Tasmania, is only present on the mainland between April and September to seek nectar resources from winter flowering events.

### Specific Impacts

The EIS proposal will result in the disturbance 0.23 ha of foraging habitat, which may provide potential foraging habitat for the Swift Parrot.

The Swift Parrot is listed as Critically Endangered under the EPBC Act. The following assessment has been undertaken following the Matters of National Environmental Significance, Significant Impact Guidelines 1.1 (Department of Environment 2013).

**An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will result in one or more of the following:**

#### **Lead to a long-term decrease in the size of a population of a species**

Approximately 0.23 ha of potential foraging habitat for the Swift Parrot would be affected by the EIS proposal. While limited habitat in the EIS proposal area has the potential to be used by these species, it is not likely to be of high importance due to its relatively small area and the availability of equal or greater quality habitat within the locality and wider region. Any identified population of Swift Parrot in the area would not be restricted to habitat within the EIS proposal area. Due to the species' large home range and nomadic nature, similar foraging habitat can be accessed in the locality. Therefore, the EIS proposal is not considered likely to significantly contribute to a long-term decline in the size of a population of these species.

#### **Reduce the area of occupancy of the species**

The EIS proposal is likely to affect approximately 0.23 ha of potential foraging habitat for this species. Although the proposed action will result in the loss of potential foraging habitat, the incremental loss of a small area of potential habitat, only represents a small component of similar locally occurring resources accessible for this species. Nevertheless, the removal of approximately 0.23 ha of potential habitat is considered to be a small incremental loss of suitable habitat locally and as such has the potential to incrementally reduce the area of occupancy for the Swift Parrot during seasons when individuals of this species may be reliant on local resources.

#### **Fragment an existing population into two or more populations**

Habitat connectivity is unlikely to be significantly exacerbated by the EIS proposal other than what already exists in the area. The proposed habitat impacted upon is a linear strip occurring on the edge of the Milperra Road and Henry Lawson Drive. The EIS proposal is would not significantly exacerbate fragmentation than what already exists. Furthermore, given that this species are highly mobile, the EIS proposal would not present a significant barrier to these species.

#### **Adversely affect habitat critical to the survival of a species**

No critical habitat has been listed for the Swift Parrot to date. The EIS proposal area does not contain any breeding areas nor is the EIS proposal area the only limiting foraging area for this specie, as such it is unlikely that the EIS proposal will adversely affect habitat critical to the survival of the Swift Parrot.

#### **Disrupt the breeding cycle of a population**

Swift Parrots breed in Tasmania during spring and summer, migrating to south-eastern Australia during autumn and winter (Department of Environment and Conservation 2006).



While Swift Parrots are dependent on flowering resources across a wide range of habitats (woodlands and forests) within their NSW wintering grounds, the removal of approximately 0.23 ha of potential foraging habitat is unlikely to disrupt their movements to Tasmanian breeding grounds. As such the EIS proposal is unlikely to affect their breeding cycle.

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

The EIS proposal is likely to involve subsurface construction work due to the installation of drainage infrastructure. These excavations could mobilise potential contaminants that may be present within the subsurface soils. Surface water drainage patterns from increased areas of pavement may occur in the operational phase of the EIS proposal. Whilst the EIS proposal may increase water surface drainage and has the potential to mobilise contaminants to the Swift Parrots foraging habitat within the EIS proposal area. Whilst there is a potential to decrease the quality of habitat due to impacts to vegetation these would be reduced and managed through recommended mitigation measures. The EIS proposal would remove 0.23 ha of potential habitat for this species. The removal of approximately 0.23 ha of potential foraging habitat is considered to be an incremental loss of suitable habitat foraging habitat locally. However, the loss of a small potential foraging habitat and the potential to reduce the quality of habitat for the Swift Parrot is unlikely to be at an extent in which this species is likely to decline.

**Result in invasive species that are harmful to an Endangered species becoming established in the Endangered species' habitat**

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Swift Parrot would become further established as a result of the EIS proposal.

**Introduce disease that may cause the species to decline**

No. It is unlikely that disease would be increased by the EIS proposal.

**Interfere with the recovery of the species**

The Action Plan for Australian Birds (Garnett and Crowley 2000) notes pressure on Swift Parrot breeding areas from forestry and firewood collection in Tasmania. On the mainland though pressures relate to the loss of foraging habitats due to clearing for agriculture and residential development (Garnett and Crowley 2000).

A National Recovery Plan for the Swift Parrot *Lathamus discolor* was prepared in 2011 (Saunders 2011). Recovery actions outlined in this plan include:

- identify the extent and quality of habitat
- manage and protect swift parrot habitat at the landscape scale
- monitor and manage the impact of collisions, competition and disease
- monitor population and habitat.

Based on the potential ecological impacts of the proposed action on the Swift Parrot, as discussed above, it is likely the proposed action would be in conflict with the second recovery action above, to manage and protect swift parrot habitat at the landscape scale.

**Conclusion**

The extent of native vegetation clearing and foraging habitat removal associated with the EIS proposal is considered to be small in terms of available habitat for the species within wider region. Although it is considered unlikely that the loss of potential foraging habitat will cause the local extinction of the Swift Parrot, the EIS proposal will remove habitat that may be utilised by this species under some intermittent seasonal contexts. The EIS proposal is not considered to fragment any locally occurring populations, affect habitat critical to their survival, disrupt their breeding cycles, or interfere with the recovery of the species. The EIS proposal is therefore considered to represent an incremental loss of available local habitat, although it is not considered likely to have a significant impact on the Swift Parrot.



## Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00024401/BAAS17046/21/00024402	Henry Lawson Drive Stage 1A - EIS	10/06/2021
Assessor Name	Report Created	BAM Data version *
Toby Lambert	30/06/2021	45
Assessor Number	BAM Case Status	Date Finalised
BAAS17046	Open	To be finalised
Assessment Revision	Assessment Type	
1	Part 5 Activities	

\* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits

# BAM Credit Summary Report

Coastal freshwater wetland										
4	781_VZ2_Moderate	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	8.8	8.8	0.02	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	0
									<b>Subtotal</b>	<b>0</b>
Coastal Swamp Paperbark - Swamp Oak scrub										
1	1236_VZ11_Poor	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	34.3	34.3	0.01	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00	1
									<b>Subtotal</b>	<b>1</b>

# BAM Credit Summary Report

Cumberland riverflat forest										
2	835_VZ3_Moderate	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	48.4	48.4	0.02	Endangered Ecological Community	Not Listed	High Sensitivity to Potential Gain	2.00	1
									<b>Subtotal</b>	<b>1</b>
Estuarine Swamp Oak forest										
3	1234_VZ12_Moderate	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	49.4	49.4	0.2	Endangered Ecological Community	Endangered	High Sensitivity to Potential Gain	2.00	5
									<b>Subtotal</b>	<b>5</b>
									<b>Total</b>	<b>7</b>

## Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAI	Species credits
<i>Myotis macropus</i> / <i>Southern Myotis</i> ( Fauna )								
1236_VZ11_Poor	34.3	34.3	0.01	Vulnerable	Not Listed	2	False	1



## BAM Credit Summary Report

835_VZ3_Moderate	48.4	48.4	0.02	Vulnerable	Not Listed	2	False	1
1234_VZ12_Moderate	49.4	49.4	0.2	Vulnerable	Not Listed	2	False	5
781_VZ2_Moderate	8.8	8.8	0.02	Vulnerable	Not Listed	2	False	1
							<b>Subtotal</b>	<b>8</b>



[transport.nsw.gov.au](https://transport.nsw.gov.au)



[contactus@transport.nsw.gov.au](mailto:contactus@transport.nsw.gov.au)



Customer feedback  
Transport for NSW  
Locked Bag 928,  
North Sydney NSW 2059



Transport  
for NSW