

Appendix I

Biodiversity Assessment

Cessnock Road Upgrade at Testers Hollow

Biodiversity Assessment

Roads and Maritime Services | July 2019



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Prepared by Jacobs and Roads and Maritime Services

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Executive summary

Jacobs has been appointed by Roads and Maritime Services to undertake an environmental impact assessment for the Cessnock Road upgrade at Testers Hollow (the proposal). This report details the methods and results of a biodiversity survey and assessment for the purposes of identifying threatened species, populations and ecological communities in the area of the proposal, to assess the extent and magnitude of ecological impacts and recommend strategies to mitigate and offset these impacts. The assessment addresses the NSW *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1996* (EPBC Act).

An ecological survey was undertaken within the study area to identify the plant communities and habitat present, which included, a habitat assessment to assess the likelihood of threatened flora and fauna recorded from a background search existing in the study area. Given the small extent of vegetation within the study area, the vegetation and targeted threatened flora survey comprised a walkover of the entire area including plots undertaken in accordance with the Biodiversity Assessment Methodology (BAM) (Office of Environment and Heritage (OEH) 2016). As the proposal involves the removal of the current culvert, the presence of roosting bats using the culvert was targeted via a dusk and nocturnal survey and inspection. The aquatic habitat value of the study area was characterised in accordance with NSW Department of Primary Industries (Fisheries) document *Policy and Guidelines for fish habitat conservation and management* (2013 update).

The key impacts of the proposal include the removal and/or disturbance of 1.54 hectares of native vegetation associated with four threatened ecological communities (EEC) and provides habitat (or potential habitat) for 15 threatened fauna species. One threatened flora species has been identified in the proposal area.

Four threatened ecological communities listed under the BC Act are present in the study area. Impacts to these TECs include:

- Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (EEC) – 0.91 hectares
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC) – 0.55 hectares
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (EEC) – 0.003 hectares
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (EEC) – 0.06 hectares.

The White-bellied Sea Eagle (listed as vulnerable under the BC Act and as marine under the EPBC Act) was observed flying over the study area in the direction of the Hunter River. No nest was observed in the study area. This species is likely to breed in larger and less disturbed patches of vegetation to the west of the study area (eg Cessnock State Forest, Lower Hunter National Park and Part State Forest), however the species may use the wetland habitat in the study area on occasion for hunting. Vegetation in the study area may also provide suitable habitat for an additional 15 threatened fauna species (10 mammals, four birds and one fish) listed under the BC Act and FM Act, which include:

- Cave roosting bats: Eastern Bentwing-bat, Little Bentwing-bat, Eastern Cave Bat, Large-eared Pied Bat and Southern Myotis
- Hollow-roosting bats: Eastern Freetail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat
- Grey-headed Flying Fox
- Grey-crowned Babbler
- Swift Parrot
- Black-necked Stork

- Purple Spotted Gudgeon.

Habitat that would be impacted by the proposal is generally limited to foraging habitat due to its disturbed nature. Up to 6.46 hectares of foraging habitat will be removed for some species. *Eucalyptus tereticornis* and *Corymbia maculata* would offer an important winter flowering resource for nectarivorous species such as the Grey-headed Flying Fox and Swift Parrot. Vegetation may also provide foraging habitat for the Grey-crowned Babbler and numerous cave roosting and hollow-roosting insectivorous bats. No hollow-bearing trees are expected to be impacted by the proposal, however the existing culvert under Cessnock Road will be replaced which may offer some suitable roosting habitat for several insectivorous bat species that are known to roost in artificial structures. All of the culvert joins are sealed except for one at the western end which may offer a shallow roost site, however this is not considered to be an important (maternity) roost for any of these species.

The eastern portion of Lot 949 DP1223319 contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Cliftleigh. *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. It is unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most are surrounded by plastic tree guards. There may be up to 300 *Eucalyptus parramattensis* subsp. *decadens* planted in the field being impacted by the proposal (Harper Somers O'Sullivan 2007). Some of the trees do not have tree guards and may be either *Eucalyptus tereticornis* or *E. amplifolia*. However, its identification is difficult at the juvenile stage and some tree guards may have been washed away in recent floods. Therefore, from an impact assessment perspective, it is assumed that all the trees are *Eucalyptus parramattensis* subsp. *decadens*. Up to 35 planted *Eucalyptus parramattensis* subsp. *decadens* trees will be removed as part of this proposal.

Assessments of Significance have been completed for all threatened species and threatened ecological communities that will be impacted as a result of the proposal. These assessments determined that the impacts are minimal and unlikely to result in a significant impact.

The unnamed creek and surrounding floodplain that connects Wallis Creek and Testers Hollow wetland is considered to form 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat' (see Plates 1 to 3). The proposal has potential to temporarily obstruct fish passage in the unnamed creek during the construction stage. However, consultation with the NSW Department of Primary Industries has confirmed that a fisheries permit under the *Fisheries Management Act 1994* is not required.

Temporary hydrological changes are also expected to occur during the construction stage, such as turbulence and changes in flow velocity however, these are considered to be short term and insignificant to the long term health of the surrounding aquatic ecosystems. Wallis Creek is mapped as indicative habitat for the Purple Spotted Gudgeon. There is moderate potential for this species to occur in the study area during periods of high rainfall when the surrounding floodplain is inundated. However, habitat that may be impacted by the proposal is unlikely to be important to the long-term survival of this species. The impact of the proposal on this species includes the removal of 0.09 hectares of aquatic habitat (moderate/good freshwater wetlands) and possible barriers to movement during construction.

The floodplain wetland at Testers Hollow is mapped as a 'Moderate potential GDE (national assessment)'. Two of the plant community types found on the site are classified as groundwater dependent terrestrial ecosystems and are likely to be dependent proportionally on groundwater, particularly during times of water stress. While there may be minor alteration to groundwater conditions in the locality, the proposal is unlikely to result in permanent damage or loss of groundwater dependent ecosystems outside of the proposal footprint.

Indirect and operational impacts including increased habitat fragmentation and edge effects are considered to be minor as the landscape is already largely disturbed and there would be minimal removal of vegetation as part of the proposal. Invasion and spread of weeds, pests, pathogens and disease are a risk with a proposal of this type. Noise and vibration increases will be restricted to the construction stage and no artificial light will be required as construction activities would be undertaken in daylight hours. Potential impacts to biodiversity will be minimised by

undertaking best practice procedures as outlined in the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011). As the proposal does not exceed the Roads and Maritime offset thresholds, offsets are not required in accordance with Roads and Maritime environmental offsets policy.

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Glossary of terms and abbreviations

Definitions	
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where an event or circumstance is a direct consequence of the action (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2017).
Indirect impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
MNES	A Matter of National Environmental Significance (MNES) protected by a provision of Part 3 of the EPBC Act.
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2017).
Mitigation	Action to reduce the severity of an impact. (OEH 2017).
Mitigation measure	Any measure that reduces impact on habitat, facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Proposal area/ Proposal site	The area of land that is directly impacted on by the proposal, including access roads, and areas used to store construction materials (OEH 2017).
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2017).
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.

Abbreviations	
BBCC	BioBanking Credit Calculator
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BVT	Biometric Vegetation Type
CEMP	Construction Environmental Management Plan

Abbreviations	
DP&E	Department of Planning and Environment, now the Department of Planning, Industry and Environment
DPI	Department of Primary Industries, now part of the Department of Planning, Industry and Environment
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Federal).
FBA	Framework for Biodiversity Assessment
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographic Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant Community Type
REF	Review of Environmental Factors
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
TECs	Threatened Ecological Communities
TSPD	Threatened Species Profile Database
VIS	Vegetation information system

1 Introduction

1.1 Proposal background

Jacobs has been appointed by Roads and Maritime Services (Roads and Maritime) to undertake a review of environmental factors (REF) to assess the environmental impacts of the upgrade of Cessnock Road at Testers Hollow (the proposal) as required under Division 5.1 of the *Environmental Planning & Assessment Act 1979* (EP&A Act). The proposal is located around 3.5 kilometres to the east of Kurri Kurri and 5.4 kilometres to the west of Maitland within the Cessnock Local Government Area (LGA) and directly alongside the western boundary of the Maitland LGA (refer to Figure 1.1). Cessnock Road is an important regional transport route that connects Kurri Kurri and Maitland and links with the Hunter Expressway.

The road is subject to flooding at Testers Hollow, which affects local residents, commuters and freight in the surrounding area. Severe weather events can result in parts of the Gillieston Heights community being cut-off from road access. The proposal is required as it would provide increased flood immunity along Cessnock Road at Testers Hollow between Gillieston Heights and Cliftleigh.

The area surrounding Testers Hollow is in a low-lying depression and includes a wetland within a rural landscape comprised of gently sloping cleared grazing land. The low-lying wetland at Testers Hollow is situated within the Hunter River floodplain. An unnamed creek connects the wetland at Testers Hollow west of the study area, to Wallis Creek to the east. The arm of Wallis Creek near the study area flows north for about 5.5 kilometres where it eventually meets the larger Hunter River, a further 3.5 kilometres north east. However, the unnamed creek and wetland at Testers Hollow is separated from Wallis Creek by a small raised ridge along the western boundary of Wallis Creek during dry periods. Consequently, the Testers Hollow area is dammed during low flow events and is only connected to Wallis Creek when the area is inundated.

1.2 The proposal

Key features of the proposal are shown in Figure 1.2 and include:

- A new two lane 60 and 80 kilometre per hour road, one lane each direction with two metre shoulders, around 900 metres long between Gillieston Heights and Cliftleigh on the western side of the existing road
- The new road will be on an earth embankment at a height of about six metres Australian Height Datum (AHD) which would allow access in a five per cent Annual Exceedance Probability (AEP). AEP refers to the likelihood of a flood event occurring in any one year
- The new road will tie in back into the existing road at the northern and southern extents
- Existing access arrangements will be maintained to private property and to the existing combined U-turn bay and intersection at Avery Lane
- New drainage to allow water to pass under the new embankment and through the existing road embankment
- Utility and street light relocations
- Partial property acquisitions
- Ancillary works including drainage works, safety barriers, signs, linemarking, landscaping and environmental protection works
- Temporary ancillary facilities including site compounds and stockpile sites.

The construction of the proposal would be expected to start in 2019 and take about 18 months to complete.

1.3 Study definitions

The following definitions are used throughout the report:

- Proposal footprint: this area comprises the limits of the construction design and compound site location

- Study area: includes the proposal footprint and surrounding area that may be indirectly affected by the proposal (refer to Figure 1.2)
- Locality: This is defined as the area within a 10 kilometre radius surrounding the proposal footprint
- Bioregion: The study area is located in the NSW North Coast bioregion (Thackway and Cresswell, 1995) and within Hunter sub-region (Figure 1.1).

1.4 Objectives

This report details the methods and results of a biodiversity assessment to identify the threatened species, populations and ecological communities in the area of the proposal and assess the extent and magnitude of potential direct and indirect impacts associated with the proposal. The report addresses the requirements for assessment of significance under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report also addresses the requirements of the *Fisheries Management Act 1994* (FM Act) with respect to identifying the importance of habitat for threatened aquatic species and assessment of impact. Avoidance and mitigation measures to ameliorate the potential ecological impacts arising from the proposal are provided.

The aims of the biodiversity assessment are to:

- Describe the characteristics and ecological condition of the vegetation communities and habitats within the study area
- Determine the occurrence, or likelihood of occurrence of threatened species, populations and communities listed under the BC Act, EPBC Act and FM Act within the study area
- Describe the potential impacts on biodiversity in the study area because of the proposal
- Undertake an Assessment of Significance for threatened species and communities that are confirmed or considered likely to occur within the study area
- Propose measures to avoid and mitigate impacts on identified ecological values.

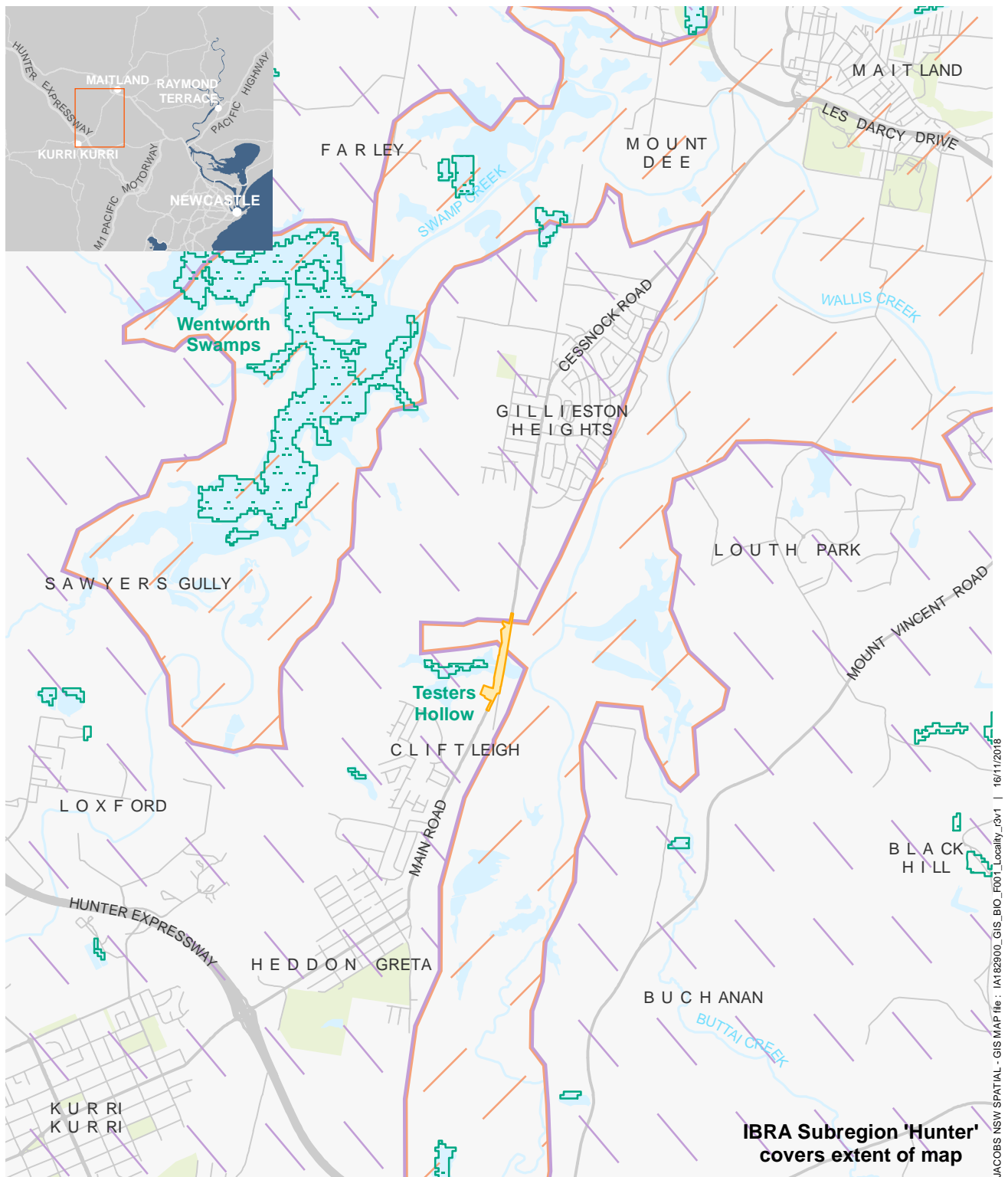
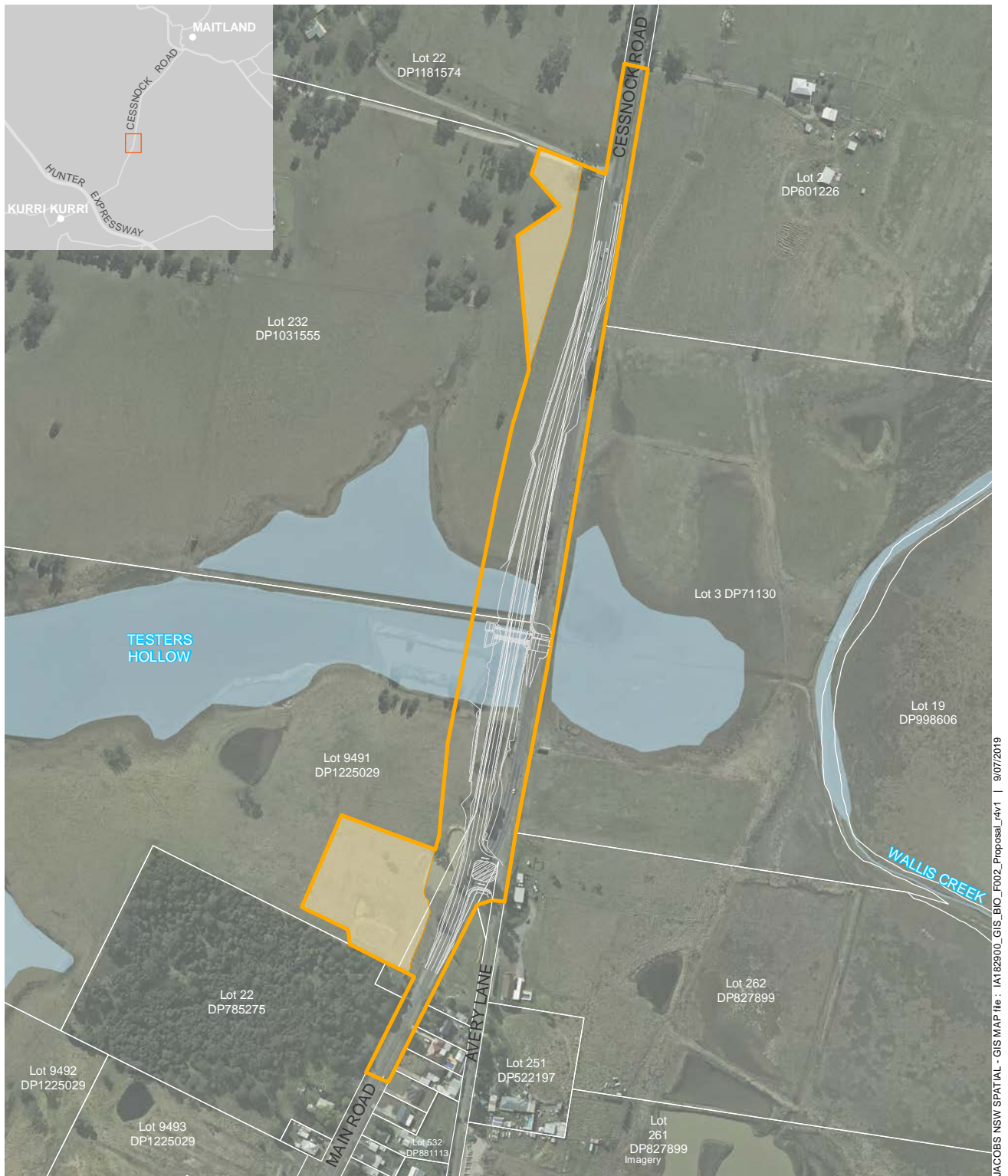


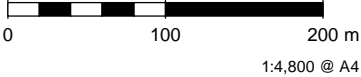
Figure 1.1 | Proposal context



JACOBS NSW SPATIAL - GIS MAP file : I\182900_GIS_BIO_F002_Proposal_rdv1 | 9/07/2019

Legend

- Proposal area
- Potential ancillary site
- Design
- Waterbody



1:4,800 @ A4

Figure 1.2 | The proposal

1.5 Legislative context

A REF is being prepared to satisfy Roads and Maritime duties under Section 5.5 of the EP&A Act to “examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity” and Section 5.7 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the Cessnock Road Upgrade at Testers Hollow, and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Under Section 5.5 of the EP&A Act, Roads and Maritime must consider the effect of an activity on any wilderness area (within the meaning of the *Wilderness Act 1987*) in the locality in which the activity is intended to be carried on.

Part 7 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act or FM Act, are assessed using a five-part test. Where a significant impact is likely to occur, a species impact statement (SIS) or Biodiversity Assessment Report (BAR) must be prepared in accordance with the Director-General’s requirements.

2 Methods

2.1 Personnel

This biodiversity assessment was undertaken and prepared by appropriately qualified and experienced ecologists (refer to Table 2.1).

Table 2.1 Personnel, role and qualifications

Name	Role	Qualifications
Chris Thomson	Principal Ecologist; Technical lead and review	GCertNatRes, BAppSc
Brenton Hays	Ecological surveys and reporting	BEnvScMgt (Hons)
Sarah Douglass	Senior Aquatic Ecologist; reporting	BScEnvBio, MEnvMgmt

2.2 Background research

A background review of existing information was undertaken to identify the existing environment of the study area within a search area of a 10 kilometre radius. The review focussed on database searches, relevant ecological reports pertaining to the study area (Harper Somers O'Sullivan 2005 and 2007), the Preliminary Environment Investigation (PEI) (Hills Environmental 2017), proposal boundaries, and relevant GIS layers. Databases searched are listed in Table 2.2. The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species and Areas of Outstanding Biodiversity Value (AOBV) with a likelihood of occurrence in the study area and locality.

Table 2.2 Date and search area of relevant databases searched during desktop review

Database	Date accessed	Search area
NSW BioNet Atlas (formerly NSW Wildlife Atlas)	3 May 2018, 4 July 2019	10 km
EPBC Act Protected Matters Search Tool	3 May 2018, 4 July 2019	10 km
Register of Declared Areas of Outstanding Biodiversity Value	17 May 2018, 4 July 2019	N/A
Bionet Vegetation Classification Database	17 May 2018, 4 July 2019	N/A
Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)	3 May 2018, 4 July 2019	10 km
Commonwealth Directory of important wetlands	3 May 2018, 4 July 2019	10 km
SEPP 14 wetlands	3 May 2018, 4 July 2019	10 km
Department of Primary Industries Aquatic TECs and freshwater threatened species distribution maps	3 May 2018, 4 July 2019	N/A
Department of Planning and Environment State Environmental Planning Policy (Coastal Management) 2018 interactive map	3 May 2018, 4 July 2019	N/A

2.3 Habitat assessment

The database searches focused on identifying the threatened flora and fauna species, populations and threatened ecological communities previously recorded within the locality.

Following collation of this data a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats contained within the study area (see Appendix A). This was further refined following field surveys and assessment of the habitat present and habitat quality. The likelihood of occurrence was classified according to the criteria described in Table 2.3.

Species were considered likely to occur where:

- The geographic distribution of the species is known or predicted to include the IBRA sub-region in which the proposal is located, and
- The proposal area contains habitat features or components associated with the species or
- Past surveys undertaken at the proposal area indicate that the species is present or likely to occur.

The habitat assessment identified the species suitable for targeted survey. Details of the preferred habitat of each species was determined through review of the habitat profile for each species from the Threatened Biodiversity Data Collection in addition to other published literature.

Species with a high or moderate likelihood of occurrence were subject to assessments of significance under the BC Act and/or EPBC Act as appropriate. A low likelihood of occurrence does not mean that the particular species would not occur in the study area, but that there is a low likelihood based on the habitat that is present.

Table 2.3 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 (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 highly 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 (10 km). 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.

2.4 Field survey

A survey of the study area was conducted on 10 May 2018 to identify the vegetation communities present, ground-truth the results of the background research and complete a detailed habitat assessment. A subsequent survey was carried out on 27 September 2018 to identify *Eucalyptus parramattensis* subsp. *decadens* individuals in the proposal area.

2.4.1 Vegetation surveys

Broad scale vegetation mapping and aerial photography was used to initially identify the extent of native vegetation. The initial vegetation mapping was then ground-truthed in the field and

where possible assigned to Plant Community Types (PCTs) according to the OEH BioNet Vegetation Classification System (Office of Environment and Heritage, 2017b). The identified PCTs and their extent were mapped across the study area.

The vegetation survey was completed using field survey methods in line with Chapter 5 of the *Biodiversity Assessment Method* (BAM) (Office of Environment and Heritage, 2017a). A plot-based vegetation survey was conducted and focused on vegetation within the immediate study area. The plot-based floristic survey used a series of 400 m² plots around a central 50 metre transect to assess vegetation structure and composition attributes (species richness and foliage cover). Function attributes (number of large trees, tree stem size class, tree regeneration and length of fallen logs) were recorded within the larger 1000 m² plot. Litter cover was assessed as the average percentage ground cover of litter recorded from five 1 metre x 1 metre plots evenly located along the central transect. The number of trees with hollows was determined by counting the number of trees with hollows that are visible from the ground in the 1000 m² plot.

The location and number of plot sampling sites used in the field survey was determined according to the extent and condition of each vegetation type present to ensure adequate representation. A summary of vegetation survey effort, outlining the number of PCTs and respective number of floristic plots / transects sampled in the field is presented in Table 2.4. The location of each plot / transect is shown in Figure 2.1.

Table 2.4 Summary of vegetation survey effort

Plant community type (PCT)	Condition	Area in hectares (ha) in proposal area	Survey effort completed*
Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (PCT 1736)	Moderate / good	0.09	1 plot
	Poor	0.82	2 plots
Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)	Regenerating	0.52	1 plot

* Note: One plot was carried out in vegetation later deemed as most likely having grown from a native seed mix. Results from this plot are not included in Table 2.4.

Transects and traverses

Transects and traverses were undertaken throughout the study area to record flora species, identify plant community types, complete searches for threatened species, and determine potential impacts from clearing. The location of any significant habitat features was also recorded. The location of any threatened species, vegetation community boundaries, and any other ecological factors were recorded with a Geographic Positioning System (GPS). The length of the study area was traversed by vehicle and by foot. Areas of interest directly adjacent to the study area were also investigated where possible.

Digital mapping of vegetation communities was conducted using ArcGIS® software. A combination of field data, aerial photograph interpretation and biophysical data such as elevation and soil type were used to delineate community boundaries. Description of PCTs was based on their structure and dominant species.

Threatened Ecological Community assessment

Identification of threatened ecological communities (TECs) as listed under the BC Act and EPBC Act was undertaken using final determinations from the NSW Scientific Committee and

approved conservation advice from the Commonwealth Threatened Species Scientific Committee. The TECs of interest to this assessment and known from the locality included:

- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered ecological community – BC Act)
- Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales (endangered ecological community – EPBC Act)
- Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (endangered ecological community – BC Act)
- Kurri sand swamp woodland in the Sydney Basin Bioregion (endangered ecological community – BC Act)
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (endangered ecological community – BC Act)
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (endangered ecological community – BC Act).

Condition thresholds are not provided for BC Act listed TECs. Condition thresholds for the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales are provided by the Commonwealth Threatened Species Scientific Committee (Threatened Species Scientific Committee 2018) and were applied in the field. These are discussed further in Section 3.9.1.

The area of each vegetation patch, and distance between canopy trees, was determined during the field survey and refined using ArcView software using the best available aerial photography. The cover of perennial understorey species was determined from the BAM plots/transect data as specified above. The survey was undertaken in May (late Autumn) so the groundcover was not in the optimal condition for survey and the results of native perennial understorey presented in this report should be considered in regard to the season. It is possible that native perennial understorey occupies a greater proportion of plots than the results in this report indicate.

2.4.2 Targeted flora surveys

Targeted searches for threatened flora were undertaken within areas of accessible land. As much of the study area consists of cleared agricultural land dominated by exotic species, searches were focussed on higher quality areas of suitable habitat (e.g. surrounding woody vegetation) and consisted of parallel traverses. The area considered to contain the most suitable habitat for threatened flora species considered to have a moderate to high likelihood of occurring in the study area is in the woodland on Lot 22 DP785275. Access to this site was not gained during the field survey. A list of threatened flora considered to have a moderate to high likelihood of occurring in the study area are listed in Table 2.5.

Entire study area was traversed during the site survey. All trees were identified and the ground layer species distinguished due to the high level of disturbance.

Table 2.5 Targeted species survey technique for threatened flora with a moderate to high likelihood of occurring in the study area

Threatened flora species		Status		Survey technique
Scientific name	Common name	BC Act	EPBC Act	
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Drooping Red Gum	V	V	Known to be present. Area of occupancy traversed and number of plants counted and mapped.

Threatened flora species		Status		Survey technique
Scientific name	Common name	BC Act	EPBC Act	
<i>Acacia bynoeana</i>	Bynoe's Wattles	V	E	Entire study area was traversed during the site survey, with particular focus on areas of woody vegetation that may provide suitable habitat for these species. All trees were identified and the ground layer species distinguished. Some suitable habitat may be present in Lot 22 DP785275. However, access was not gained to this site. This habitat is disturbed and would not be impacted by the proposal.
<i>Callistemon linearifolius</i>	Netted Bottlebrush	-	V	
<i>Cymbidium canaliculatum</i> (endangered population)		-	E	
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	
<i>Eucalyptus camaldulensis</i> (endangered population)	River Red Gum population in the Hunter Catchment	-	EP	
<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	V	
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E	
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	These species do not have any above ground plant parts at this time of year. Some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	

2.4.3 Targeted fauna surveys

Terrestrial fauna surveys were guided by the survey guidelines in the *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft* (Department of Environment and Conservation, 2004c). The following Commonwealth survey guidelines were also consulted:

- *Survey Guidelines for Australia's Threatened Bats* (Department of the Environment Water Heritage and the Arts, 2010a)
- *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment Water Heritage and the Arts, 2010b).

Targeted surveys were undertaken for threatened bird species in the woodland and wetlands. A 20-minute transect was undertaken along the perimeter of Lot 22 DP785275 searching for woodland birds. A one-hour census was undertaken around the wetland documenting all wetland and waterfowl present at the time.

A thorough search was also undertaken for roosting insectivorous bats within the culvert located beneath Cessnock Road as the initial habitat assessment determined potential suitable roosting

habitat for threatened insectivorous bats. In addition to the physical search two bat call detectors were placed at each opening of the culvert prior to sunset on one evening. The culvert was then 'stag-watched' at dusk from 4:30pm to 6pm by waiting at the eastern end of the culvert, looking into the setting sun through the culvert to the west to actively record any bats seen leaving their roost. Weather conditions consisted of mostly clear skies with temperatures reaching 25.5 °C during the day and wind speed reaching a maximum of 44 km/h WNW (BOM 2018). After this time, the wetland areas were briefly surveyed until 6:30pm with a spotlight, looking and listening for fauna and actively call recording any bats flying around. This was not undertaken to satisfy targeted survey guidelines, but provide insight as to what species are using the site.

Targeted fauna survey techniques such as mammal trapping, and frog surveys, were not undertaken or considered necessary due to the disturbed nature of the roadside vegetation and wetland, the narrow width of road reserve being assessed and the relatively narrow scope of the proposal, these specific and targeted fauna survey techniques were not feasible. To address this limitation, the potential for threatened fauna species to occur was determined through habitat assessment.

2.4.4 Fauna habitat assessment survey

Fauna habitat assessments were completed to assess the likelihood of threatened fauna occurring in the study area. Fauna habitats were assessed by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation; the structure and composition of the litter layer; and other habitat attributes important for feeding, roosting and breeding. The criteria used to evaluate the condition of general fauna habitat values are outlined in Table 2.7.

2.4.5 Aquatic habitat assessment

The study area is situated within the floodplain that connects Testers Hollow wetland west of the study area, to Wallis Creek to the east. The arm of Wallis Creek near the study area is a fifth order stream (Strahler) that flows north for about 5.5 kilometres where it turns into a sixth order stream and then eventually meets the Hunter River (ninth order stream) a further 3.5 kilometres north east. The aquatic habitat in the study area comprises of the constructed unnamed third order stream that connects Wallis Creek with Testers Hollow wetland, artificial agricultural ponds and the surrounding inundation area of the floodplain.

Aquatic habitats were assessed by examining characteristics such as the structure and floristics of aquatic vegetation, channel width, the presence of surface water, water flow, water depth, turbidity, visible pollutants, erosion, the presence of shelter (rocks, submerged vegetation and woody debris) and channel substrate. The habitat value of each waterway (ie habitat sensitivity and classification of waterways for fish passage) have been characterised in accordance with NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management* (Department of Primary Industries, 2013).

2.4.6 Summary of survey effort

A summary of the targeted surveys undertaken for this proposal is provided in Table 2.6.

Table 2.6 Targeted species survey details

Species	Minimum survey requirements	Survey completed
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	40-metre-wide parallel field traverse	This species was identified as planted individuals. All plants were recorded within the study area.
Species identified in Table 2.5	10 to 40-metre-wide parallel field traverse	Entire study area was traversed during the site survey, with particular focus on areas of woody vegetation that may

Species	Minimum survey requirements	Survey completed
		provide suitable habitat for these species.
Insectivorous bats	<p>Suggested survey methods include:</p> <ul style="list-style-type: none"> • Roost site identification – hollows, caves and artificial structures; all species • Trapping (e.g. harp-trapping); all species; Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night) per 100 hectares (or portion thereof) of stratification unit. • Call survey; Two recording devices per 100 hectares (or portion thereof) of stratification unit, utilised for the entire night (a minimum of four hours), starting at dusk for two nights. • Call survey only appropriate for Little Pied Bat, Large-eared Pied Bat and Yellow-bellied Sheath-tail-bat. <p>Species-specific requirements according to Commonwealth guidelines for Large-eared pied bat include a combination of the following techniques and effort over a proposal area less than 50ha:</p> <ul style="list-style-type: none"> • Unattended bat detectors; 16 detector nights over 4 nights • Attended bat detectors; 6 detector hours over 3 nights <p>Harp traps; 16 trap nights 4 nights.</p>	<p>Identification of roost potential within culvert.</p> <p>Stag-watch culvert from 4:30 pm to 6 pm on eastern side of culvert.</p> <p>Two call detectors deployed from 4:30 pm to 6 pm – one on each side of the culvert.</p> <p>Spotlighting and active call detection around artificial ponds from 6pm to 6:30pm.</p>
Woodland birds	<p>Surveys should include:</p> <ul style="list-style-type: none"> • Area searches; 20 minute surveys of 2 hectare plots, noting that a study has shown that 3 x 20 minute censuses of a 2ha block revealed only 53% of the species present. 	20-minute survey along the perimeter of Lot 22 DP785275 at dawn.
Wetland birds	<p>Surveys should include:</p> <ul style="list-style-type: none"> • A 20-minute census at dawn or dusk, for each identified water source. • A one-hour census at dawn or dusk, for each identified wetland. 	A one-hour census was undertaken around the wetland habitat at dawn.
<p>Note 1: Based on <i>NSW Guide to Surveying Threatened Plants</i> (Office of Environment and Heritage, 2016) and <i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft, 2004</i> for NSW BC Act listed species and the following guidelines for Commonwealth species:</p> <ul style="list-style-type: none"> • <i>Survey guidelines for Australia's threatened bats</i> • <i>Survey guidelines for Australia's threatened birds</i> 		

Table 2.7 General fauna habitat condition assessment criteria

Condition	Characteristics	Patch size/connectivity	Naturalness	Floristic diversity	Groundcover	Habitat feature	Weed abundance
High	Vegetation still retains the majority of native species and structural characteristics of the pre-European equivalent. Such vegetation is usually in a near natural state and displays resilience to weed invasion due to intact ground cover, shrub and canopy layers and lack of soil disturbance. Some limited weed cover is present in edge habitats.	>2 hectares and well connected to other areas of vegetation outside the study area	Remnant woodland / forest	High	Intact	Habitat for threatened fauna, mature trees abundant and tree hollows, dead trees and natural logs	Low
Moderate	Vegetation generally still retains most of its structural integrity but has been partially disturbed and has lost some component of its original species complement. Weed invasion varies from slight to high.	>2 hectares and tentative links to other vegetation outside the study area	Disturbed woodland / forest	Moderate	Intact with few or no invasive grasses	Some habitat for threatened fauna, mature trees low density, few hollows and logs	Moderate - High
Low	Modified areas where most of the native diversity and vegetation structure has been lost. Includes thin strips of roadside vegetation, areas of derived grassland and shrubby vegetation. Environmental weeds are often co-dominant with the original indigenous species, particularly invasive grasses.	< 1-2 hectares and with fragmented connectivity with areas of habitat outside the study area	Derived native grassland, scattered shrubs, isolated paddock trees, and landscape plantings	Low-Moderate	Partial with high proportion of invasive grasses and forbs	Limited habitat for threatened fauna, mature trees absent, very few hollows or logs	High - Moderate
Very Low	Includes cleared paddock areas and clearings dominated by exotic species including noxious weeds. Some regenerating shrubs and native groundcovers may be present in low abundance.	< 1-2 hectares and isolated from other areas of habitat outside the study area	Exotic pasture and cleared areas	Low	None dominated by invasive grasses	Minimal habitat for threatened fauna, mature trees absent, no hollows or logs	High

2.5 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of GDE (Bureau of Meteorology, 2018) and the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* released by the NSW DPI (Kuginis et al., 2012).

2.5.1 Classification of groundwater dependant ecosystems

The degree of groundwater dependence of ecosystems is classified in three broad categories:

- Non-dependent ecosystems; ecosystems that occur mostly in recharge areas and have no connection with groundwater
- Facultative GDEs; require groundwater in some locations but not in others, particularly where an alternative source of water can be accessed to maintain ecological function
- Obligate GDEs; ecosystems that are restricted to locations of groundwater discharge (eg mound springs) and ecosystems located within aquifers (eg subterranean cave and stygofauna communities (Kuginis *et al.* 2012).

Facultative GDEs have varying degrees of groundwater dependence and are described under three dependence subcategories:

- Highly dependent; some locations within the ecosystem likely to require continual access to groundwater; likely to be damaged or destroyed if groundwater attributes fall below a critical threshold
- Proportional; exhibit proportional responses to changes in groundwater attributes; do not generally exhibit the threshold type response of the more dependent ecosystems
- Opportunistic; ecosystems which use groundwater as required when surface water / soil moisture is unavailable, such as at the end of a dry period.

Minor changes to the groundwater regime in facultative GDEs with proportional or opportunistic groundwater dependence may not have any adverse impacts but these ecosystems can be damaged or destroyed if a lack of access to groundwater is prolonged (Kuginis *et al.* 2012).

Groundwater dependant ecosystems have been classified into seven types under two broad categories as follows (Kuginis *et al.* 2012):

- Subsurface ecosystems – Underground ecosystems
 - Karst systems and caves (limestone geology)
 - Subsurface aquifer (phreatic) ecosystems
 - Baseflow streams (hyporheic or subsurface component)
- Surface ecosystems – Above ground ecosystems
 - Groundwater dependent wetlands
 - Baseflow surface streams (surface/free-water component)
 - Estuarine and near shore marine ecosystems
 - Groundwater dependent terrestrial ecosystems; dependent on subsurface groundwater (phreatophytic).

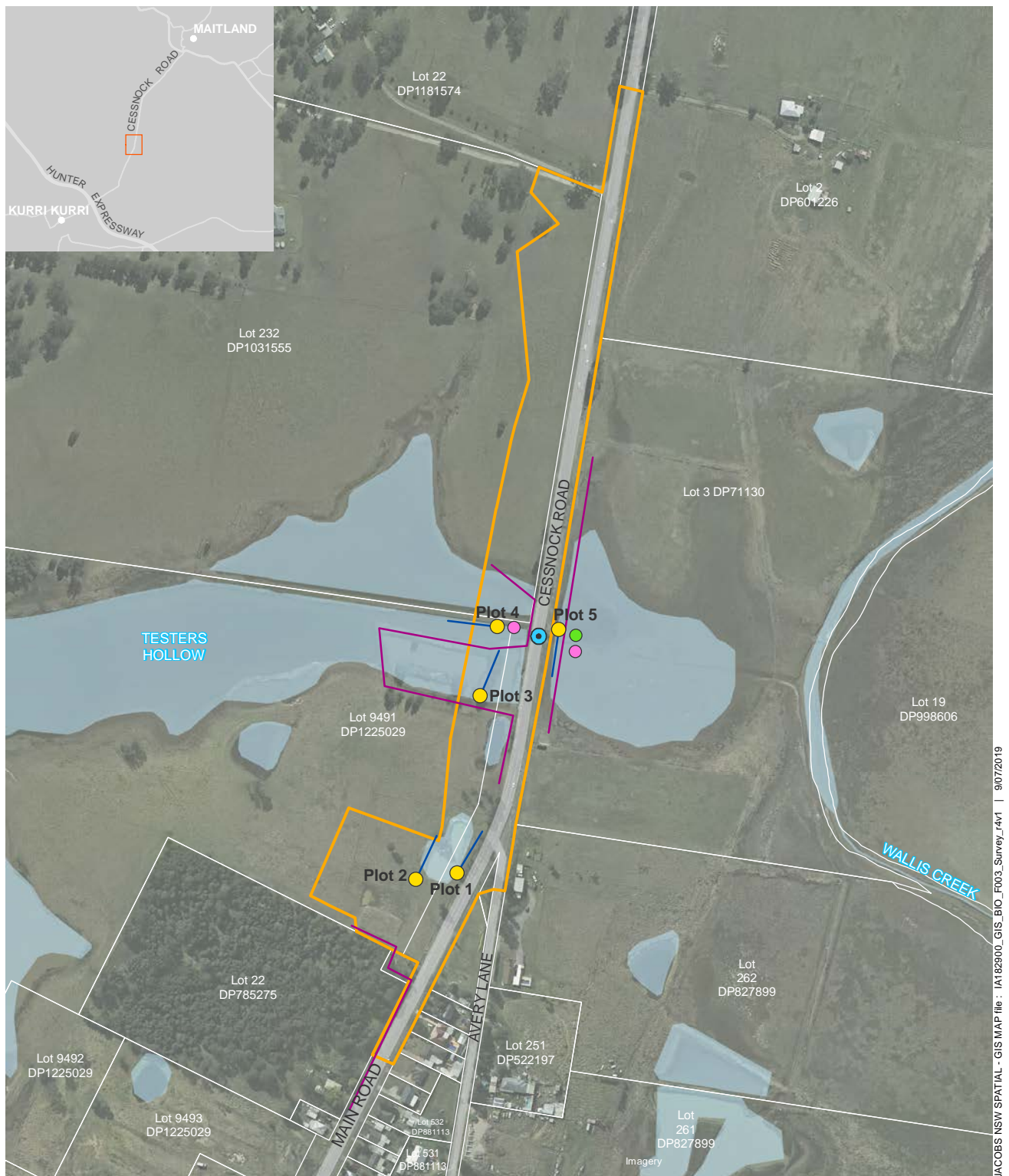
2.6 Limitations

The list of flora and fauna species recorded from this study should not be seen to be fully comprehensive, but rather an indication of the species present at the time of the survey. A period of several seasons or years is needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (eg orchids, annual herbs and grasses, or migratory birds). Some species require specific weather conditions for optimum detection (eg frogs). The conclusions of this report are therefore based upon available data and the field surveys and are therefore merely indicative of the environmental condition of the site at the time of the survey. It should be recognised that site conditions, including the presence of

threatened species, could change with time. To address this limitation, a precautionary approach has been used which aimed to identify the presence and suitability of the habitat for threatened species.

A precautionary approach was used concerning identifying the presence of suitable habitat for where there is insufficient evidence to discount the presence of the species due to seasonal limitations or other constraints.

The methods used and time spent surveying some of the vegetation on private properties around the study area was limited (Lot 22 DP785275). Private property was not accessed therefore assessment of vegetation and fauna habitat within these areas is largely based on what could be seen from the road corridor and available existing information.



Legend

- Proposal area
- Waterbody
- Anabat
- Stag-watch
- Culvert
- Bird survey
- Vegetation plot
- Vegetation plot transect

0 100 200 m
1:5,000 @ A4



Figure 2.1 | Vegetation and threatened species survey locations

3 Existing environment

3.1 Plant community types

The study area is located within the area mapped by both the Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855 and the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) vegetation Survey, Classification and Mapping for the Lower Hunter and Central Coast Region (House 2003). After review of both mapping datasets, it is apparent that LHCCREMS (House 2003) is more accurate and has been referenced as part of this assessment. House (2003) lists three vegetation communities in and surrounding the study area including (refer to Figure 3.1):

- Hunter Lowlands Red Gum Forest,
- Hunter Spotted Gum – Ironbark Forest, and
- Alluvial Tall Moist Forest.

Harper Somers O’Sullivan (2005) ground-truthed vegetation as part of their assessment of the proposed residential subdivision at Cliftleigh and recorded Hunter Lowland Redgum Forest, Swamp Oak Floodplain Forest, Lower Hunter Spotted Gum - Ironbark Forest and Freshwater Wetlands on Coastal Floodplain within parts of their study area that are similar in landscape position to this proposal.

The detailed floristic plots undertaken in the study area during the field survey allowed for quantitative analysis of the vegetation against published descriptions of Plant Community Types (PCTs) in the NSW BioNet Vegetation Classification database and final determinations of threatened ecological communities published by the NSW Scientific Committee and the Commonwealth Threatened Species Scientific Committee. The results of the field surveys and data analysis suggest there are four PCTs within the study area (refer Table 3.1).

Vegetation in the study area and surrounding landscape is patchy and highly fragmented, and contains a mix of isolated and small remnant and regrowth patches associated with a number of different communities. Existing vegetation is a product of landscape and both historical and current land use practices. Historically the study area would likely have contained a mix of floodplain vegetation and grassy woodland vegetation types. Presently the site contains remnant paddock trees, constructed dams/drains, large areas of cleared pasture and patches of regrowth vegetation in and around the road corridor. In some cases, it is difficult to determine if vegetation in the road corridor was planted or has regrown naturally after the construction of the road, however as a precaution much of this vegetation has been assigned to a PCT.

Table 3.1 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposal area
Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (PCT 1736).	Moderate / good	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions endangered ecological community (BC Act)	0.09
	Poor		0.82
Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)	Regenerating	Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregion endangered ecological community (BC Act)	0.52
	Poor		0.04

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposal area
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1601)	Poor	Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion endangered ecological community (BC Act)	<0.01
Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598)	Poor	Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	0.06
Total			1.56

Due to the level of disturbance and modification in the study area, vegetation within the study area has been assigned to several condition categories:

- 1) Moderate / Good condition – This vegetation zone had a dominance of native species but possessed a low to moderate abundance and cover of exotic species in the ground layer. PCT 1736 within the drain is the only area of this category within the study area that can be verified by floristic analysis. The patch of PCT 1598 in Lot 22 DP785275 has also been assigned to this condition category based on previous studies and a visual assessment from the road corridor.
- 2) Poor condition – This vegetation has mature remnant trees however is in poor condition as evidenced by a lack of habitat attributes (ie few to no hollow bearing trees, little woody debris in the ground layer, little to no canopy species regeneration), missing structural layers, and dominance of exotic species (eg *Chloris gayana*) in the ground layer. In relation to PCT 1736, this includes areas dominated by an exotic groundcover and low diversity of native species.
- 3) Regeneration (Poor condition) – This vegetation has been previously cleared and is characterised by regrowth stands of canopy species. This category has been assigned to a patch of PCT 1728 in Lot 949 DP1223319 and a strip of PCT 1601 within the road corridor at the northern end of the study area.

The road corridor contains an assemblage of vegetation that is likely to be a mix of native regrowth and possibly seeding/planting from when Cessnock Road was last constructed. This is obvious as most of the vegetation is growing out of the road fill / batter. Depending on the landscape position, this includes small rows and patches of Swamp Oak (*Casuarina glauca*), Forest Red Gum (*Eucalyptus tereticornis*) and Narrow-leaved Apple (*Angophora bakeri*) closer to the culvert, with Narrow-leaved Ironbark (*Eucalyptus crebra*) and Spotted Gum (*Corymbia maculata*) further up the slope in the north of the study area. In most cases, these trees have been assigned to PCTs, such as Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1601). This community consists of mostly young trees with an absent understorey, however is regenerating from the scattered remnant trees in surrounding cleared areas. Similarly patches of *E. tereticornis* have been assigned to Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598). Only one small patch of vegetation containing *E. tereticornis*, *A. bakeri*, *C. glauca* and *Melia azedarach* has not been assigned to a PCT and mapped as 'native regrowth / seed mix'.

The rest of the study area contains a mixture of cleared agricultural land with scattered trees. Groundcover in these areas is generally dominated by exotic species including Windmill Grass (*Chloris gayana*) (dominant), *Paspalum dilatatum*, *Sporobolus* sp. (dominant), *Setaria* sp., African Lovegrass (*Eragrostis curvula*), Kikuyu Grass (*Pennisetum clandestinum*), Plantain (*Plantago lanceolata*), Common Sowthistle (*Sonchus oleraceus*), Paddy's Lucerne (*Sida rhombifolia*), Purple Top (*Verbena bonariensis*), Dock (*Rumex crispus*) and Onion Weed

(*Nothoscordum gracile*). There are also numerous native groundcover species present at varying levels of abundance throughout these areas including Common Couch (*Cynodon dactylon*) (generally dominant), *Juncus usitatus*, Pigweed (*Portulaca oleracea*), *Eriochloa* sp., Brown's Lovegrass (*Eragrostis brownii*), *Bothriochloa* sp. and *Phyllanthus* sp. These areas have been mapped as cleared/agricultural land.

The patch of woodland in the south-west of the study area (Lot 22 DP785275) was not able to be accessed during the field survey and therefore no detailed floristic surveys were undertaken. No direct impacts to this vegetation are expected as part of the proposal. Therefore, the vegetation was only viewed from the road corridor and the dominant and obvious species were noted including scattered large *E. tereticornis* and a midstorey of *C. glauca*, Prickly-leaved Paperbark (*Melaleuca styphelioides*) and *M. sieberi*. This vegetation has been previously mapped as numerous different communities. Harper Somers O'Sullivan (2005) mapped it as a 'Degraded variant – Melaleuca thicket' of the Hunter Lowland Redgum Forest (MU19) as described by LHCCREMS. The PEI (Hills Environmental 2017), mapped this vegetation as Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633), however few of the diagnostic canopy species for this PCT were observed during the field survey or have been reported by previous studies. Considering the most detailed investigation was done by Harper Somers O'Sullivan (2005) and the presence of *E. tereticornis* in the canopy, this vegetation has been classified as a poor condition variant of Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598). As noted by Harper Somers O'Sullivan (2005), the presence of *Melaleuca* species is likely due to past clearing and subsequent regrowth of vegetation possibly influenced by PCT 1728. Without undertaking a detailed floristic analysis, this classification as PCT 1598 should be considered a high-level assessment.

Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter – Moderate / Good

Vegetation formation: Freshwater Wetlands

Vegetation class: Coastal Freshwater Lagoons

PCT: 1736

Conservation status: Listed as an endangered ecological community under the BC Act as *Freshwater wetlands on coastal floodplains of the NSW North Coast Sydney Basin and South East Corner bioregions*

Estimate of percent cleared: 80 per cent

Condition: Moderate/Good

Extent in the study area: 0.09 ha

Plots completed in vegetation zone: 1 plot (Plot 4)

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	-	-	-
Small trees	-	-	-
Shrubs	-	-	-
Ground covers	0-1.5 m	72%	Dominated by natives including <i>Cynodon dactylon</i> , <i>Paspalum distichum</i> , <i>Eleocharis sphacelata</i> , <i>Baumea articulata</i> , <i>Bolboschoenus medianus</i> and <i>Typha orientalis</i> . Low abundance of exotic species present including <i>Nothoscordum gracile</i> *.
Vines & climbers	-	-	-

Description: Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (PCT 1736) is present in various states of condition across the site depending on the current land use, but is generally characterised by a groundcover of native grasses including *Paspalum distichum* and *Cynodon dactylon*. The highest quality areas are in the constructed drain on the western side of Cessnock Road, which connects Testers Hollow with Wallis Creek. While disturbed by historic land use (predominantly agriculture in the form of grazing) and construction of the existing Cessnock Road, this PCT still possesses the characteristic species complement for PCT 1736. Macrophyte vegetation in the drain includes *Eleocharis sphacelata*, *Baumea articulata*, *Bolboschoenus medianus* and *Typha orientalis*. The edges and banks of the drain are dominated by *Cynodon dactylon* and *Paspalum distichum*. This assemblage of vegetation only occurs in this drain and continues to the west into the large open wetland that is known as Testers Hollow – a low lying overflow of the Wallis Creek and Hunter River floodplain.

The species complement of this PCT in the study area is typical of Freshwater wetlands on coastal floodplains of the NSW North Coast Sydney Basin and South East Corner bioregions, which is listed as an endangered ecological community under the BC Act.



Plate 1: Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter – Moderate / Good condition (Plot 4). This area is the constructed drain on the western side of Cessnock Road.

Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter – Low

Vegetation formation: Freshwater Wetlands

Vegetation class: Coastal Freshwater Lagoons

PCT: 1736

Conservation status: Listed as an endangered ecological community under the BC Act as *Freshwater wetlands on coastal floodplains of the NSW North Coast Sydney Basin and South East Corner bioregions*

Estimate of percent cleared: 80 per cent

Condition: Low

Extent in the study area: 0.82 ha

Plots completed in vegetation zone: 2 plots (Plot 3 and Plot 5)

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	10 m (5 -15 m)	15 % (0 - 75 %)	<i>Casuarina glauca</i> and <i>Eucalyptus robusta</i> (planted)
Small trees	-	-	-
Shrubs	-	-	-
Ground covers	0-1.5 m	70%	Open areas generally dominated by natives including <i>Cynodon dactylon</i> , <i>Paspalum distichum</i> , <i>Typha orientalis</i> , <i>Juncus continuous</i> , <i>Juncus usitatus</i> , <i>Persicaria decipiens</i> , <i>Eleocharis sphacelata</i> , <i>Triglochin striata</i> and <i>Bacopa monnieri</i> . Higher weed abundance under and around tree canopy including <i>Cirsium vulgare</i> *, <i>Nothoscordum gracile</i> *, <i>Verbena bonariensis</i> *, <i>Sida rhombifolia</i> *, <i>Ehrharta erecta</i> *, <i>Chenopodium album</i> * and flatweeds. Paddocks contain low abundance of exotic species present including <i>Nothoscordum gracile</i> * and <i>Cotula coronopifolia</i> *.
Vines & climbers	-	-	-

Description: This includes all low lying areas surrounding the third order creek. To the south of the drain on a modified built up area is three constructed dams. The dams are not fed by the drain and likely only refreshed during floods when the drain and floodplain become inundated. The dams have high banks which are dominated by *Cynodon dactylon* (in some places 100 per cent), with occasional occurrences of *Paspalum distichum*. The isolated and small patches of trees (most likely planted) around the dams and road are dominated by *Casuarina glauca* and several *Eucalyptus robusta*. Exotic groundcover species are most dominant around the trees and includes *Cirsium vulgare*, *Nothoscordum gracile*, *Verbena bonariensis*, *Sida rhombifolia*, *Ehrharta erecta*, *Chenopodium album* and flatweeds. The dams have little macrophyte or fringing vegetation, however the smallest dam to the south is lined by *Typha orientalis* and *Ludwigia peploides*. The rest of this vegetation includes the grazed paddocks on the north side of the creek and east side of the road. These areas contained shallow water during the site

survey, likely a result of recent rain. The paddock north of the creek is dammed and only likely to receive water from run-off down the hill. Similarly, the west side of the road would only flow during periods of high rainfall. Despite the high level of disturbance from cattle trampling and grazing, the assemblage of vegetation within these areas remains largely dominated by native species compliment for PCT 1736 including *Cynodon dactylon* and *Paspalum distichum* with occurrences of *Juncus continuous*, *Eleocharis sphacelata*, *Triglochin striata*, *Bacopa monnieri* and native graminoids.

The species complement of this PCT in the study area is typical of Freshwater wetlands on coastal floodplains of the NSW North Coast Sydney Basin and South East Corner bioregions, which is listed as an endangered ecological community under the BC Act. However, the number of species identified within this area are substantially lower than the scientific determination for this TEC, which is a reflection of the long history of disturbance.



Plate 2: Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter – Moderate / Good-modified condition (Plot 3). This area contains the constructed dams on the western side of Cessnock Road.



Plate 3: Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter – Poor condition (Plot 5). This area is the low-lying and often inundated areas used for grazing. Plot 5 was placed on the eastern side of Cessnock Road (left photo), however this condition variant is also on the western side of Cessnock Road (right photo).

Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast – Regenerating

Vegetation formation: Forested Wetlands

Vegetation class: Coastal Swamp Forests

PCT: 1728

Conservation status: Listed as an endangered ecological community under the BC Act as Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This vegetation does not meet condition thresholds for the EPBC Act listed TEC Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland (refer Section 3.8.1 for discussion).

Estimate of percent cleared: 81 per cent

Condition: Regenerating

Extent in the study area: 0.52 ha

Plots completed in vegetation zone: 1 plots (Plot 2)

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	-	-	-
Small trees	1.5 m (0.3 - 2 m)	5 %	<i>Casuarina glauca</i> , <i>Eucalyptus tereticornis</i> and/or <i>E. amplifolia</i>
Shrubs	-	-	-
Ground covers	0 - 1 m	80 %	Dominated by <i>Chloris gayana</i> * and <i>Cynodon dactylon</i> with <i>Sporobolus fertilis</i> *, <i>Paspalum dilatatum</i> *, <i>Setaria sp.</i> *, <i>Aster subulatus</i> *, <i>Plantago lanceolata</i> *, <i>Sonchus oleracea</i> *, <i>Sida rhombifolia</i> *, <i>Verbena bonariensis</i> *, <i>Rumex crispus</i> * and <i>Phyla canescens</i> *.
Vines & climbers	-	-	-

Description: The road corridor contains an assemblage of vegetation that is likely to be a mix of native regrowth and possibly seeding/planting from when Cessnock Road was last constructed. This is obvious as most of the vegetation is growing out of the road fill / batter. This includes small rows and patches of Swamp Oak (*Casuarina glauca*). These trees range in maturity, however have reached the age where they are causing natural regeneration around them. This is evident in the eastern portion of Lot 949 DP1223319, which contains juvenile *Eucalyptus parramattensis* subsp. *decadens* that were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2005). *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. As a result of planting these trees, it appears that a portion of this lot has been flagged for conservation and there is no longer grazing or any other agricultural practices being undertaken. As such, natural regeneration of canopy species is evident, including *C. glauca* and either *E. tereticornis* and/or *E. amplifolia* (identification is difficult at the juvenile stage). This patch, and other areas of planted and regrowing *C. glauca* do not have any midstorey species due to the level of

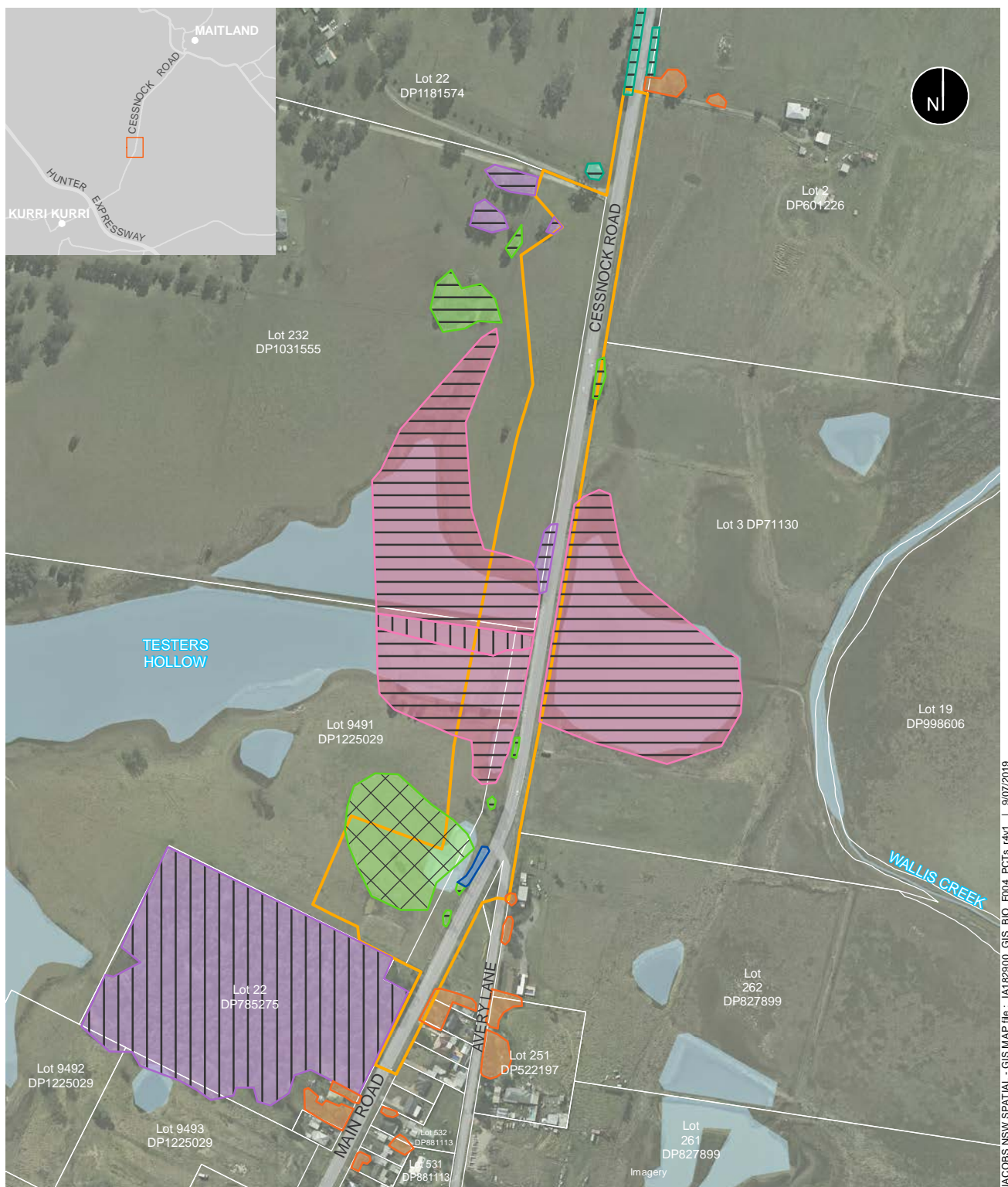
disturbance. Although the groundcover is dominated by exotic species, this vegetation is consistent with the diagnostics species and landform requirements for *Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast* (PCT 1728). Due to the presence of natural regeneration, this small patch of vegetation has been assigned to PCT 1728.

The species complement of this PCT in the study area is typical of a more disturbed *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* which is listed as an endangered ecological community under the BC Act. *Casuarina glauca* is a pioneer species and has likely grown opportunistically along the road corridor and in Lot 949 DP1223319. However, the scientific determination for this TEC does not list any condition thresholds, therefore all condition variants of PCT 1728 within the study area are mapped as this BC Act listed TEC.

Conversely, the Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community lists condition thresholds for the EPBC Act listed TEC that are not met by PCT 1728 in the study area (refer Section 3.8.1 for discussion).



Plate 4: Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Plot 2)



JACOBS NSW SPATIAL - GIS MAP file: I\182900_GIS_BIO_F004_PCTs_r4v1 | 9/07/2019

Legend

 Proposal area

 Waterbody

Condition

Moderate / Good

Poor

Regenerating

Plant community type

 Forest Red Gum grassy open forest on floodplains of the lower Hunter

 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter

 Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter

 Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast

 Planted exotic and non-indigenous

 Native regrowth/seed mix

Figure 3.1 | Plant community types

3.2 Threatened ecological communities

The detailed floristic plots undertaken in the study area during the field survey allowed for quantitative analysis of the vegetation at Testers Hollow against the final determinations of threatened ecological communities issued by the NSW Scientific Committee. Some areas of vegetation have also been assigned to TECs without the use of detailed floristic plots due to occurrence within the study area in small patches only. The BC Act listed TECs identified in the study area include:

- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered ecological community)
- Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (endangered ecological community)
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (endangered ecological community)
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (endangered ecological community).

Kurri sand swamp woodland in the Sydney Basin Bioregion (endangered ecological community – BC Act) was identified in the desktop review as potentially occurring in the study area. This TEC was not identified during the field survey.

3.2.1 Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (BC Act)

The data collected in Plots 3, 4 and 5 suggest that Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (PCT 1736) is equivalent to the endangered ecological community listed under the BC Act: Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. The distribution of this TEC is shown in Figure 3.2.

As detailed in the identification guidelines for the EEC, this community occurs on periodically inundated coastal floodplains, with relatively few woody plants and these communities are dominated by diagnostic flora species listed in the final determination for this EEC such as Bulrush (*Typha orientalis*), *Eleocharis sphacelata* and Water Couch (*Paspalum distichum*), *Bolboschoenus caldwellii*, *Triglochin microtuberosum*, Common Reed (*Phragmites australis*) and *Persicaria* sp.

Most of the vegetation within areas mapped as PCT 1736 in the study area are listed as diagnostic species for this EEC. Typically, this EEC does not contain woody vegetation, however the *C. glauca* in these areas has been planted. *Casuarina glauca* does occur naturally in the floodplain and may have historically been the dominant species in the study area. As such, areas of PCT 1736 around the dams could be classified as the BC Act listed endangered ecological community Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. However, the scientific determination for this EEC states “The combination of features that distinguish Swamp Oak Floodplain Forest from other endangered ecological communities on the coastal floodplains include: its dominance by a tree canopy of either *C. glauca* or, more rarely, *Melaleuca ericifolia* with or without subordinate tree species; the relatively low abundance of *Eucalyptus* species; and the prominent groundcover of forbs and graminoids” (OEH 2004). However, considering this these areas would not be considered as dominated by a tree canopy and has a prominent groundcover of grasses, it does not meet the criteria for Swamp Oak Floodplain Forest.

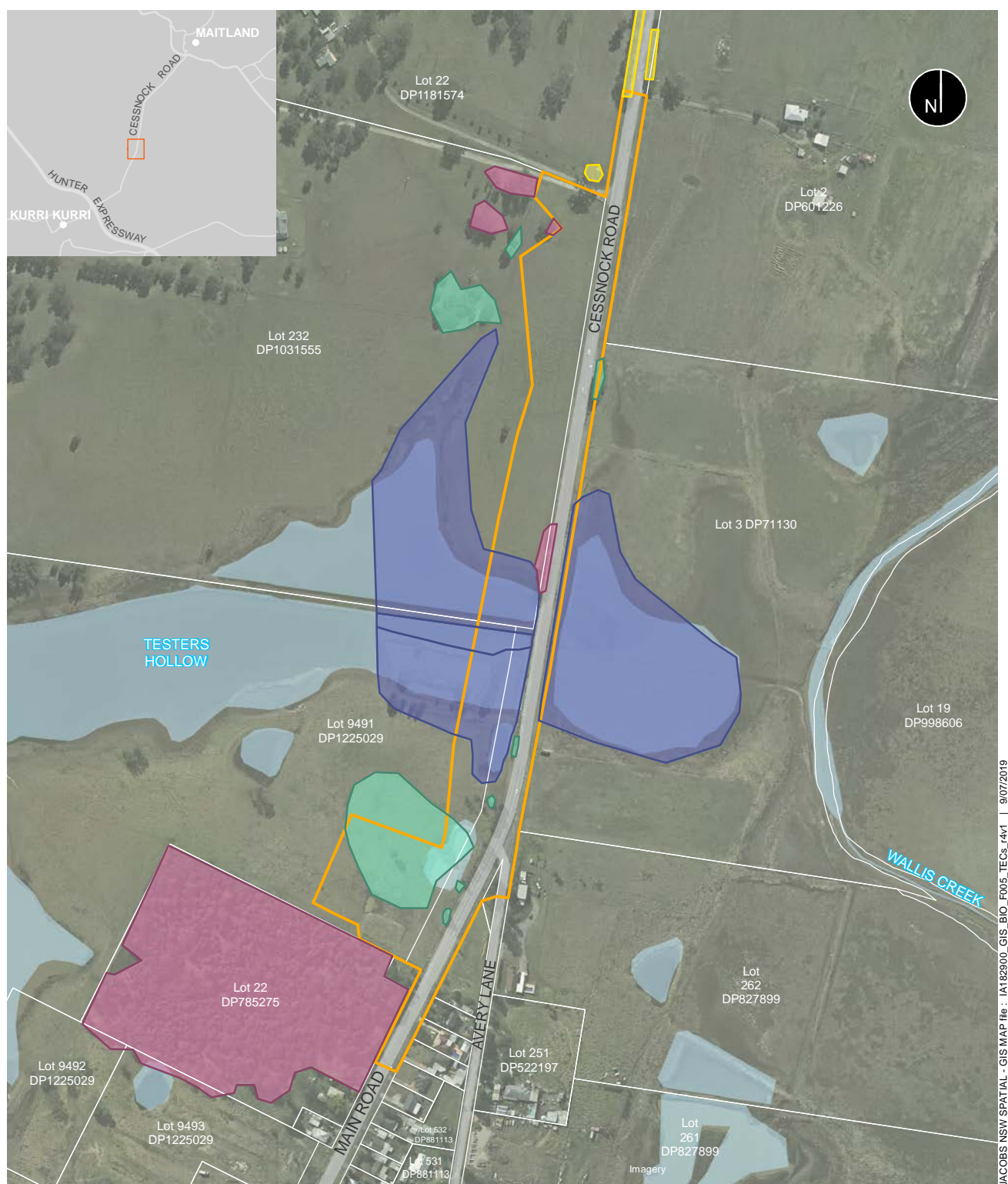


Figure 3.2 | Threatened ecological communities

All condition variants of PCT 1736 within the study area have been included in the EEC listing. This is justified by the scientific determination for this EEC which states “The composition and structure of the vegetation is also influenced by grazing history, changes to hydrology and soil salinity, catchment runoff and disturbance, and may have a substantial component of exotic grasses and forbs. Artificial wetlands created on previously dry land specifically for purposes such as sewerage treatment, stormwater management and farm production, are not regarded as part of this community, although they may provide habitat for threatened species” (OEH, 2011). Testers Hollow wetland is highly modified for agricultural purposes and little data exists regarding the original state and condition of the land within the hollow. Testers Hollow wetland may have historically been more permanently linked to Wallis Creek, however it is also possible that it has been modified to increase its water storage capacity. Considering the landscape position of the study area, it is unlikely that the modified dams and channelised third order creek in the study area were once “previously dry land” and hence come under the EEC listing.

3.2.2 Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions

Casuarina glauca occurs in varying levels of abundance and age across the study area. Historically, it is likely that *C. glauca* would have been the dominant canopy species around the fringes of the low-lying areas of the floodplain. Since the last construction of Cessnock Road, this species has regrown along the road corridor in numerous locations and around the constructed dams where there have been no land use practices to prevent it. All areas of *Casuarina glauca*, including a patch of *M. styphelioides* and *M. linariifolia*, have been mapped as Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)

The species compliment of this PCT in the study area is typical of a more disturbed Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as an endangered ecological community under the BC Act. *Casuarina glauca* is a pioneer species and has likely grown opportunistically along the road corridor and in Lot 949 DP1223319. However, the scientific determination for this TEC does not list any condition thresholds, therefore all condition variants of PCT 1728 within the study area are mapped as this BC Act listed TEC.

3.2.3 Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion

The occurrence of this TEC is in the form of isolated remnant trees and regenerating roadside vegetation. Since the last construction of Cessnock Road, vegetation has regrown back into the road corridor where there are no land use practices to prevent it. In the north of the study area this includes a very narrow strip of young trees dominated by Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) with no midstorey and limited groundcover vegetation. This vegetation is derived from the isolated and small patches of remnant trees in the cleared paddocks across the hillside. No detailed floristic analysis was undertaken within these thin patches, however they contain the canopy species diagnostic of the Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion endangered ecological community and have been mapped as a regenerating condition variant. Several large remnant trees within the north west compound site have also been assigned to this TEC as low condition.

3.2.4 Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions

The largest occurrence of this TEC is in the south west of the study area (Lot 22 DP785275). However, this vegetation was not able to be accessed during the field survey and would not be impacted by the proposal, therefore no detailed floristic surveys were undertaken. This block of woodland was only viewed from the road corridor as part of this assessment and the dominant and obvious species were noted including scattered large *E. tereticornis* and a midstorey of *C. glauca*, *M. styphelioides* and *M. sieberi*. This vegetation has been previously mapped as numerous different communities. Harper Somers O’Sullivan (2005) mapped it as a ‘Degraded variant – Melaleuca thicket’ of the Hunter Lowland Redgum Forest (MU19) as described by

LHCCREMS. The PEI (Hill Environmental 2017), mapped this vegetation as Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633), however few of the diagnostic canopy species for this PCT were observed during the field survey or have been reported by previous studies. Considering the most detailed investigation was done by Harper Somers O'Sullivan (2005) and the presence of Forest Red Gum in the canopy, this vegetation has been classified as a poor condition variant of Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598). As noted by Harper Somers O'Sullivan (2005), the presence of *Melaleuca* species is likely due to past clearing and subsequent regrowth of vegetation possibly influenced by PCT 1728. Without undertaking a detailed floristic analysis, this classification as PCT 1598 should be considered a high-level assessment.

The study area also contains large isolated trees (likely planted or natural regrowth). All these areas meet the description of Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions listed in the final determination (Threatened Species Scientific Committee, 2003)

3.3 Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of GDE (Bureau of Meteorology, 2017) and the *Risk Assessment Guidelines for Groundwater Dependiant Ecosystems* released by the NSW DPI (Kuginis *et al.*, 2012). The level of groundwater dependence for terrestrial ecosystems identified in the study area is outlined in Table 3.2.

Aquatic groundwater dependant ecosystems

Mapped aquatic GDEs in the locality are restricted to rivers and wetlands including:

- Testers Hollow – Floodplain Wetland (directly west of the study area)
- Unnamed wetland – Floodplain Wetland (about 5 kilometres south/upstream of the study area)
- Telarah Lagoon Wetland – Coastal Lagoons and Lakes (about 7 kilometres north/downstream of the study area)
- Hunter River – Watercourse (about 7.5 kilometres north/downstream of the study area).

GDEs associated with these waterbodies would consist of:

- Baseflow streams (subsurface component and surface/free-water component), and
- Groundwater dependent wetlands.

The floodplain wetland at Testers Hollow is mapped as a 'Moderate potential GDE (national assessment)'. The other three aquatic GDEs in the locality are mapped as 'High potential GDE (national assessment)' (refer to Figure 3.3). Testers Hollow wetland and the other two wetlands are likely to be facultative GDEs which are reliant on both surface water and groundwater. Testers Hollow has been historically modified to retain and channel water for agricultural purposes. It is fed directly by Wallis Creek which flows into the Hunter River (however the aquatic habitat in the study area is not considered tidal). During periods of high rainfall, the wetlands are charged by water overflowing from Wallis Creek which is able to be retained for long-periods of time. However, a review of historical imagery from the study area shows that the Testers Hollow Wetland is slightly ephemeral and appears to have lost surface water on several occasions over the last 5 years. This aquatic GDE is considered to be proportionally reliant on groundwater. The areas more reliant on groundwater (such as Telarah Lagoon) would be considered to be in the facultative-highly-dependent category.

Most of these aquatic GDEs are quite distant from the proposal. They are thus unlikely to be affected by the localised effects on groundwater likely to result from the increased width and elevation of the roadway.

Other aquatic habitats in the study area, such as the broader freshwater wetlands that are not shown by the Atlas of GDE mapping, which have only ephemeral flow and intermittent expression of surface water are unlikely to have base flow characteristics and are unlikely to be significantly dependent on groundwater. These systems would be in the facultative-opportunistic category. They are therefore unlikely to be significantly affected by the potential minor influence of the proposal on groundwater.

The proposal is immediately adjacent to Testers Hollow wetland and crosses an unnamed creek that connects the wetland. There is therefore some potential for impacts on the Testers Hollow GDE, related to altered groundwater movement patterns associated with the proposal. The proposal will directly affect lands within regularly inundated areas of the broader wetland, however not the mapped GDE itself. The proposal is unlikely to result in significant changes to surface water penetration or groundwater movement. It is therefore unlikely to significantly affect these GDEs.

Terrestrial groundwater dependant ecosystems

The only correctly mapped terrestrial GDE in the study area is Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter, which is considered to have a high potential for GDE interaction (refer Figure 3.4). The Atlas of GDEs also shows Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby open woodland in the Cessnock-Kurri Kurri Area, however this community was not confirmed in the study area during the field survey. Three other communities were identified in the study area and are listed in Table 3.2. As these communities are not mapped in the study area, their 'potential for GDE interaction' has been taken from areas mapped in the broader locality.

Two communities are however considered to have significant potential for groundwater dependence as shown in Table 3.2 The low potential GDEs would be classified either as non-dependent ecosystems or as facultative-opportunistic GDEs with only minor interaction with groundwater.

Table 3.2 Level of groundwater dependence of terrestrial ecosystems in study area

Ecosystem	Potential for GDE interaction (BoM, 2017)	Type of GDE (Kuginis <i>et al.</i> 2012)	Likely type and degree of groundwater dependence (Kuginis <i>et al.</i> 2012)
Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter	High potential GDE – from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-proportional; Likely to be dependent in part on groundwater may be modified (eg in species composition) by changes in groundwater attributes but is unlikely to be destroyed. Likely to be moderately reliant on groundwater particularly during times of water stress.
Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)	High potential GDE – from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-proportional; Likely to be dependent in part on groundwater may be modified (eg in species composition) by changes in groundwater attributes but is unlikely to be destroyed. Likely to be moderately reliant on groundwater particularly during times of water stress.
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1601)	Low potential GDE – from regional studies		Non-dependent ecosystems or possibly facultative-opportunistic May use groundwater where available during times of water stress but to be dependent chiefly on rainfall.
Forest Red Gum grassy open forest on floodplains of the	Low to high potential GDE – from		Facultative-opportunistic

Ecosystem	Potential for GDE interaction (BoM, 2017)	Type of GDE (Kuginis <i>et al.</i> 2012)	Likely type and degree of groundwater dependence (Kuginis <i>et al.</i> 2012)
lower Hunter (PCT 1598)	regional studies		Likely to use groundwater where available during times of water stress but to be dependent chiefly on rainfall.

Subterranean groundwater dependant ecosystems

There is no data on the GDE atlas for subterranean GDEs in the region. Apart from the subsurface component of the streams discussed under aquatic ecosystems, no other shallow subterranean GDEs are likely to occur in the study area. The proposal is therefore unlikely to significantly impact subterranean GDEs.

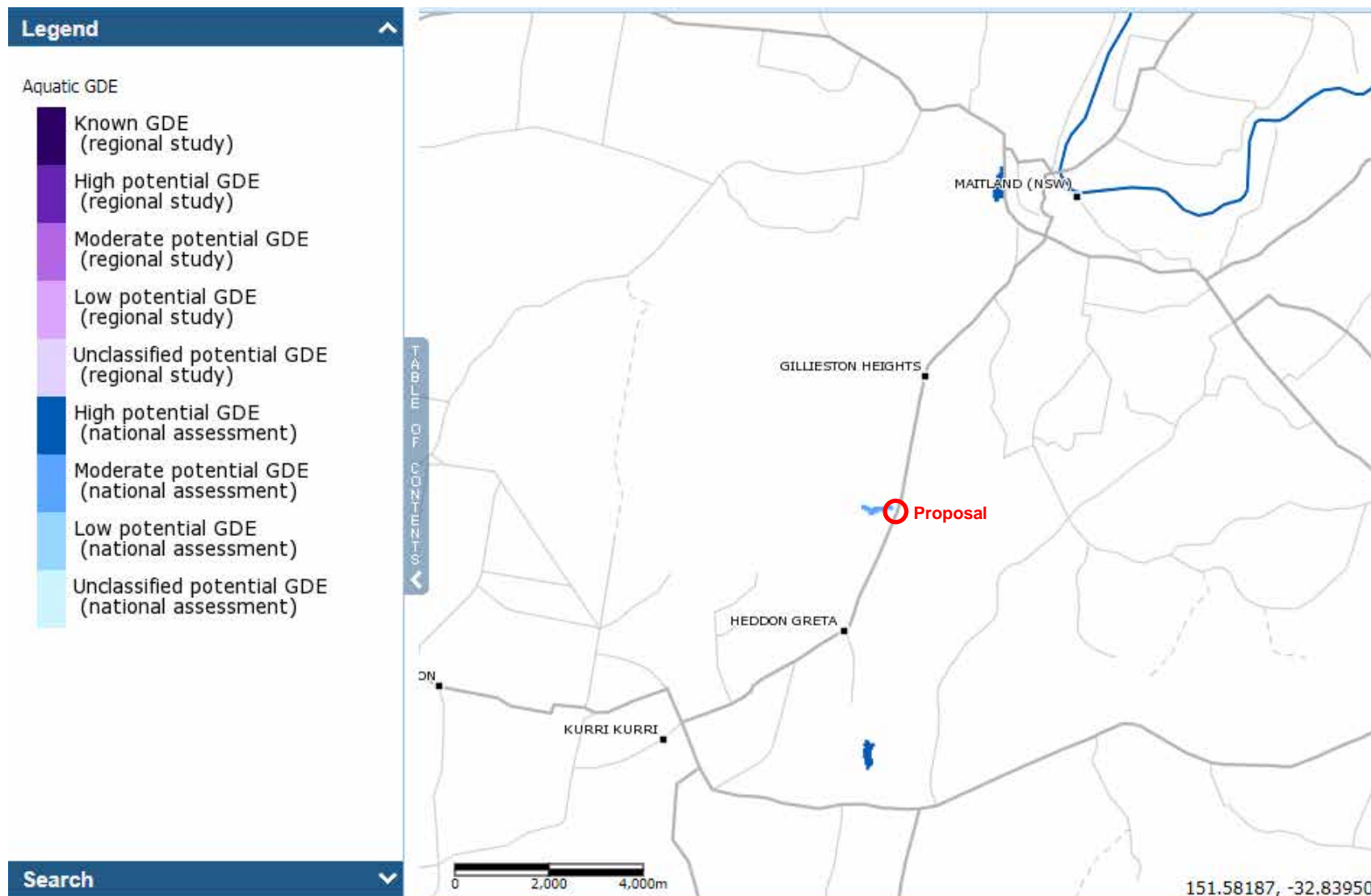


Figure 3.3 Aquatic GDEs (Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems)



Figure 3.4 Terrestrial GDEs (Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems)

3.4 Threatened species and populations

3.4.1 Threatened flora

Twenty-two threatened flora species and two endangered populations have been previously recorded or modelled as having potential to occur in the locality (see Table 3.3 and Appendix A). Many of these species favour habitats that are not represented in the study area or are only known to exist in populations restricted to specific geologies, vegetation types and localities. This list of species is shown in Table 3-3 along with an assessment of their likelihood to occur in the study area. Species identified within the study area are shown in Figure 3.5.

Table 3.3 Habitat assessment and surveys results for threatened flora species

Scientific name	Common name	BC Act	EPBC Act	Potential occurrence
<i>Acacia bynoeana</i>	Bynoe's Wattle	V	E	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Asterolasia elegans</i>		E	E	Unlikely – no suitable habitat in the study area.
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	V	E	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Callistemon linearifolius</i>	Netted Bottlebrush	-	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Cymbidium canaliculatum</i> (endangered population)		-	EP	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Dichanthium setosum</i>	Bluegrass	V	V	Low – some areas of potential habitat though no records of this species nearby.
<i>Diuris pedunculata</i>	Small Snake Orchid	E	E	Low – no suitable habitat in the study area.
<i>Eucalyptus camaldulensis</i> (endangered population)	River Red Gum population in the Hunter Catchment	-	EP	Low – Most of the smooth barked trees identified in the study area were <i>Eucalyptus tereticornis</i> . This was verified by fruits and leaves. Unlikely that seedlings in the study area are this species due to the proximity of the closest record.
<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	Low – Most of the smooth barked trees identified in the study area were <i>Eucalyptus tereticornis</i> . This was verified by fruits and leaves. Unlikely that seedlings in the study area are this species due to the proximity of the closest record.

Scientific name	Common name	BC Act	EPBC Act	Potential occurrence
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>		V	V	Present – up to 35 planted trees (juveniles < 2m high) in the construction footprint.
<i>Euphrasia arguta</i>		CE	CE	Low – suitable habitat though this species is not known from the locality.
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Low – suitable habitat though no individuals identified in the study area.
<i>Pelargonium</i> sp. <i>G.W. Carr 10345</i>	Omeo Storksbill	E	E	Unlikely – no suitable habitat in the study area.
<i>Prasophyllum</i> sp. <i>Wybong (C. Phelps ORG 5269)</i>		CE	-	Low – some areas of potential habitat though no records of this species nearby.
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Rhodamnia rubescens</i>	Scrub Turpentine	-	CE	Unlikely – no suitable habitat in the study area.
<i>Rhodomyrtus psidioides</i>	Native Guava	-	CE	Unlikely – no suitable habitat in the study area.
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Thesium australe</i>	Austral Toadflax	V	V	Low – some areas of potential habitat though no records of this species nearby.

Eucalyptus parramattensis* subsp. *decadens

The eastern portion of Lot 949 DP1223319 located in the southern section of the proposal area contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. It is unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most are surrounded by plastic tree guards. The offset for the residential subdivision in Cliftleigh required 300 individuals to be planted, and therefore there may be up to 300 individuals planted in Lot 949 DP1223319, including in areas not impacted by the proposal (Harper Somers O'Sullivan 2007) (refer to Chapter 6). Some of the trees in the study area do not have tree

guards and may be either *Eucalyptus tereticornis* or *E. amplifolia*. Species identification is difficult at the juvenile stage and some tree guards may have been washed away in previous floods. Therefore, from an impact perspective, it is assumed that all the trees are *Eucalyptus parramattensis* subsp. *decadens*. Assessments under the BC Act and EPBC Act have been undertaken and are provided in Appendix B. The removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees is unlikely to result in a significant impact to this species.

Other threatened flora

No other threatened flora species were recorded in the study area during the field survey. However, the field survey was undertaken in late autumn (May) when many of the target species (ie ground orchids) are not above ground. As such, the survey would not have recorded these species even if they were present underground. However, for species that may occur in the open grassy areas, the study area is not considered to provide suitable habitat.

Most of the species that are likely to occur in the area and have been recorded nearby grow in woodland. These species include *Callistemon linearifolius*, *Grevillea parviflora* subsp. *parviflora*, *Rutidosis heterogama* and *Tetratheca juncea*. Suitable habitat may be present for these species in Lot 22 DP785275, however this woodland was only surveyed from the road corridor as part of this assessment due to access restrictions. None of this woodland will be directly impacted as part of the proposal. The eastern edge of the woodland that can be seen from the road is highly disturbed and has a midstorey dominated by *Lantana camara*. If any of these species are present in Lot 22 DP785275 they are unlikely to be impacted by the proposal.

The study area is within part of the known distribution of *Eucalyptus glaucina*. Fifteen records of this species exist in the locality, most are 8 kilometres south west of the study area, several are three and five kilometres south west and two records 10 kilometres north west. Most of the smooth barked trees identified in the study area were *Eucalyptus tereticornis*. This was verified by fruits and leaves. Additionally, none of the mature trees are likely to be *Eucalyptus glaucina* as they were all flowering at the time of the survey and *Eucalyptus glaucina* is known to flower in November. It is possible that the juvenile *Eucalyptus* species identified on Lot 949 DP1223319 could be *Eucalyptus glaucina*, however it is unlikely, as these trees appear to be regenerating from seed produced by mature trees in the adjacent areas.

The endangered *Acacia pendula* population in the Hunter catchment is not known to occur in any of the PCTs in the study area. *Acacia pendula* was not recorded during the field surveys and as this species is relatively large and conspicuous it is considered to have a low likelihood of occurrence. The *Eucalyptus camaldulensis* population in the Hunter catchment is considered unlikely to occur in the study area. Although suitable habitat in the form of alluvial flats is present, is also relatively large and conspicuous and is likely to have been identified during the surveys. As with *Eucalyptus glaucina*, it is possible that the juvenile *Eucalyptus* species identified on Lot 949 DP1223319 could be *Eucalyptus camaldulensis*, however it is unlikely as the closest trees required to produce seed are 10km north.

3.4.2 Threatened fauna

Based on regional records and the presence of suitable habitat, 66 threatened fauna species have been identified in the locality (see Table 3.4 and Appendix A). This includes 19 mammals, 40 birds and six frogs. The study area does not contain suitable habitat for many of the species listed in Table 3.4 and Appendix A (eg no woodland, sandstone ridge tops or gullies, no wet or rainforest habitat), however habitats within the study area are of suitable quality for a number of threatened birds and microbats. No suitable habitat for threatened fish is present in the study area. Species identified within the study area are shown in Figure 3.5.

Table 3.4 Habitat assessment and surveys results for threatened fauna species

Species name	Common name	EPB C Act	BC Act	Likelihood of occurrence
Birds				
<i>Anseranas semipalmata</i>	Magpie Goose	-	V	Low – only one record within the region from 2013. Previously locally extinct, this species is an uncommon resident in the region. There is a small captive bred population that inhabits the Hunter Wetland Centre (HWC) in Shortland. This species may utilise Testers Hollow wetlands for foraging, however habitat in the study area is considered low quality for this species.
<i>Anthochaera Phrygia (Xanthomyza phrygia)</i>	Regent Honeyeater	CE	CE	Low – only three records within the last 10 years. Records are within larger contiguous vegetation.
<i>Artamus cyanopterus</i>	Dusky Woodswallow	-	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Unlikely – no suitable habitat in study area.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E	Unlikely – no suitable habitat in study area.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	-	V	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.
<i>Calyptorhynchus lathami</i>	Glossy-black Cockatoo	-	V	Low – no suitable roosting habitat and limited foraging habitat present in study area.
<i>Chthonicola sagittata (Pyrrholaemus sagittatus)</i>	Speckled Warbler	-	V	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.
<i>Circus assimilis</i>	Spotted Harrier	-	V	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	-	V	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Low – no records in the locality. Presence based on modelled habitat.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	E	Moderate – this species is a rare resident of the hunter. It may occur in the floodplain around the study area at any time though particularly after suitable rainfall.

Species name	Common name	EPB C Act	BC Act	Likelihood of occurrence
<i>Epthianura albifrons</i>	White-fronted Chat	-	V	Unlikely – no suitable habitat in the study area.
<i>Erythroriorchis radiatus</i>	Red Goshawk	V	CE	Low – no records in the locality. Presence based on modelled habitat.
<i>Falco subniger</i>	Black Falcon	-	V	Low – unlikely to occur in the study area.
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	Low – the high number of records are from larger patches of contiguous vegetation around the study area. Some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Low – no records in the locality. Presence based on modelled habitat. No mistletoes observed in the study area.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	V	Present – observed flying over the study area during the field survey. The ephemeral wetlands are unlikely to be important habitat and no nesting sites were found.
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	-	V	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Irediparra gallinacea</i>	Comb-crested Jacana	-	V	Low – not likely to use habitat in the study area.
<i>Ixobrychus flavicollis</i>	Black Bittern	-	V	Unlikely – no suitable habitat in the study area.
<i>Lathamus discolor</i>	Swift Parrot	CE	E	Moderate – although the study area is not considered high quality habitat for this species, the Red Gums were flowering the field survey and may provide winter foraging resources for individuals passing through.
<i>Limosa lapponica baueri</i>	Bar-tailed godwit (western Alaskan)	V	-	Unlikely – no suitable habitat in the study area.
<i>Limosa lapponica menzbieri</i>	Bar-tailed godwit (northern Siberian)	CE	-	Unlikely – no suitable habitat in the study area.
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.

Species name	Common name	EPB C Act	BC Act	Likelihood of occurrence
<i>Melithreptus gularis</i>	Black-chinned Honeyeater (eastern subsp.)	-	V	Low – the high number of records are predominately from vegetation SW of Kurri Kurri. Some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Neophema pulchella</i>	Turquoise Parrot	-	V	Low – records mostly old. One recent record east of the study area. May occur in woody vegetation on rare occasion.
<i>Ninox connivens</i>	Barking Owl	-	V	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.
<i>Ninox strenua</i>	Powerful Owl	-	V	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, M	-	Unlikely – no suitable habitat in the study area.
<i>Oxyura australis</i>	Blue-billed Duck	-	V	Low – suitable habitat at Testers Hollow during field survey, however habitat in the study area was lower quality. Most water birds were seen to the west of the study area around more densely vegetated areas of open water. Habitat may be more widespread for brief periods following high rainfall.
<i>Pandion cristatus</i>	Eastern Osprey	M	V	Low – no suitable habitat in the study area.
<i>Petroica boodang</i>	Scarlet Robin	-	V	Low – no suitable habitat in the study area.
<i>Petroica boodang</i>	Scarlet Robin	-	V	Low – no suitable habitat in the study area.
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	-	V	Moderate – records and suitable habitat widespread. This species has been previously recorded in the study area in 2005 on the east side of Cessnock Road (BioNet Atlas).
<i>Rostratula australis</i>	Australian Painted Snipe	E, M	E	Low – wetland habitat in the study area is not considered suitable for this species.
<i>Sternula albifrons</i>	Little Tern	M	E	Unlikely – no suitable habitat in the study area.
<i>Tyto novaehollandiae</i>	Masked Owl	-	V	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.
<i>Tyto tenebricosa</i>	Sooty Owl	-	V	Unlikely – no suitable habitat in the study area.

Species name	Common name	EPB C Act	BC Act	Likelihood of occurrence
Mammals				
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate – foraging habitat present.
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	E	V	Low – few records in locality. Species is known to traverse home ranges along creek lines. This species may pass through however there is very limited habitat features in the study area.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Micronomus norfolkensis</i>	Eastern Freetail-bat	-	V	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Miniopterus australis</i>	Little Bentwing-bat	-	V	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	-	V	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
<i>Myotis macropus (Myotis adversus)</i>	Southern Myotis	-	V	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
<i>Petauroides volans</i>	Greater Glider	V	-	Low – vegetation in study area is not considered ideal for this species.
<i>Petaurus australis</i>	Yellow-bellied Glider	-	V	Low – numerous records in the locality however there is no habitat in the study area for this species.
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	Low – numerous records in the locality however there is no habitat in the study area for this species.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	E	Low – no suitable habitat in the study area.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	-	V	Low – no suitable habitat in the study area.

Species name	Common name	EPB C Act	BC Act	Likelihood of occurrence
<i>Phascolarctos cinereus</i>	Koala	V	V	Low – only two records in the last 10 years. One from 2015 is located between Black Hill and Buttai. There may be a low density population in the locality, and a low likelihood that koalas may occur in red gums around the study area. However there is a lack of suitable habitat in the part of the study area that will be impacted.
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	Low – no suitable habitat in the study area.
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	-	Low – no suitable habitat in the study area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	High – foraging habitat widespread. Back hill camp 11km SE of the study area and a further 15 camps within 50km.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	-	V	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
Amphibians				
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	Low – this species was once present as a key population in the Gillieston Heights / East Maitland / Ravensfield area. It has not been confirmed in the Middle Hunter since 2000. The habitat in the study area does not meet all the documented attributes for this species as described by Pyke and White (1996). This species has a low potential of occurring in the study area.
<i>Litoria brevipalmata</i>	Green-thighed Frog	-	V	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Unlikely – no suitable habitat in study area. No known population nearby.

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

One threatened species, the White-bellied Sea Eagle, was observed flying over the study area around 7:30am during the field survey. The individual did not land. The ephemeral and shallow nature of the wetlands in the study area are unlikely to present high quality foraging habitat for the White-bellied Sea Eagle, however it may hunt and may perch in the trees on occasion. Although it is unknown if the wetlands contain any fish species of suitable size for foraging. No large stick nests were identified during the site survey.

Woodland habitat

Woodland vegetation in the study area provides suitable habitat for a number of woodland bird species including the Dusky Woodswallow, Varied Sittella, Black-chinned Honeyeater, Little Lorikeet and Grey-crowned Babbler. However most of these species are only likely to occur in Lot 22 DP785275 and this habitat would not be impacted by the proposal. The Grey-crowned Babbler is common in the locality and has been previously recorded in the study area in 2005 on the east side of Cessnock Road (BioNet Atlas). This species is known to utilise areas of scattered paddock trees in cleared landscapes and may utilise habitat in the study area. However, no sticks nests were observed during the field survey. The Swift Parrot is also considered to be a potential visitor to the study area in the winter. It is well known from around Kurri Kurri and may utilise flowering *Eucalyptus tereticornis* as a foraging resource. The Grey-headed Flying Fox is also highly likely to occur in the study area due to the presence of winter flowering trees and 16 known camps within 50 kilometres.

Wetland habitat

The wetland habitat in the study area provides habitat for a range of water birds and 11 different species were observed during the targeted survey. The Black-necked Stork is considered moderately likely to occur in the study area on occasion due to the presence of suitable habitat and previous sightings within Testers Hollow. Although this species is relatively uncommon in the Hunter Region compared to the North Coast Bioregion, it is known to breed in the Hunter Wetlands National Park. There is unlikely to be any suitable breeding habitat at Testers Hollow or in the study area, however this species may utilise habitat for foraging. Other aquatic species confined to areas of open water, including the Blue-billed Duck, may occur in Testers Hollow however are restricted to periods following suitable rainfall and unlikely to occur within the study area.

Insectivorous bats

The study area likely provides foraging habitat for a number of threatened insectivorous bats known to occur in the locality. An inspection of the culvert during the day did not locate any roosting bats. Most of the culvert joins, where bats are known to roost, are sealed. This was identified using a spotlight. One join at the western end is open providing limited low quality roosting habitat. A targeted survey of the culvert was undertaken around dusk using a spotlight and Anabat Express call detectors (one at each end). No bats were seen leaving the culvert or recorded by the call detectors. The culvert is considered to offer low potential for roosting. Only one hollow-bearing tree was identified in the north west compound site which may offer suitable roosting habitat for hollow roosting species. The wetland habitats were walked after dusk in an attempt to actively record foraging bats. No bats were seen or recorded during this time, however the wetland and woodland habitats in the study area are likely to provide foraging habitat for threatened insectivorous bats including Eastern Bentwing-bat, Eastern Cave Bat, Large-eared Pied Bat, Little Bentwing-bat, Southern Myotis, Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat.



Photo 1. Western end of culvert with an Anabat Express positioned over the entrance (left). The culvert joins are mostly sealed (middle), except for one at the western end which provides possible low quality roosting habitat (right).

Green and Golden Bell Frog (*Litoria aurea*)

The study area is close to a recorded key population of the Green and Golden Bell Frog at Gillieston Heights / East Maitland / Ravensfield. This population was discovered in 1995 in a pond associated with an abandoned quarry on private rural land. However, since excavation of the pond, creekline and riparian vegetation in 2001/02, no frogs have been recorded in this location. There were also sightings of this species in ponds around the fringes of Wentworth Swamp in Ravensworth. The Green and Golden Bell Frog has not been recorded at these locations or anywhere else in the Middle Hunter since 2000. The Green and Golden Bell Frog Key Population in the Middle Hunter Management Plan (DECC 2007) recognises that although the species has not been confirmed in the Middle Hunter, the somewhat transient nature of appearance and disappearance of the species at other sites and the unconfirmed observation at the newly rehabilitated Tenambit Wetland at East Maitland may mean that population still exists.

Within the study area, a habitat assessment was undertaken for the Green and Golden Bell frog using habitat requirements for this species documented by White and Pyke (1996). Table 3.5 shows an assessment of three different habitat types in the study area: constructed dams, unnamed creek and flooded pasture/wetland. Each of these habitat types are compared against the White and Pyke (1996b) habitat requirements. The habitat assessment in Table 3.5 shows that potential habitat in the study area is considered low quality when compared against the known habitat characteristics for this species. Considering this species has not been recorded in the Middle Hunter since 2000, it is unlikely to remain in the habitat within the study area and is not assessed further.

Table 3.5 Green and Golden Bell Frog habitat analysis

Critical habitat feature (from White and Pyke 1996)	Presence within habitat type recorded within the study area		
	Dams	Unnamed creek	Flooded pasture/wetland
Ephemeral or fluctuating water level, with still or slow moving water	No. Water appears stagnant. Apart from infrequent inundation.	Yes, ephemeral and infrequent inundation.	Yes, ephemeral and infrequent inundation.

Critical habitat feature (from White and Pyke 1996)	Presence within habitat type recorded within the study area		
	Dams	Unnamed creek	Flooded pasture/wetland
No visible signs/sources of water pollution	None obvious.	None obvious.	None obvious.
Absence of shaded cover	Swamp Oak around dam edges.	Swamp Oak on south side of drain.	No shaded cover.
Absence of predatory fish (in particular <i>Gambusia</i> sp.)	Gambusia present.	None observed but likely present after flooding.	None observed but likely present after flooding.
Pond substrate is sand or rock	Unknown, likely muddy.	No, substrate muddy.	No, substrate muddy.
Presence of emergent aquatic vegetation or rocks for diurnal shelter	Only one dam has <i>Typha orientalis</i> around fringes.	Low abundance of sedges growing in centre of drain.	None.
Adjacent to grassy area	Yes.	Yes	Yes
Adjacent vegetation is no higher than woodland	Swamp Oak around dam edges.	Swamp Oak on south side of drain.	Some large trees close.

3.5 Fauna species richness

The study area is considered to have moderate fauna species richness, mostly to do with avifauna utilising the aquatic habitats. A total of 27 fauna species were recorded during field survey, comprising 26 birds and one terrestrial mammal (Eastern Grey Kangaroo). One threatened fauna species, White-bellied Sea Eagle, was recorded in the study area, as discussed in Section 3.4.

3.6 Aquatic surface water ecosystems and fish habitat

The study area is situated within the floodplain that connects Testers Hollow wetland west of the study area, to Wallis Creek to the east. The arm of Wallis Creek near the study area is a fifth order stream (Strahler) that flows north for about 5.5 kilometres where it turns into a sixth order stream and then eventually meets the Hunter River (ninth order stream) a further 3.5 kilometres north east. Testers Hollow is connected to Wallis Creek by a constructed unnamed third order stream that flows under Cessnock Road through the study area. It is noted the unnamed creek only flows during periods of high rainfall. Due to the slightly raised pasture land on the western bank of Wallis Creek, water is trapped in Testers Hollow and the unnamed creek most of the year.

The aquatic habitat in the study area comprises of the constructed unnamed third order stream, artificial agricultural ponds and the surrounding inundation area of the floodplain. An assessment of the fish habitat value of these areas, based on the modelled habitat of threatened fish, field observation and aerial photograph interpretation is provided below. The assessment has also considered the *Policy and Guidelines for fish habitat conservation and Management* (Department of Primary Industries 2013) and the current indicative distribution of the threatened

Southern Purple Spotted Gudgeon in NSW, modelled from past catchment data and environmental conditions as provided by the Department of Primary Industries (2017).

The only Key Fish Habitat mapped by DPI in and around the study area includes Wallis Creek and the floodplain wetland on the eastern side of Cessnock Road (refer Figure 3.6). Wallis Creek is about 10 metres wide and had murky brown water flowing slowly on the date of the field survey. The banks of the creek are dominated by Couch grass (*Cynodon dactylon*) with occasional occurrences of native sedges (*Juncus* sp.) and mid-stream macrophytes (*Triglochin* sp.).

The ephemeral drainage line has been dammed for agriculture by raised areas for vehicle/cattle crossing and fencing. Wallis Creek is mapped as indicative habitat for the Purple Spotted Gudgeon, which is listed as a threatened species under the FM Act. Therefore, Wallis Creek is considered to be 'Type 1 – Highly sensitive key fish habitat' and 'Class 1 – Major key fish habitat'. As the floodplain wetland on the east side of the road is highly degraded from agricultural practices and is likely only inundated for short periods following rainfall, it is not considered habitat for the Purple Spotted Gudgeon. Therefore, it has been classed as 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat'.



Plate 1. Wallis Creek showing impacts of grazing



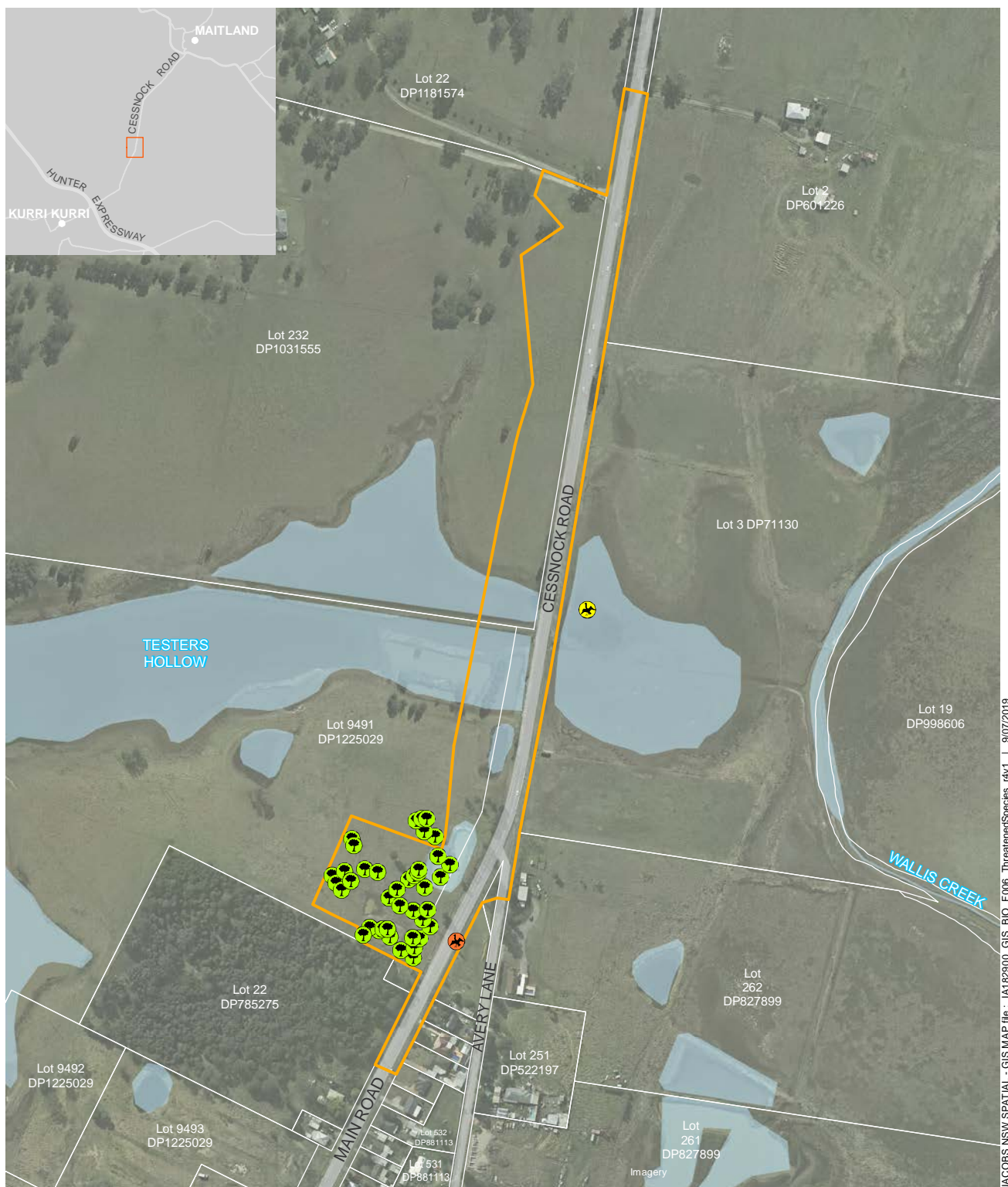
Plate 2. Floodplain wetland between Cessnock Road and Wallis Creek

As can be seen in Figure 3.6, the Key Fish Habitat is somewhat indicative as it covers areas currently occupied by Cessnock Road. Higher quality aquatic areas on the western side of the road (eg Testers Hollow) are also likely to provide suitable fish habitat characteristics, particularly during periods of high rainfall when the entire floodplain is inundated. Testers Hollow is a natural wetland/billabong that has been historically modified to retain and channel water for agricultural purposes. During periods of high rainfall, the wetlands are charged by water overflowing from Wallis Creek which is able to be retained for long-periods of time. However, a review of historical imagery from the study area shows that the Testers Hollow Wetland is slightly ephemeral and appears to have lost surface water in shallow areas on several occasions over

the last 5 years. Using the criteria in *Policy and Guidelines for fish habitat conservation and Management* (Department of Primary Industries 2013), Testers Hollow wetland and the constructed drain that connects it to Wallis Creek are also considered 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat'. The constructed agricultural ponds on the western side of Cessnock Road are not classed as key fish habitat.



Plate 3. Testers Hollow Wetland (left) and the constructed drain (right)



Legend

- Proposal area
- Waterbody

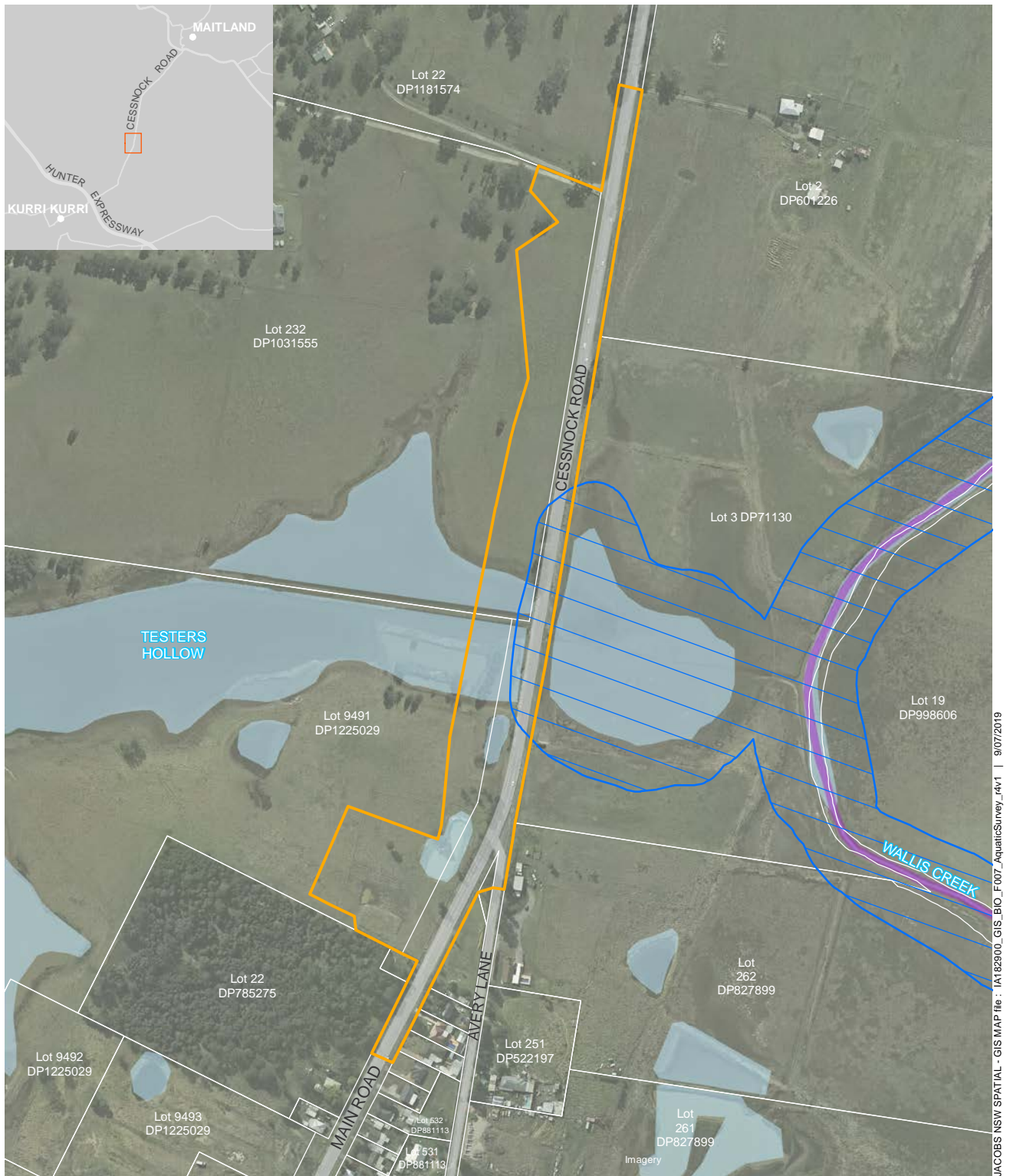
Recorded threatened species

- *Eucalyptus parramattensis* subsp. *decedens*
- White-bellied Sea Eagle

Recorded threatened species (BioNet Atlas 2018)

- Grey-crowned Babbler (eastern subspecies)

Figure 3.5 | BioNet Atlas search and surveyed threatened species recorded in the study area



JACOBS NSW SPATIAL - GIS MAP file : I\162900_GIS_BIO_F007_AquaticSurvey_rdw1 | 9/07/2019

Legend

- Proposal area
- Key Fish Habitat (DPI 2016)
- Waterbody
- Southern Purple Spotted Gudgeon indicative habitat

0 100 200 m
1:5,000 @ A4



Figure 3.6 | Aquatic survey results

3.7 Wildlife connectivity corridors

The habitats within the study area are heavily fragmented and exist as mosaic of planted, remnant and regrowth vegetation and floodplain wetlands highly modified by a history of agricultural activities. There has been little connectivity through the study area by way of vegetated corridors for long period of time. The greatest area of remaining east-west connectivity is via the wetlands and constructed drain that connects Testers Hollow with Wallis Creek. Most of the time the wetlands in the study area are dry and not connected by open water with Wallis Creek. This means that aquatic habitat is generally confined to Testers Hollow wetlands, the drain and artificial ponds on the west side of the road. However, the drain and culvert do facilitate connection across the road, particularly for aquatic species after sufficient rainfall. The upgrade to the road and culvert will remove a small area of wetland habitat however the new culvert will be larger and should improve this connectivity.

3.8 State Environmental Planning Policies (SEPPs)

State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection does not apply to proposals that are being assessed under Part 5 of the EP&A Act. However, the Koala (*Phascolarctos cinereus*) is listed as vulnerable under the Commonwealth EPBC Act and in NSW under the BC Act and so its potential to occur has been assessed.

Seven records of Koala were identified during database searches within a 10 kilometre radius of the study area. The study area is located within Cessnock LGA, which is included in the list of recognised LGAs on Schedule 1 of SEPP 44. Two recognised food trees (Schedule 2, SEPP 44), *Eucalyptus tereticornis* and *E. robusta*, for this species occurred within the study area. These trees mostly occur as isolated and regrowth trees. The two *E. robusta* are likely to be planted. No evidence of Koala was recorded within the study area during the site inspection.

The landscape has been subject to a history of clearing for agricultural purposes and as a result vegetation is heavily fragmented. Large patches of contiguous vegetation exist to the west of Kurri Kurri. As such, the habitat within the study area is not considered to form core or potential Koala habitat.

3.9 Matters of National Environmental Significance

3.9.1 Threatened ecological communities

The vegetation in the study area does not meet condition thresholds required for the Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales ecological community.

Portions of the native vegetation in the study area meet some of the key diagnostic characteristics of the Coastal Swamp Oak (*Casuarina glauca*) Forest ecological community which is listed as endangered under the EPBC Act. The key diagnostic characteristics are the main features of the Coastal Swamp Oak (*Casuarina glauca*) Forest ecological community as identified by the Threatened Species Scientific Committee (2018). Condition thresholds also apply to the Coastal Swamp Oak (*Casuarina glauca*) Forest ecological community. In order to be considered a Matter of National Environmental Significance under the EPBC Act, areas of the ecological community must meet:

- The key diagnostic characteristics
- At least the minimum condition thresholds for Moderate quality (ie for class C or D as outlined below in Table 3.6).

Table 3.6 Condition thresholds

Category and rationale	Patch size thresholds	Biotic thresholds
A. High condition class		
A1. A <u>large patch</u> that meets key diagnostics and has <u>excellent quality</u> native understorey.	The patch is at least 2 ha.	Non-native species comprise less than 20% of total understorey vegetation cover*
A2. A <u>small patch</u> that meets key diagnostics and has <u>excellent quality</u> native understorey and is <u>contiguous</u> with another area of native vegetation***.	The patch is at least 0.5 ha within a larger patch of native vegetation of at least 2 ha.	
B. Good condition class		
B1. A <u>large patch</u> that meets key diagnostics and has <u>good quality</u> native understorey.	The patch is at least 1 ha.	Non-native species comprise less than 50% of total understorey vegetation cover* AND Transformer species** comprise less than 30% of total understorey vegetation cover.
B2. A <u>small patch</u> that meets key diagnostics and has <u>good quality</u> native understorey and is <u>contiguous</u> with another area of native vegetation***.	The patch is at least 0.5 ha within a larger patch of native vegetation of at least 2 ha.	
C. Moderate condition class		
C1. A <u>large patch</u> which meets key diagnostics and has <u>moderate quality</u> native understorey.	The patch is at least 5 ha.	Non-native species comprise less than 80% of total understorey vegetation cover* AND Transformer species** comprise less than 50% of total understorey vegetation cover.
C2. A <u>small patch</u> that meets key diagnostics and has <u>moderate quality</u> native understorey and is <u>contiguous</u> with another area of native vegetation***.	The patch is at least 1 ha within a larger patch of native vegetation of at least 5 ha.	
<p>* Refers to total perennial understorey vegetation cover for the patch. Includes vascular plant species of both the ground layer and the shrub layer (where present) with a life-cycle of more than two growing seasons. It includes herbs (graminoids and forbs), grasses, shrubs and juvenile canopy species, but does not include annuals, cryptogams, leaf litter or exposed soil.</p> <p>** Transformer species (eg <i>Chrysanthemoides monilifera</i>, <i>Asparagus</i> spp, <i>Pennisetum</i> spp, <i>Ipomea</i> spp etc) may change the character, condition, form or nature of patches of the ecological community. See page 13 (TSSC 2018) for further information on weeds, including transformer species.</p> <p>*** Contiguous means the patch is connected to or in close proximity (within 100 m) to another area of native vegetation.</p>		

The Threatened Species Scientific Committee uses the term 'patch' to describe any discrete remnant/area of the ecological community. A break between two or more patches is defined by a canopy gap (or gap between seedling regeneration at the edge of a canopy) of 30 metres or more.

An assessment of the patch size of PCT 1728 in the study area is shown in Table 3.7. One of these patches meets the patch size threshold to qualify for the good condition class as it is greater than 0.5 hectares and contiguous (ie within 100 metres) with the extent of PCT 1736

(includes Testers Hollow wetland) which is larger than 2 hectares. This patch includes the area of regenerating PCT 1728 in Lot 949 DP1223319, as well as other isolated regrowth patches within cleared agricultural land. Groundcover in these areas is dominated by exotic species which make up over 50%. Therefore, the patches of PCT 1728 in the study area do not meet the condition thresholds for this EPBC Act ecological community.

Table 3.7 Patch size assessment of Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)

Patch size (ha)	Within 100 m of another patch	Total patch size (ha)
0.569	Yes	0.60
0.007		
0.005		
0.007		
0.005		
0.194	Yes	0.21
0.018		
0.023	No	0.02

3.9.2 Threatened species

No threatened species listed under the EPBC Act were recorded in the study area during the field survey. Three fauna species are considered to have a moderate to high likelihood of occurring based on the presence of suitable habitat including:

- Swift Parrot
- Grey-headed Flying Fox
- Large-eared Pied Bat.

The presence of winter flowering Eucalypt trees offers suitable habitat for the Swift Parrot and Grey-headed Flying Fox. The Swift Parrot is considered to be a potential visitor to the study area in the winter. It is well known from around the Kurri Kurri and Cessnock Area. The Grey-headed Flying Fox is also highly likely to occur in the study area due to the presence of 16 known camps within 50 kilometres.

The study area also likely provides foraging habitat for the Large-eared Pied Bat. An inspection of the culvert during the day did not locate any roosting bats. Most of the culvert joins, where bats are known to roost, are sealed. This was identified using a spotlight. One join at the western end is open providing limited low quality roosting habitat. A targeted survey of the culvert was undertaken around dusk using a spotlight and Anabat Express call detectors (one at each end). No bats were seen leaving the culvert or recorded by the call detectors. The culvert is considered to offer low potential for roosting.

Koala was recorded within a 10 kilometre radius of the study area under the EPBC Act, Protected Matters Search Tool. As such, an assessment of the habitat for this species within the study area has been undertaken using the habitat assessment tool in the EPBC Act referral guidelines for the vulnerable Koala (2014) and is shown in Table 3.8. Two recognised feed trees for Koala, *Eucalyptus tereticornis* and *E. robusta*, were identified within the study area.

The White-throated Needletail may potentially fly over the study area on occasion during seasonal migration, however this species is considered unlikely to utilise the habitat within the study area.

Table 3.8 Results of the koala habitat assessment tool for habitat within the study area

Attribute	Score and criteria (inland <800mm rainfall)	Koala habitat to be impacted
		<i>Eucalyptus tereticornis</i> (Forest Redgum) – two isolated, mature specimens, within the study area
Koala occurrence	<p>+2 (high) = Evidence of one or more koalas within the last 5 years.</p> <p>+1 (medium) = Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years</p> <p>0 (low) = None of the above.</p>	<p>2 (high)</p> <p>7 records identified within a 10km radius of the study area (BioNet Atlas search, April 2018). Of these, 1 was recorded in the last 5 years. One record exists within 2km of the study area from 2004. No evidence of Koalas was identified within the study area during the site inspection.</p>
Vegetation composition	<p>+2 (high) = Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species,</p> <p><u>OR</u></p> <p>1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.</p> <p>+1 (medium) = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.</p> <p>0 (low) = None of the above.</p>	<p>0 (low)</p> <p>Two recognised feed trees, occurring as isolated, mature regrowth or planted specimens within the study area.</p>
Habitat connectivity	<p>+2 (high) = Area is part of a contiguous landscape \geq 1000 ha.</p> <p>+1 (medium) = Area is part of a contiguous landscape < 1000 ha, but \geq 500 ha.</p> <p>0 (low) = None of the above.</p>	<p>0 (low)</p> <p>Habitat with the study area is restricted to several isolated specimens of two recognised feed tree species.</p>
Key existing threats	<p>+2 (high) = Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence,</p> <p><u>OR</u></p> <p>Areas which score 0 for koala occurrence and have no dog or vehicle threat present.</p> <p>+1 (medium) = Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence,</p> <p><u>OR</u></p> <p>Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.</p> <p>0 (low) = Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present,</p> <p><u>OR</u></p> <p>Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.</p>	<p>2 (high)</p> <p>None of the records from the locality refer to identification of dead individuals. Three of the observations are in the same location within a week and were the result of a dog disturbing an individual.</p>

Attribute	Score and criteria (inland <800mm rainfall)	Koala habitat to be impacted
		<i>Eucalyptus tereticornis</i> (Forest Redgum) – two isolated, mature specimens, within the study area
Recovery value	<p>+2 (high) = Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.</p> <p>+1 (medium) = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.</p> <p>0 (low) = Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.</p>	<p>0 (low)</p> <p>Considering the study area is restricted to several isolated specimens of two recognised feed trees within a fragmented agricultural landscape, and that no evidence of Koalas was recorded within the study area during the site inspection, the identified habitat is considered unlikely to be important for achieving the interim recovery objectives for this local population/s.</p>
TOTAL		4 = not critical habitat

Based on the EPBC assessment for the Koala in Table 3.8 and the EPBC referral guidelines for this species (2014), the study area is not considered to comprise critical habitat for Koala.

3.9.3 Migratory and marine species

One White-bellied Sea Eagle (*Haliaeetus leucogaster*), was recorded flying over the study area during the survey. The study area provides potential foraging and perching habitat for this species. This species did not alight in the study area. White-bellied Sea Eagle is listed as a marine species under the EPBC Act, however it is not listed as migratory or threatened and as such, does not require an assessment of significance under this Act.

The Fork-tailed Swift may potentially fly over the study area on occasion during seasonal migration, however this species is considered unlikely to utilise the habitat within the study area. Several wetland species are considered moderately likely to occur after suitable rainfall including Latham's Snipe, Little Curlew and Marsh Sandpiper. These species are only considered likely to occur around Testers Hollow wetland and are unlikely to be impacted by the proposal.

The full list of species considered in this assessment is provided in Appendix A.

4 Impact assessment

4.1 Construction impacts

4.1.1 Removal of native vegetation

The potential loss of vegetation associated with the proposal has been quantified by calculating the area of vegetation communities in the proposal area. The potential loss of vegetation associated with the proposal is summarised in Table 4.1. The proposal would potentially impact on up to about 1.56 hectares of native vegetation and 0.01 hectares of planted exotic/non-indigenous vegetation (see Table 4.1).

Table 4.1 Impacts on native vegetation

Plant community type (PCT)	Condition	Status		Proposal area ¹ (hectares)	Percent cleared in bioregion ²
		BC Act	EPBC Act		
Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter (PCT 1736)	Moderate / good	Freshwater Wetlands on Coastal Floodplains (endangered)	-	0.09	80 %
	Poor			0.82	
Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728)	Regen.	Swamp oak floodplain forest (endangered).	Does not meet condition thresholds	0.52	No value provided in BioNet
	Poor			0.04	
Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter (PCT 1601)	Poor	Lower Hunter Spotted Gum - Ironbark Forest (endangered)	-	<0.01	76 %
Forest Red Gum grassy open forest on floodplains of the lower Hunter (PCT 1598)	Poor	Hunter Lowland Redgum Forest (endangered)	-	0.06	No value provided in BioNet
Native regrowth / seed mix	-	-	-	0.02	-
Total				1.56	

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

2- Based on the BioNet Vegetation Classification database.

4.1.2 Removal of threatened fauna habitat

The extent of vegetation clearing estimated to result from the proposal is outlined above in Section 4.1.1. This vegetation provides potential habitat for 15 threatened fauna species listed under the BC Act which are listed in Table 4.2.

The White-bellied Sea Eagle was the only threatened species identified within the study area during surveys. It was observed flying over the study area in the direction of the Hunter River. No nest was observed in the study area. This species is likely to breed in larger and less disturbed patches of vegetation to the west of the study area (eg Cessnock State Forest, Lower Hunter National Park and Part State Forest).

The vegetation to be impacted also provides some potential habitat for many other threatened fauna species. These are all highly mobile species including birds and bats (see Table 4.2). Habitat that would be impacted by the proposal is generally limited to foraging habitat due to its

disturbed nature. *Eucalyptus tereticornis* and *Corymbia maculata* would offer an important winter flowering resource for nectarivorous species such as the Grey-headed Flying Fox and Swift Parrot. Vegetation may also provide foraging habitat for the Grey-crowned Babbler and numerous cave roosting and hollow-roosting insectivorous bats. No hollow-bearing trees are expected to be impacted by the proposal, however the existing culvert under Cessnock Road will be replaced which may offer some suitable roosting habitat for several insectivorous bat species that are known to roost in artificial structures. All of the existing culvert joins are sealed except for one at the western end which may offer a shallow roost site, however this is not considered to be an important (maternity) roost for any of these species.

The predicted impacts to habitat for threatened species are outlined in Table 4.2. All vegetation to be impacted is considered potential foraging habitat for most of these threatened species. Areas of cleared/pasture have also been included in the impact calculation for insectivorous bats as they offer suitable foraging habitat, especially during periods of inundation.

Table 4.2 Impacts on threatened fauna and fauna habitat

Species	Potential occurrence	Impacted by proposal?	Impact
Eastern Bentwing-bat	Moderate - foraging habitat for these species is widespread in and around the study area. Culvert has limited roosting opportunities.	Yes	Removal of 1.56 hectares of potential foraging habitat and one low quality temporary roost site.
Eastern Cave Bat			
Large-eared Pied Bat			
Little Bentwing-bat			
Southern Myotis			
Eastern False Pipistrelle	Moderate - foraging habitat for these species is widespread in and around the study area Roosting habitat limited.	Yes	Removal of 1.56 hectares of potential foraging habitat. No expected impact to roosting habitat.
Eastern Freetail-bat			
Greater Broad-nosed Bat			
Yellow-bellied Sheath-tail-bat			
Grey-headed Flying Fox	High - foraging habitat widespread. Back Hill camp 11km SE of the study area and a further 15 camps within 50km.	Yes	Removal of 0.59 hectares of potential foraging habitat. No expected impact to roosting habitat.
Grey-crowned Babbler	All woody vegetation in the study area presents suitable foraging and perching habitat.	Yes	Removal of 0.59 hectares of foraging habitat. No nesting/breeding habitat likely to be impacted by the proposal.
Swift Parrot	<i>Eucalyptus tereticornis</i> and <i>Corymbia maculata</i> are winter flowering and offer suitable foraging habitat for migrating individuals.	Yes	Removal of 0.64 hectares of potential foraging resources. No nesting/breeding habitat likely to be impacted by the proposal.
White-bellied Sea Eagle	This species was observed flying over the study area during survey but did not land. It may hunt and perch in the study area on occasion however the ephemeral wetlands are unlikely to be an important resource.	Yes	Removal of 1.52 hectares of potential foraging habitat. No nesting/breeding habitat likely to be impacted by the proposal.

Species	Potential occurrence	Impacted by proposal?	Impact
Black-necked Stork	Moderate – this species is a rare resident of the Hunter Region. It may occur in the floodplain around the study area at any time though particularly after suitable rainfall.	Yes	Removal of 0.91 hectares of habitat potentially used for temporary refuge or transient birds moving through the region. No nesting/breeding habitat likely to be impacted by the proposal.
Purple Spotted Gudgeon	Moderate – Wallis Creek is mapped by DPI as indicative habitat for this species. It may spread into Testers Hollow wetland during periods of high rainfall and inundation. The study area does not contain high quality habitat for this species.	Yes	Removal of 0.09 hectares of potential aquatic habitat (moderate/good freshwater wetlands) for this species. Not recorded

4.1.3 Removal of threatened flora

The eastern portion of Lot 949 DP1223319 contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. It is unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most contain plastic tree guards. There may be up to 300 planted *Eucalyptus parramattensis* subsp. *decadens* field being impacted by the proposal (Harper Somers O'Sullivan 2007). Some of the trees do not have tree guards and may be either *Eucalyptus tereticornis* or *E. amplifolia*. However, identification is difficult at the juvenile stage and some tree guards may have been washed away in floods. Therefore, from an impact perspective, it is assumed that all the trees are *Eucalyptus parramattensis* subsp. *decadens*. Assessments under the BC Act and EPBC Act have been undertaken and are provided in Appendix B. The removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees is unlikely to result in a significant impact to this species. Impacts to threatened flora are summarised in Table 4.3.

Table 4.3 Impacts on threatened flora (planted individuals only)

Threatened species	Ecosystem or species credit species	Status		Habitat or individuals to be impacted	Habitat or individuals in the study area
		BC Act	EPBC Act		
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Species	V	-	The proposal will result in the removal of 35 planted trees.	Up to 300 planted trees may have been planted as part of a residential subdivision in Lot 949 DP1223319.

4.1.4 Aquatic impacts

The proposal may result in the temporary modification of aquatic habitat along the unnamed creek adjoining Wallis Creek and Testers Hollow wetland. In-stream impacts are considered likely in the unnamed creek and surrounding floodplain during the proposed construction works.

The habitat sensitivity and classification of the waterway for fish passage has been characterised in accordance with NSW DPI (Fisheries) document Policy and Guidelines for fish habitat conservation and management (2013 update). As such, the unnamed creek and surrounding floodplain is considered to form 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat' (see Plates 1 to 3).

The only Key Fish Habitat mapped by DPI in and around the study area includes Wallis Creek and the floodplain wetland on the eastern side of Cessnock Road (refer Figure 3.6). Wallis Creek is about 10 metres wide and has murky brown water flowing slowly on the date of the field survey. The banks of the creek are dominated by *Cynodon dactylon* with occasional occurrences of native sedges (*Juncus* sp.) and mid-stream macrophytes (*Triglochin* sp.). The creek has been modified for agriculture by raised areas for vehicle/cattle crossing and fencing. Wallis Creek is mapped as indicative habitat for the Purple Spotted Gudgeon, which is listed as a threatened species under the FM Act. Therefore, Wallis Creek is considered to be 'Type 1 – Highly sensitive key fish habitat' and 'Class 1 – Major key fish habitat'. As the floodplain wetland on the east side of the road is highly degraded from agricultural practices and is likely only inundated for short periods following rainfall, it is not considered habitat for the Purple Spotted Gudgeon. Therefore, it has been classed as 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat'.

Construction activities such as removal and installation of culverts, widening of the road and installation of coffer dams are likely to impact the instream environment.

In accordance with the policy and guidelines for fish habitat conservation and management (DPI 2013) a permit is required for all works that may obstruct the free passage of fish whether permanently or temporarily in Type 1-3 habitats. Based on the above proposed activities during the proposal it is considered that the proposal may temporarily create a barrier to fish passage. Consultation with NSW DPI has confirmed that a fisheries permit under the *Fisheries Management Act 1994* is not required.

One threatened fish species listed as endangered under the FM Act, the Southern Purple Spotted Gudgeon (*Mogurnda adspersa*), has been mapped as having indicative habitat in Wallis Creek, approximately 200 metres east of the study area. During periods of high rainfall, Wallis Creek overflows and much of the study area can become inundated during which time Purple Spotted Gudgeon may be transported into Testers Hollow wetland. As such there may be individuals of this species currently inhabiting Testers Hollow wetland. Habitat in the study area is generally unsuitable for this species outside of these periods of inundation, particularly the artificial ponds on the western side of Cessnock Road which are stagnant and have little vegetation or refuge. An Assessment of Significance (7-part test) has been completed for the Purple Spotted Gudgeon (see Appendix B) in accordance with Section 220ZZ of the FM Act and the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007). Considering the likely marginal impact of the proposal on aquatic habitat and the extent of higher quality habitat in the locality, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to the Purple Spotted Gudgeon.

The potential impacts of the proposal on aquatic habitats are discussed in Table 4.4 below. Through this analysis it has been concluded that significant impacts to aquatic ecosystems are unlikely to occur as a result of the proposal.

Table 4.4 Potential impacts of the proposal on aquatic habitats

Potential impacts of activities in aquatic habitats	Impact of proposal
Activation of acid sulfate soils and associated acid metal pollution of water	<p>Construction activities such as excavation and land clearing pose a risk to water quality when the activity is carried out in areas of actual or potential acid sulfate soils (ASS). Disturbance and exposure of ASS to oxygen from construction activities could generate sulphuric acid and toxic quantities of aluminium and other heavy metals that could be readily released into the surrounding environment, polluting nearby surface waters and potentially resulting in a loss of aquatic flora and fauna.</p> <p>The PEI (Hills Environmental 2017) identifies much of the low lying areas around the unnamed creek between Wallis Creek and Testers Hollow as being high risk for containing acid sulfate soils (ASS) on the premise that ASS occurs predominantly on coastal lowlands, with elevations generally below five metres. However, ASS has not been mapped as likely to be present in the substrates associated with the study area (OEH 2018). Construction activities may expose ASS, however suitable controls will be incorporated as part of the Acid Sulfate Materials Management Plan for the proposal (refer to proposal REF).</p>
Changed hydrology; flow velocity, depth, turbulence, flooding regime	<p>The proposal is likely to result in some temporary changes to factors including flow velocity and turbulence. The extent of these changes would be controlled through design measures and construction environmental management and are likely to be temporary during the construction phase of the proposal. The changes associated with the proposal are only likely to occur during periods when the unnamed stream is flowing and given their temporary nature are considered unlikely to significantly impact the hydrology of the stream.</p>
Loss of aquatic habitat	<p>The proposal would result in the loss and modification of aquatic habitat during the construction of the new road and culvert. This small loss and modification of habitat is unlikely to significantly impact the aquatic ecosystems of the Testers Hollow wetland and Wallis Creek floodplain environment.</p>
Obstruction to fish passage	<p>The proposed activities likely to impact the instream environment include installation of new culverts on the new section of Cessnock Road. However the unnamed stream only flows during periods of high rainfall. Obstruction to fish passage during construction is only likely to be temporary, and limited to the area between Testers Hollow and the small ponded area of wetland on the eastern side of Cessnock Road.</p> <p>Based on the above proposed activities it is considered that the proposal may temporarily create a barrier to fish passage along the unnamed stream during construction works.</p>
Potential impacts of tannins entering waterways from mulch	<p>Any riparian revegetation activities will exclude the mulching of areas likely to be inundated and use alternative materials for soil stabilisation such as rocks and erosion matting. As such, the risk of substantial tannin pollution of the streams is considered to be low.</p>

Potential impacts of activities in aquatic habitats	Impact of proposal
Temporary displacement of fauna	The proposal will result in the modification of a small area of habitat during the construction of the new culverts. The displacement of any fauna (eg water fowl) is likely to be temporary during the construction works. The time-lag between construction and the completion of aquatic habitat restoration in these areas is unlikely to be significant so as to permanently displace any fauna.
Turbidity and sedimentation	Proposal construction activities could result in sediment entering the streams. With the installation of standard erosion and sediment controls, the risk of substantial amounts of sediment entering the streams would be low. Small amounts of sediment may enter the stream despite the installation of sediments controls. However, due to the very low flow conditions any sediment is likely to settle almost entirely in the immediate vicinity of the proposal footprint and is unlikely to significantly affect habitat downstream.

4.1.5 Injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing and culvert replacement occurs. Vegetation removal within the disturbance area is considered to be minimal and limited to planted and regrowth roadside trees. None of the trees identified for removal within the study area provide significant habitat features such as hollows. As such, arboreal fauna that are nocturnal and nest or roost in trees during the day are considered unlikely to occur. Those that are likely to be present, such as birds, are highly mobile and will be able to leave the impact area during clearing activities. Other non-mobile species such as reptiles and frogs may be injured or killed during construction as habitat is cleared, particularly in the wetland areas.

The study area may provide roosting habitat in the culvert underneath Cessnock Road for threatened cave-roosting insectivorous bat species. An inspection of the culvert revealed only one roosting opportunity near the western end of the culvert as nearly all the culvert joins have been sealed. However, no roosting bats were identified or recorded during the field survey. The culvert is unlikely to provide breeding habitat and may only be used for roosting on occasion. It is recommended that a thorough inspection of the culvert is undertaken by a suitable qualified ecologist for roosting bats before the commencement of demolition works

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.

There is a chance of fauna mortality during the operational phase of the proposal through vehicle collision (ie roadkill). Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia (Coffin, 2007, Rowden et al., 2008). Mammals, reptiles, amphibians and birds are all at risk of vehicle strike, particularly those common species (eg macropods) that are tolerant of disturbance and/or those species that can utilise roadways for movement pathways or as foraging habitat.

As there are no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations is unknown. Cessnock Road currently experiences high volumes of peak hour traffic, so the risk of vehicle strike is unlikely to increase after the completion of the project.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity and habitat fragmentation

Habitat fragmentation relates to the physical dividing up of once continuous habitats into separate smaller 'fragments' (Fahrig, 2002). The habitats created by fragmentation tend to be smaller and separated from each other by a matrix of less suitable habitats. The new dividing habitat type between fragments is often artificial and less suitable to the species remaining within these newly created fragments (Bennett, 1990, Bennett, 1993, Lindenmayer and Fischer, 2006) or is generally only used by adaptive and aggressive generalist species (eg Noisy Miners) which further decreases population levels of other species remaining in the fragments.

The habitats within the study area are a mix of planted, remnant and regrowth vegetation and floodplain wetlands highly fragmented and modified by a history of agricultural activities. There has been little connectivity through the study area by way of vegetated corridors for long period of time. The greatest area of remaining east-west connectivity is via the wetlands and constructed drain that connects Testers Hollow with Wallis Creek. Most of the time the wetlands in the study area are dry and not connected by open water within Wallis Creek. This means that aquatic habitat is generally confined to Testers Hollow wetlands, the drain and artificial ponds on the west side of the road. However, the drain and culvert do facilitate connection across the road, particularly for aquatic species after sufficient rainfall. The upgrade to the road and culvert will remove a small area of wetland habitat however the new culvert will be larger and should improve this connectivity.

As the proposal will remove just a small area of vegetation, it will contribute to the fragmentation of habitat however, the impact is not considered to be significant due to the presence of more viable habitat, with greater connectivity in the surrounding area and the already heavily fragmented nature of the vegetation.

4.2.2 Edge effects on adjacent native vegetation and habitat

Vegetation in the study area has been subject to a long history of disturbance from agricultural activity. Surrounding vegetation was likely removed a long time ago and since then the study area has had some native regrowth. The remaining remnant vegetation consists of isolated stands of paddock trees with missing structural layers and a dominance of exotic groundcover species.

Edge effects refer to the changes in environmental conditions (eg altered light levels, wind speed, temperature) that occur along the edges of habitats. These new environmental conditions along the habitat edges can promote the growth of different vegetation types (including weeds), promote invasion by pest animals specialising in edge habitats, or change the behaviour of resident animals (Moenting and Morris, 2006). Edge zones can be subject to higher levels of predation by introduced mammalian and native avian predators. The distance of edge effect influence can vary, with the extent of edge effects having been recorded greater than 1 kilometre from an edge (Forman et al., 2000) and stopping as little as 50 metres from an edge (Bali, 2005).

As the proposal will remove just a small area of vegetation and areas to remain are already highly modified, it is unlikely to significantly result in any further impacts from edge effects.

4.2.3 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (ie not a direct result of proposal activities). Proliferation of weeds is likely to occur during construction and operation, although impacts will be greatest because of vegetation clearing during the construction phase. Most of the study area already has significant weed growth. Therefore, the potential for habitat modification from weed invasion is relatively low.

Without appropriate management strategies, proposal activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited or in low density. Proposal activities also have the potential to import new weed species into the study area. The most likely causes of weed dispersal and importation associated with the proposal

include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. Weed dispersal by vehicles along roads and access tracks is a key source of weed invasion (Birdsall et al., 2012).

Mitigation measures designed to limit the spread and germination of weeds are provided in Section 5.

4.2.4 Invasion and spread of pests

No invasive species were observed in the study area during the site survey. However, the study area may be habitat for several common species including the feral cat and European Red Fox. Due to the minimal vegetation clearing, the proposal is unlikely to result in invasion or spread of pest species.

4.2.5 Invasion and spread of pathogens and disease

Several pathogens known from NSW have potential to affect biodiversity as a result of their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- Dieback caused by *Phytophthora* (Root Rot; EPBC Act and BC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction.

Mitigation measures to deal with the potential introduction and spread of pathogens are provided in Section 5.

4.2.6 Changes to hydrology

Impacts to hydrology may include changes to factors including flow velocity, depth, turbulence and flooding regimes.

The extent of these changes in Testers Hollow and Wallis Creek as a result of the proposal would be controlled through design measures and construction environmental management and are likely to be temporary and limited to the construction phase of the proposal. The changes associated with the proposal are only likely to occur over small areas and given their temporary nature are considered unlikely to significantly impact the hydrology of the surrounding aquatic environment.

Mitigation measures to minimise changes in hydrology are provided in Section 5.

4.2.7 Noise, light and vibration

Noise, light and vibration are direct impacts that are likely to result from proposal activities. The proposed working hours are likely to include the following:

- Mondays – Fridays 7.00am – 6.00pm
- Saturdays – 8.00am – 1.00pm
- Sundays and Public Holidays – No work.

Night works are likely to be required for the proposal. Artificial lighting would be required during night works.

Lighting would be used at night to enable work to be completed that may result in impacts to nocturnal fauna. Common nocturnal species such as possums and microbats may avoid the habitat in the study area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the study area. The magnitude of this impact would be low and mitigation measures are not deemed necessary. During all phases of the proposal, there

will be increased noise and vibration levels in the study area and immediate surrounds due to vegetation clearing, ground disturbance, machinery and vehicle movements and general human presence. The noise and vibration from activities associated with the proposal will potentially disturb resident fauna and may disrupt foraging, reproductive, or movement behaviours.

There is likely to be an impact from noise and vibration but the level of noise and vibration into adjacent habitats during construction and operation cannot be quantified. The proposed work will not be undertaken near any areas of high quality habitat that would be expected to contain a high abundance of fauna.

Mitigation measures to deal with the impacts from noise, light and vibration are provided in Section 5.

4.2.8 Groundwater dependent ecosystems

The floodplain wetland at Testers Hollow is mapped as a 'Moderate potential GDE (national assessment)'. Testers Hollow wetland and the other two wetlands are likely to be facultative GDEs which are reliant on both surface water and groundwater. Testers Hollow has been historically modified to retain and channel water for agricultural purposes. It is fed directly by Wallis Creek which flows into the Hunter River (however the aquatic habitat in the study area is not considered tidal). It is noted the unnamed creek only flows during periods of high rainfall. Due to the slightly raised pasture land on the western bank of Wallis Creek, water is trapped in Testers Hollow and the unnamed creek most of the year. However, a review of historical imagery from the study area shows that the Testers Hollow Wetland is slightly ephemeral and appears to have lost surface water on several occasions over the last 5 years. This aquatic GDE is considered to be a proportionally reliant on groundwater.

The plant community types which are found on the site are listed as having a low to high potential for groundwater interaction in the NSW Department of Water *Groundwater Dependent Ecosystem (GDE) Atlas* (BoM, 2018). Two of the plant community types found on the site and are classified as groundwater dependent terrestrial ecosystems, do occur solely in association with areas of impeded drainage and are located in areas with high annual rainfall. As discussed in section 3.4, they are likely to be in the Facultative – proportional dependence class of GDEs are likely to be dependent in part on groundwater. These GDEs are likely to be moderately reliant on groundwater particularly during times of water stress and may be modified (eg in species composition) by changes in groundwater attributes, however are not likely to be destroyed.

Other GDEs in the study area are considered to be Facultative - Opportunistic dependence class of GDEs (or non-dependant) and are unlikely to be heavily dependent on groundwater.

The proposal may cause minor local impacts to groundwater such as slight, localised changes to groundwater depth but it is unlikely to cause significant alteration to groundwater conditions outside of the immediate vicinity of the study area. While there may be minor alteration to groundwater conditions in the locality, the proposal is unlikely to result in permanent damage or loss of groundwater dependent ecosystems outside of the proposal footprint.

4.3 Cumulative impacts

The potential biodiversity impacts of the proposal must be considered as a consequence of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

The accumulative impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure would likely include continued loss of biodiversity in the region. The study area is situated within the Lower Hunter Channels and Floodplain Mitchell Landscape. This landscape is considered to be over-cleared because of historic activities.

While data from all recent projects in the locality is not freely available, some information on the likely biodiversity impacts from past similar projects is shown in Table 4.5. The region is progressively rapidly with housing developments and there have been numerous new residential areas appear in the last 10 years.

Table 4.5 Past, present and future projects

Project	Construction impacts	Operational impacts
Residential subdivision in Clifftleigh (Harper Somers O'Sullivan, 2005)	Although no specific impact numbers are available, the Flora and Fauna Assessment (Harper Somers O'Sullivan 2005) states that the development would potentially involve the removal or modification of about 17.5 ha of native vegetation.	Unknown
F3 Freeway to Branxton link (information obtained from Acacia, 2007)	Removal of 182 hectares of native vegetation, including removal of 16.8 hectares of Hunter Lowland Redgum Forest EEC (significant impact). Significant impact to <i>Eucalyptus parramattensis</i> ssp. <i>decadens</i> through clearing of 3.1 ha of Kurri Sand Swamp Woodland.	Increased noise and vibration.

4.4 Assessments of Significance

An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat. The Assessments of Significance are summarised in the tables below and provided in full in Appendix B.

4.4.1 Biodiversity Conservation Act 2016

Section 7 of the *Biodiversity Conservation Act 2016* (BC Act) requires that a five-part test be undertaken to assess the likelihood of a significant impact occurring to a threatened species, population or ecological community listed under the BC Act. Section 7.3 of the BC Act outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment.

Full details of assessments of significance under the BC Act are presented in Appendix B. The conclusions of the BC Act assessment are provided in Table 4.6, which indicates that a significant impact is unlikely for all species and ecological communities.

Table 4.6 Summary table of the findings of BC Act significance assessments

Species	Status (BC Act)	Five-part test questions					Likely Significant Impact	Potential to occur in the study area and predicted impact
		1	2	3	4	5		
Threatened Ecological Communities								
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	X	N	Y	N	Y	No	Present throughout most of the lower lying areas of the study area. 0.91 ha will be removed as part of the proposal.
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	X	N	Y	N	Y	No	Present as scattered regrowth / regenerating trees throughout the study area. 0.5 ha will be removed as part of the proposal.
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	E	X	N	Y	N	Y	No	Present as isolated remnant paddock trees and a thin strip of regenerating roadside vegetation in the north of the study area. <0.01 ha will be removed as part of the proposal.
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	E	X	N	Y	N	Y	No	Present as regrowth roadside trees and a patch of woodland Lot 22 DP785275. 0.06 ha will be removed as part of the proposal.
Threatened flora								
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	N	X	Y	N	N	No	Up to 35 planted juvenile trees will be cleared by the proposal.
Cave-roosting bats								
Eastern Bentwing-bat	V	N	X	Y	N	N	No	Moderate - foraging habitat widespread. Culverts has limited roosting opportunities.
Eastern Cave Bat	V	N	X	Y	N	N	No	
Large-eared Pied Bat	V	N	X	Y	N	N	No	
Little Bentwing-bat	V	N	X	Y	N	N	No	The proposal will result in the removal of 1.56 ha of potential foraging habitat and one low quality temporary roost site.
Southern Myotis	V	N	X	Y	N	N	No	
Hollow-roosting bats								
Eastern False Pipistrelle	V	N	X	Y	N	N	No	Moderate - foraging habitat widespread. Roosting habitat limited. Only one hollow identified in the north west compound.
Eastern Freetail-bat	V	N	X	Y	N	N	No	
Greater Broad-nosed Bat	V	N	X	Y	N	N	No	
Yellow-bellied Sheathtail-	V	N	X	Y	N	N	No	The proposal will result in the removal of 1.56 ha of

Species	Status (BC Act)	Five-part test questions					Likely Significant Impact	Potential to occur in the study area and predicted impact
		1	2	3	4	5		
bat								potential foraging habitat. No expected impact to roosting habitat.
Mammals								
Grey-headed Flying Fox	V	N	X	Y	N	Y	No	High – foraging habitat widespread. Back Hill camp 11km SE of the study area and a further 15 camps within 50km. The proposal will result in the removal of 0.59 ha of winter flowering trees. No roost camp is likely to be impacted by the proposal.
Birds								
Grey-crowned Babbler	V	N	X	Y	N	Y	No	Moderate – foraging habitat widespread. The proposal will result in the removal of 0.59 ha of foraging habitat. No nesting/breeding habitat likely to be impacted by the proposal.
Swift Parrot	E	N	X	Y	N	Y	No	Moderate – <i>Eucalyptus tereticornis</i> and <i>Corymbia maculata</i> are winter flowering and offer suitable foraging habitat. The proposal will result in the removal of 0.64 ha of winter flowering trees. No nesting/breeding habitat likely to be impacted by the proposal.
White-bellied Sea Eagle	V	N	X	Y	N	Y	No	Present – observed flying over the study area during the field survey. The ephemeral wetlands are unlikely to be an important foraging resource however this species may occur hunting over the study area on occasion. The proposal may result in the removal of 1.52 ha foraging and perching habitat, however this is likely an overestimate as most of the study area is possibly only suitable during periods of inundation.

Species	Status (BC Act)	Five-part test questions					Likely Significant Impact	Potential to occur in the study area and predicted impact
		1	2	3	4	5		
Black-necked Stork	V	N	X	Y	N	Y	No	Moderate – this species is a rare resident of the Hunter Region. It may occur in the floodplain around the study area at any time though particularly after suitable rainfall. The proposal will result in the removal of 0.91 ha of foraging habitat.
<p>* Y= Yes (negative impact), N = No (no or positive impact), X = not applicable,</p> <p>Significance assessment questions</p> <ol style="list-style-type: none"> In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: <ol style="list-style-type: none"> is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction In relation to the habitat of a threatened species, population or ecological community: <ol style="list-style-type: none"> the extent to which habitat is likely to be removed or modified as a result of the action proposed whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process. 								

4.4.2 Environment Protection and Biodiversity Conservation Act 1999

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 the Environment 2013). The summary of the EPBC Act assessment of significance for each species are provided in Table 4.7 which indicates that a significant impact is considered unlikely for any MNES and a referral of the proposal would not be required. Full details of the assessment of significance for threatened species under the EPBC Act are presented in Appendix B.

One marine species listed under the EPBC Act, White-bellied Sea Eagle, was observed flying over the study area during field survey and is considered ‘moderately’ likely to use habitat within the study area (Appendix A). As this species is not listed as threatened under the EPBC Act, no assessment of significance was undertaken. The study area does not provide suitable breeding habitat for this species and given the small extent of vegetation removal and areas of higher habitat value in the locality the proposed action is unlikely to have a significant impact on this species.

A number of other migratory species are considered moderately likely to occur in the study area on occasion including the Fork-tailed Swift, Rainbow Bee-eater, Latham’s Snipe, Marsh Sandpiper and Little Curlew. The Fork-tailed Swift is considered moderately likely to occur flying over the study during migration however is unlikely to be impacted by the proposal. Suitable habitat for waders is likely to occur after suitable rainfall, however these fringing areas will only be temporarily disturbed by the proposal. The Rainbow Bee-eater may use vegetation in the

study area during annual migration. The proposal will not impact on any areas of important habitat for these migratory species.

Table 4.7 Summary of EPBC Act assessments of significance

Species/Ecological Community	Important population*	Likely significant impact
Vulnerable		
Large-eared Pied Bat	No	No
Grey-headed Flying Fox	No	No
Swift Parrot	No	No

4.4.3 Fisheries Management Act 1994

The Purple Spotted Gudgeon is listed as endangered under the FM Act and is considered moderately likely to occur in the study area based on the presence of mapped indicative habitat along Wallis Creek. The summary of the FM Act assessment of significance for Purple Spotted Gudgeon is provided in Table 4.8 which indicates that a significant impact is considered unlikely.

Table 4.8 Summary of FM Act assessments of significance

Species	Status (BC Act)	Seven-part test questions							Likely Significant Impact	Potential to occur in the study area and predicted impact
		1	2	3	4	5	6	7		
Purple Spotted Gudgeon	E	N	X	X	Y	N	N	Y	No	Moderate – Wallis Creek is mapped by DPI as indicative habitat for this species. It may spread into Testers Hollow wetland during periods of high rainfall and inundation. The study area does not contain high quality habitat for this species. The proposal will result in the removal of 0.09 ha of aquatic habitat for this species.

4.5 Impact summary

A summary of the predicted ecological impacts from the proposal is provided in Table 4.9.

Table 4.9 Summary of impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation	All terrestrial threatened ecological communities (BC Act)	Direct Cumulative	The proposal will result in the removal of 1.50 ha of TECs listed under the BC Act including: <ul style="list-style-type: none"> Freshwater Wetlands on Coastal Floodplains = 0.91 ha Swamp oak floodplain forest = 0.55 ha Lower Hunter Spotted Gum – Ironbark forest = <0.01 ha Hunter Lowland Redgum forest = 0.06 ha 	Permanent	<ul style="list-style-type: none"> Clearing of native vegetation 	Known Irreversible
	Up to 300 planted <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> trees (juveniles < 2m high) may be planted in Lot 949 DP1223319. .	Direct Cumulative	The proposal will result in the removal of up to 35 planted juvenile trees, however there is potential to translocate these individuals or plant more to supplement loss.	Permanent		Known Reversible
Removal of threatened fauna habitat	<ul style="list-style-type: none"> Eastern Bentwing-bat Eastern Cave Bat Large-eared Pied Bat Little Bentwing-bat Southern Myotis Eastern False Pipistrelle 	Direct Cumulative	The proposal will result in the removal of fragmented patches of forest and woodland habitat, that could potentially be used on occasion for foraging, although is not important breeding habitat for the following threatened species: <ul style="list-style-type: none"> Cave-roosting bats = 1.56 ha Hollow-roosting bats = 1.56 ha Grey-headed Flying Fox = 0.59 ha Grey-crowned Babbler = 0.59 ha 	Long term	<ul style="list-style-type: none"> Clearing of native vegetation Removal of dead wood and dead trees 	Known Irreversible

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
	<ul style="list-style-type: none"> • Eastern Freetail-bat • Greater Broad-nosed Bat • Yellow-bellied Sheath-tail-bat • Grey-headed Flying Fox • Grey-crowned Babbler • Swift Parrot • White-bellied Sea Eagle • Black-necked Stork 		<ul style="list-style-type: none"> • Swift Parrot = 0.64 ha • White-bellied Sea Eagle = 1.52 ha • Black-necked Stork = 0.91 ha <p>The proposal is not expected to impact breeding habitat for any of these species.</p>			
Aquatic impacts	Purple Spotted Gudgeon moderately likely to occur. Also common and disturbance-tolerant species (eg eels) likely to be affected	Direct	Difficult to quantify. The proposal will result in the removal of 0.09 hectares of aquatic habitat (moderate/good freshwater wetlands) for the Purple Spotted Gudgeon. Temporary obstruction of fish passage during the construction phase.	Long term and short-term	<ul style="list-style-type: none"> • Clearing of native vegetation • Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands 	Known Irreversible
Injury and mortality of fauna	All fauna present in the habitat	Direct	Difficult to quantify. This will likely be restricted to non-mobile species such as reptiles and frogs, which may be injured or killed during construction as habitat is cleared, particularly in the wetland areas. The study area may provide roosting habitat in the culvert underneath Cessnock Road for threatened cave-roosting insectivorous bat species. An inspection of the culvert revealed only one roosting	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Unpredictable Irreversible

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
			opportunity near the western end of the culvert as nearly all the culvert joins have been sealed. However, no roosting bats were identified or recorded during the field survey. The culvert is unlikely to provide breeding habitat and may only be used for roosting on occasion.			
Fragmentation of identified biodiversity links and habitat corridors	All vegetation and fauna present in the study area	Direct/ indirect Cumulative	Difficult to quantify. Minimal.	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known Irreversible
Edge effects on adjacent native vegetation and habitat	All vegetation and fauna present in the study area	Indirect Cumulative	Minimal as no core habitat is present	Long term	<ul style="list-style-type: none"> • Clearing of native vegetation 	Known Irreversible
Invasion and spread of weeds	All vegetation and fauna present in the study area	Indirect	Without appropriate management strategies, proposal activities have the potential to disperse weeds into areas of remnant vegetation where weed species are currently limited or in low density. However much of the study area currently contains a high abundance of weed species.	Long term	<ul style="list-style-type: none"> • Invasion and establishment of exotic vines and scramblers • Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) • Invasion, establishment and spread of <i>Lantana camara</i> • communities by exotic perennial grasses 	Unknown Unpredictable

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of pathogens and disease	All vegetation and fauna present in the study area	Indirect	While pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction	Long term	<ul style="list-style-type: none"> • Infection of native plants by <i>Phytophthora cinnamomi</i> • Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae • Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations • Infection of frogs by amphibian chytrid causing the disease chytridiomycosis 	Unknown Unpredictable
Groundwater dependent ecosystems	All vegetation and fauna present in the study area	Indirect	Minor local impacts to groundwater such as slight, localised changes to groundwater depth; unlikely to cause significant groundwater conditions outside of the immediate vicinity of the proposal site. While there may be minor alteration to groundwater conditions in the locality, the proposal is unlikely to result in permanent damage or loss of groundwater dependent ecosystems outside of the proposal footprint.	Short-term	No	Known Irreversible
Changes to hydrology	All vegetation and fauna present in the study area	Direct/ indirect	Changes to factors including flow velocity, depth, turbulence and flooding regime would be largely restricted to the proposal	Short-term	<ul style="list-style-type: none"> • Alteration to the natural flow regimes of rivers, 	Known Irreversible

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
			footprint and immediate surrounds and restricted to the construction phase of the proposal.		streams, floodplains & wetlands	
Noise, light and vibration	All vegetation and fauna present in the study area	Direct/indirect	There will be an impact from noise and vibration however, these impacts will be restricted to predominately the construction phase. Artificial light may be used during night works, but instances of night works are expected to be short-term and limited in duration.	Short-term	No	Known Unpredictable

5 Avoid, minimise and mitigate impacts

In managing biodiversity, Roads and Maritime aims to achieve a balanced outcome, taking account of environmental considerations together with economic and community objectives. This includes a balanced approach to examining the particular environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Roads and Maritime's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy.

Roads and Maritime's current approach with respect to biodiversity is:

1. Avoid and minimise impacts as the highest priority
2. Mitigate impacts where avoidance is not feasible or practicable in the particular circumstance
3. Offset where residual, significant unavoidable impacts would occur.

5.1 Avoidance and minimisation

Avoiding environmental impacts as the first step is consistent with the application of the precautionary principle. Roads and Maritime's first priority is to avoid impacts to the environment. This can be achieved by early consideration of environmental issues from identification of constraints at project inception through to options analysis and selection of a preferred option, design investigation and assessment of the preferred option, detailed design, and implementation of on-ground safeguards during construction and operation and maintenance of the activity.

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value. In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles and location of the primary site compound in a largely cleared area to avoid impacts).

Where it is not possible to avoid impacts the proposal has been designed to minimise impacts where reasonably practicable.

5.2 Mitigation measures

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 proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Roads and Maritime 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 project, 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* (NSW Roads and Traffic Authority, 2011) are recommended for implementation (see Table 5.1). The NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* has also been used.

Table 5.1 Mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	Native vegetation removal will be minimised where reasonably practicable through detailed design.	Detailed design	Effective	The predicted residual impact to native vegetation is estimated to be removal of up to about 1.56 hectares.
	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> (RTA 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> (RTA 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> (RTA 2011) and the NSW DPI (Fisheries) document <i>Policy and Guidelines for fish habitat conservation and management (2013 update)</i> .	Post 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 threatened ecological communities that have not been assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Removal of threatened species habitat and habitat features. This includes replacement of the	Habitat removal will be minimised where reasonably practicable through detailed design.	Detailed design	Effective	The predicted residual impact to threatened species foraging habitat is estimated to be up to 1.56 ha for some species.
	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> (RTA 2011).	During construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
existing culvert which may provide roosting habitat for threatened insectivorous bats.	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna that have not been assessed in the biodiversity assessment are identified in the proposal site.	During construction	Proven	At least one low quality potential roosting opportunity will be removed with the replacement of the existing culvert. New culverts, however, may provide new roosting opportunities.
Removal of threatened plants	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> (RTA 2011).	During construction	Proven	Removal of up to 35 <i>Eucalyptus parramattensis</i> subsp. <i>decadens</i> trees
	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Proven	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened flora species that have not been assessed in the biodiversity assessment are identified in the proposal site.	During construction	Proven	
Aquatic impacts	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> (RTA 2011) and Section 3.35.2 <i>Standard precautions and mitigation measures</i> of the <i>Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	During construction	Effective	Removal of 0.09 ha of low quality habitat for the Purple Spotted Gudgeon. Temporary obstruction to fish passage during construction.

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Changes to hydrology	Changes to existing surface water flows will be minimised through detailed design where possible.	Detailed design and during construction	Effective	Flow velocity may be temporarily changed during construction.
Edge effects on adjacent native vegetation and habitat	Exclusion zones will be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	No residual impact is anticipated
Injury and mortality of fauna	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> (RTA 2011).	During construction	Effective	There is potential for injury and mortality of fauna due to the required vegetation clearing and culvert replacement. The mitigation measures should be effective but injury or death to fauna may still occur.
Invasion and spread of weeds	Weed species will be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Invasion and spread of pests	Pest species would be managed within the proposal site.	During construction	Effective	None expected

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Invasion and spread of pathogens and disease	Pathogens will be managed in accordance with <i>Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Noise, light and vibration	Noise and vibration impacts will be minimised through detailed design where possible.	Detailed design and during construction	Effective	Temporary during the construction phase only.

6 Offset strategy

6.1 Quantification of impacts

Roads and Maritime will provide biodiversity offsets or where offsets are not reasonable or feasible, provide supplementary measures (activities such as funding research, funding conservation management activities as part of the OEH Saving our Species program, or funding vegetation restoration activities in partnership with local Landcare groups) for impacts that exceed the following thresholds (see Table 6.1).

The works will involve clearing of BC Act listed threatened ecological communities as follows:

- Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (endangered ecological community) – 0.91 hectares
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered ecological community) – 0.55 hectares
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (endangered ecological community) – <0.01 hectares
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (endangered ecological community) – 0.06 hectares.

The proposal will also result in clearing of BC Act listed threatened flora species and BC Act and EPBC Act listed threatened fauna species habitat (refer Table 4.2 for list of species). Up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees will be removed. Foraging habitat to be removed for threatened fauna species is minimal, comprising up to 1.56 hectares of planted and regrowth roadside vegetation for some species. The Roads and Maritime offset thresholds are outlined below in Table 6.1.

Table 6.1 Roads and Maritime offset thresholds (RMS 2011)

Description of activity or impact	Consider offsets or supplementary measures
Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of an CEEC in moderate to good condition
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS

Description of activity or impact	Consider offsets or supplementary measures
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat

The proposal is relatively small in the context of other road and intersection upgrade projects and is not a major project. Based on the criteria in Table 6.1, the proposal does not meet the clearing requirements of any of the offset thresholds.

The *Eucalyptus parramattensis* subsp. *decadens* trees that will be impacted as part of this proposal were planted as an offset for the construction of the residential subdivision in Cliftleigh. Details of the offset agreement were retrieved from Appendix 5 Flora and Fauna Addendum Letter for a Proposed Residential Subdivision Over Various Allotments Maitland - Kurri Kurri Road, at Cliftleigh (Harper Somers O'Sullivan 2007). The report states that the Offset Agreement was reached in consultation with the then Department of Environment and Conservation (DEC) and Winten Property Group and included "Retention or planting within the property of at least 300 *Eucalyptus parramattensis* ssp. *decadens*". The Roads and Maritime Guideline for Biodiversity Offsets (RMS 2011) does not specify how to offset impacts to planted threatened species. Additionally, it is unclear what the implication of clearing these planted trees will be on the current Offset Agreement for the residential subdivision. It is recommended that these planted trees are salvaged and replanted in a suitable location.

6.2 Biodiversity offset strategy

In accordance with the *Roads and Maritime Guideline for Biodiversity Offsets* (RMS 2011) an offset is not required for the small area of vegetation clearing proposed.

7 Conclusion

The proposal would include the removal and/or disturbance of 1.50 hectares of native vegetation associated with four threatened ecological communities and provides potential habitat for 15 threatened fauna species. One threatened flora species has been identified in the proposal area.

Four threatened ecological communities listed under the BC Act are present in the study area. Impacts to these TECs include:

- Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (EEC) – 0.91 hectares
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (EEC) – 0.55 hectares
- Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (EEC) – 0.06 hectares
- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (EEC) – 0.003 (<0.01) hectares.

The White-bellied Sea Eagle (listed as vulnerable under the BC Act and marine under the EPBC Act) was observed flying over the study area in the direction of the Hunter River. No nest was observed in the study area. This species is likely to breed in larger and less disturbed patches of vegetation to the west of the study area (eg Cessnock State Forest, Lower Hunter National Park and Part State Forest), however may use the wetland habitat in the study area on occasion for hunting. Vegetation in the study area may also provide suitable habitat for an additional 15 threatened fauna species (10 mammals, four birds and one fish) listed under the BC Act and FM Act, which include:

- Cave roosting bats: Eastern Bentwing-bat, Little Bentwing-bat, Eastern Cave Bat, Large-eared Pied Bat and Southern Myotis
- Hollow-roosting bats: Eastern Freetail-bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat
- Grey-headed Flying Fox
- Grey-crowned Babbler
- Swift Parrot
- Black-necked Stork
- Purple Spotted Gudgeon.

Habitat that would be impacted by the proposal is generally limited to foraging habitat due to its disturbed nature. Up to 1.56 hectares of foraging habitat will be removed for some species. *Eucalyptus tereticornis* and *Corymbia maculata* would offer a potential winter flowering resource for nectarivorous species such as the Grey-headed Flying Fox and Swift Parrot. Vegetation may also provide foraging habitat for the Grey-crowned Babbler and numerous cave roosting and hollow-roosting insectivorous bats. No hollow-bearing trees are expected to be impacted by the proposal, however the existing culvert under Cessnock Road will be replaced which may offer some suitable roosting habitat for several insectivorous bat species that are known to roost in artificial structures. All of the culvert joins are sealed except for one at the western end which may offer a shallow roost site, however this is not considered to be an important (maternity) roost for any of these species.

Assessments of Significance have been undertaken for all threatened species and threatened ecological communities that will be impacted as a result of the proposal (see Section 4.4 and Appendix B). These assessments determined that the impacts are minimal and unlikely to result in a significant impact.

The eastern portion of Lot 949 DP1223319 contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Clifftleigh. *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. It is

unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most contain plastic tree guards. There may be up to 300 *Eucalyptus parramattensis* subsp. *decadens* planted in the field being impacted by the proposal (Harper Somers O'Sullivan 2007). Some of the trees do not have tree guards and may be either *Eucalyptus tereticornis* or *E. amplifolia*. However, identification is difficult at the juvenile stage and some tree guards may have been washed away in recent floods. Therefore, from an impact perspective, it is assumed that all the trees are *Eucalyptus parramattensis* subsp. *decadens*. Up to 35 planted *Eucalyptus parramattensis* subsp. *decadens* trees will be removed as part of this proposal. Assessments under the BC Act and EPBC Act have been undertaken and are provided in Appendix B. The removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees is unlikely to result in a significant impact to this species.

The unnamed creek and surrounding floodplain that connects Wallis Creek and Testers Hollow wetland is considered to form 'Type 3 – Minimally sensitive key fish habitat' and 'Class 4 – Minimal key fish habitat' (see Plates 1 to 3). The proposal has potential to temporarily obstruct fish passage in the unnamed creek during the construction stage. A fisheries permit, under the FM Act, may be required, subject to further consultation with the DPI.

Temporary hydrological changes are also expected to occur during the construction stage, such as turbulence and changes in flow velocity however, these are considered to be short term and insignificant to the long term health of the surrounding aquatic ecosystems. Wallis Creek is mapped as indicative habitat for the Purple Spotted Gudgeon. There is moderate potential for this species to occur in the study area during periods of high rainfall when the surrounding floodplain is inundated. However, habitat that may be impacted by the proposal is unlikely to be important to the long-term survival of this species. The impact of the proposal on this species includes the removal of 0.15 hectares of aquatic habitat (moderate/good freshwater wetlands) and possible barriers to movement during construction.

The floodplain wetland at Testers Hollow is mapped as a 'Moderate potential GDE (national assessment)'. Two of the plant community types found on the site and are classified as groundwater dependent terrestrial ecosystems and are likely to be dependent proportionally on groundwater, particularly during times of water stress. While there may be minor alteration to groundwater conditions in the locality, the proposal is unlikely to result in permanent damage or loss of groundwater dependent ecosystems outside of the proposal footprint.

Indirect and operational impacts including increased habitat fragmentation and edge effects are considered to be insignificant due to the already largely disturbed landscape within the study area and the minimal removal of vegetation proposed. Invasion and spread of weeds, invasion and spread of pests, and invasion and spread of pathogens and disease are a risk with a proposal of this type, however these potential impacts will be minimised by undertaking best practice procedures as outlined in the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011). Noise and vibration increases will be restricted to the construction stage and no artificial light will be required as all works will be undertaken in daylight hours. As the proposal does not exceed the Roads and Maritime offset thresholds, offsets are not required in accordance with Roads and Maritime environmental offsets policy.

Based on the recommendations outlined above and listed in Table 7.1 below, the proposal is considered unlikely to have any significant impact on threatened species, population or communities.

Table 7.1 Summary of recommendations

Recommendation	Reasoning
Consultation with the DPI to determine whether a fisheries permit, under the FM Act, is required.	The temporary obstruction of fish passage is possible in the unnamed stream during the construction phase. However the unnamed stream only flows during periods of high rainfall. Obstruction from during construction is

Recommendation	Reasoning
	only likely to be temporary, and limited to the area between Testers Hollow and the small ponded area of wetland on the eastern side of Cessnock Road.
All mitigation measures not already listed above and outlined in Table 5.1	To reduce the impacts of the proposal on threatened species known or likely to occur in the study area. Mitigation measures have been based on the <i>Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects</i> (NSW Roads and Traffic Authority, 2011) and the NSW DPI (Fisheries) document <i>Policy and Guidelines for fish habitat conservation and management (2013 update)</i> (Department of Primary Industries, 2013).

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and South East Queensland ecological community.

Appendix A – Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10 km) 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 (10 km). 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.

Habitat assessment table – Flora

Habitat assessment table - Flora						
Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
Flora						
<i>Acacia bynoeana</i>	Bynoe's Wattles	V	E	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (<i>Corymbia gummifera</i>), Scribbly Gum (<i>Eucalyptus haemastoma</i>), Drooping Red Gum (<i>E. parramattensis</i>), Old Man Banksia (<i>Banksia serrata</i>) and Small-leaved Apple (<i>Angophora bakeri</i>).	169 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Asterolasia elegans</i>		E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone. Found in sheltered forests on mid-to lower slopes and valleys, eg in or adjacent to gullies which support sheltered forest. The canopy at known sites includes Turpentine (<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>), Smooth-barked Apple (<i>Angophora costata</i>), Sydney Peppermint (<i>Eucalyptus piperita</i>), Forest Oak (<i>Allocasuarina torulosa</i>) and Christmas Bush (<i>Ceratopetalum gummiferum</i>).	PMST	Unlikely – no suitable habitat in the study area.
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	V	E	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Callistemon linearifolius</i>	Netted Bottlebrush	-	V	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Was more widespread across its distribution in the past. Some populations are reserved in Kuring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park and Werakata National Park. Grows in dry sclerophyll forest on the coast and adjacent ranges.	962 – OEH	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Cymbidium canaliculatum</i> (endangered population)		-	EP	Scattered distribution across northern and eastern Australia, extending from Hunter River in NSW to Cape York and across northern NT and Queensland to the Kimberley region in WA. Typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor.	4 – OEH	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (<i>Leptospermum laevigatum</i>) – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honeymyrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.	PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Dichanthium setosum</i>	Bluegrass	V	V	<i>Dichanthium setosum</i> has been reported from mid-coastal to inland NSW and Queensland. <i>Dichanthium setosum</i> occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending west to Narrabri. <i>Dichanthium setosum</i> is associated with heavy basaltic black soils and red-brown loams with clay subsoil.	PMST	Low – some areas of potential habitat though no records of this species nearby.
<i>Diuris pedunculata</i>	Small Snake Orchid	E	E	Confined to north east NSW. It was originally found scattered from Tenterfield south to the Hawkesbury River, but is now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor. The Small Snake Orchid grows on grassy slopes or flats. Often on peaty soils in moist areas. Also on shale and trap soils, on fine granite, and among boulders.	1 – OEH	Low – no suitable habitat in the study area.
<i>Eucalyptus camaldulensis</i> (endangered population)	River Red Gum population in the Hunter Catchment	-	EP	This endangered population is located in the Wingecarribee local government area. Three sub populations, comprising less than 100 plants in total, are located in Berrima, Medway and Sutton Forest. Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (<i>Eucalyptus pauciflora</i>), Manna or Ribbon Gum (<i>E. viminalis</i>), Candlebark (<i>E. rubida</i>), Black Sallee (<i>E. stellulata</i>) and Swamp Gum (<i>E. ovata</i>). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by	5 – OEH	Low – Most of the smooth barked trees identified in the study area were <i>Eucalyptus tereticornis</i> . This was verified by fruits and leaves. Unlikely that seedlings in the study area are this species due to the proximity of the closest record.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				River Tussock (<i>Poa labillardierei</i>) or Kangaroo Grass (<i>Themeda australis</i>), but with few shrubs.		
<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common and farther south, from Taree to Broke, west of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.	15 – OEH PMST	Low – Most of the smooth barked trees identified in the study area were <i>Eucalyptus tereticornis</i> . This was verified by fruits and leaves. Unlikely that seedlings in the study area are this species due to the proximity of the closest record.
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>		V	V	There are two separate meta-populations of <i>E. parramattensis</i> subsp. <i>decadens</i> . The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, <i>E. parramattensis</i> subsp. <i>decadens</i> is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000). Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals.	1286 – OEH PMST	Present – up to 300 planted trees (juveniles < 2m high) in the field being impacted by the proposal (Harper Somers O'Sullivan 2007).
<i>Euphrasia arguta</i>		CE	CE	Historically, <i>Euphrasia arguta</i> has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. Was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Historic records of the species	PMST	Low – suitable habitat though this species is not known from the locality.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance.		
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast, and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	319 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	PMST	Low – suitable habitat though no individuals identified in the study area.
<i>Pelargonium</i> sp. <i>G.W. Carr 10345</i>	Omeo Storksbill	E	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. 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 sometimes colonises exposed lake beds during dry periods.	PMST	Unlikely – no suitable habitat in the study area.
<i>Prasophyllum</i> sp. <i>Wybong</i>		CE	-	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. A perennial orchid, appearing as a single leaf over winter and spring.	PMST	Low – some areas of potential habitat

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>(C. Phelps ORG 5269)</i>				Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland.		though no records of this species nearby.
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>).	1 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Rhodamnia rubescens</i>	Scrub Turpentine	-	CE	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of <i>R. rubescens</i> typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m a.s.l. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust.	3 – OEH	Unlikely – no suitable habitat in the study area.
<i>Rhodomyrtus psidioides</i>	Native Guava	-	CE	Occurs from Broken Bay, approximately 90 km north of Sydney, New South Wales, to Maryborough in Queensland. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	4 – OEH	Unlikely – no suitable habitat in the study area.
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	V	Recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Woolli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows in	866 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.		
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	E	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. 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.	2 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Tetratheca juncea</i>	Black-eyed Susan	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.	58 – OEH PMST	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat is disturbed and would not be impacted by the proposal.
<i>Thesium australe</i>	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (<i>Themeda australis</i>).	PMST	Low – some areas of potential habitat though no records of this species nearby.

* Distribution and habitat requirement information adapted from:

Australian Government Department of the Environment <http://www.environment.gov.au/biodiversity/threatened/index.html>

NSW Office of Environment and Heritage <http://www.environment.nsw.gov.au/threatenedspecies/>

Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx

+ Data source includes

Number of records from the NSW Office of Environment and Heritage Wildlife Atlas record data (Accessed November 2012); and

Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Sustainability, Environment, Water, Populations and Community

<http://www.environment.gov.au/epbc/pmst/index.html>

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<u>Key:</u> EP = endangered population CE = critically endangered E = endangered V = vulnerable M = migratory						

Habitat assessment table – Fauna

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
Birds						
<i>Anseranas semipalmata</i>	Magpie Goose	-	V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	1 – OEH	Low – only one record within the region from 2013. Previously locally extinct, this species is an uncommon resident in the region. There is a small captive bred population that inhabits the Hunter Wetland Centre (HWC) in Shortland. This species may utilise Testers Hollow wetlands for foraging, however habitat in the study area is considered low quality for this species.
<i>Anthochaera Phrygia</i> (<i>Xanthomyza phrygia</i>)	Regent Honeyeater	CE	CE	Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks.	12 – OEH PMST	Low – only three records within the last 10 years. Records are within larger contiguous vegetation.
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open	16 – OEH	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				forests and woodlands, and may be seen along roadsides and on golf courses.		be impacted by the proposal.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	PMST	Unlikely – no suitable habitat in study area.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	PMST	Unlikely – no suitable habitat in study area.
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	-	V	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests with an acacia understorey. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas, occasionally feeding on exotic plant species on urban fringe areas. Favours old growth forest and woodland attributes for nesting and roosting. Nesting occurs in Spring and Summer with nests located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.	11 – OEH	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Calyptrorhynchus lathamii</i>	Glossy-black Cockatoo	-	V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. 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> , and <i>A. gymnanthera</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>).	13 – OEH	Low – no suitable roosting habitat and limited foraging habitat present in study area.
<i>Chthonicola sagittata</i> (<i>Pyrrholaemus sagittatus</i>)	Speckled Warbler	-	V	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.	13 – OEH	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.
<i>Circus assimilis</i>	Spotted Harrier	-	V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. 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	2 – OEH	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				occurs in agricultural land, foraging over open habitats including edges of inland wetlands.		
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	-	V	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. Hollows in standing dead or live trees and tree stumps are essential for nesting.	57 – OEH	Low – records within larger contiguous vegetation surrounding study area. Habitat in study area unlikely to be suitable.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. 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 decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	18 – OEH	Low – some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	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	PMST	Low – no records in the locality. Presence

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				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.		based on modelled habitat.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	E	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 Bulahdelah. 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. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). 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).	13 – OEH	Moderate – this species is a rare resident of the hunter. It may occur in the floodplain around the study area at any time though particularly after suitable rainfall.
<i>Epthianura albifrons</i>	White-fronted Chat	-	V	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.	1 – OEH	Unlikely – no suitable habitat in the study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).		
<i>Erythroriorchis radiatus</i>	Red Goshawk	V	CE	This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	PMST	Low – no records in the locality. Presence based on modelled habitat.
<i>Falco subniger</i>	Black Falcon	-	V	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	1 – OEH	Low – unlikely to occur in the study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (<i>Angophora</i> sp.), paperbarks (<i>Melaleuca</i> sp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (eg paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	77 – OEH	Low – the high number of records are from larger patches of contiguous vegetation around the study area. Some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Grantiella picta</i>	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	PMST	Low – no records in the locality. Presence based on modelled habitat. No mistletoes observed in the study area.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, the it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially <i>Eucalyptus</i> species), bushes, mangroves, cliffs,	19 – OEH	Present – observed flying over the study area during the field survey. The individual was not hunting, only passing through. The ephemeral wetlands are unlikely to be an important foraging resource however this species may occur hunting over the study area on occasion.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				rocky outcrops, caves, crevices, on the ground or even on artificial structures.		
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	-	V	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	1 – OEH	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V	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.	3 – OEH	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Hirundapus caudacutus</i>	White-throated Needletail	V	-	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	7 – OEH PMST	Low – may fly over the study area on occasion, however low likelihood of using habitat within the study area.
<i>Irediparra gallinacea</i>	Comb-crested Jacana	-	V	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 NSW (possibly in response to unfavourable conditions further north). 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.	15 – OEH	Low – not likely to use habitat in the study area.
<i>Ixobrychus flavicollis</i>	Black Bittern	-	V	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as	1 – OEH	Unlikely – no suitable habitat in the study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.		
<i>Lathamus discolor</i>	Swift Parrot	CE	E	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 Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>).	63 – OEH PMST	Moderate – although the study area is not considered high quality habitat for this species, the Red Gums were flowering during the field survey and may provide winter foraging resources for individuals passing through.
<i>Limosa lapponica baueri</i>	Bar-tailed godwit (western Alaskan)	V	-	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of bar-tailed godwit (western Alaskan) is predominately New Zealand, northern and eastern Australia. The migratory bar-tailed godwit (western Alaskan) does not breed in Australia. The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	PMST	Unlikely – no suitable habitat in the study area.
<i>Limosa lapponica menzbieri</i>	Bar-tailed godwit (northern Siberian)	CE	-	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of <i>L. l. menzbieri</i> is predominantly in the north and north-west of Western Australia and in south-eastern Asia. The migratory bar-tailed godwit (northern Siberian) does not breed in Australia. The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats	PMST	Unlikely – no suitable habitat in the study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.		
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	4 – OEH	Low – may occur hunting over the study area on occasion, however the study area is not considered to contain important habitat that will be impacted.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subsp.)	-	V	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. 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.	72 – OEH	Low – the high number of records are predominately from vegetation SW of Kurri Kurri. Some suitable habitat may be present in Lot 22 DP785275, though this habitat would not be impacted by the proposal.
<i>Neophema pulchella</i>	Turquoise Parrot	-	V	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.	10 – OEH	Low – records mostly old. One recent record east of the study area. May occur in woody vegetation on rare occasion.
<i>Ninox connivens</i>	Barking Owl	-	V	Found throughout continental Australia except for the central arid regions. 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.	3 – OEH	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Ninox strenua</i>	Powerful Owl	-	V	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 may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl 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.	32 – OEH	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, M	-	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	PMST	Unlikely – no suitable habitat in the study area.
<i>Oxyura australis</i>	Blue-billed Duck	-	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer.	5 – OEH	Low – suitable habitat at Testers Hollow during field survey, however habitat in the study area was lower quality. Most water birds were seen to the west of the study area around more densely vegetated areas of open water. Habitat

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.		may be more widespread for brief periods following high rainfall.
<i>Pandion cristatus</i>	Eastern Osprey	M	V	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	PMST	Low – no suitable habitat in the study area.
<i>Petroica boodang</i>	Scarlet Robin	-	V	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 re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is an open cup made of plant fibres and cobwebs and is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	5 – OEH	Low – no suitable habitat in the study area.
<i>Petroica boodang</i>	Scarlet Robin	-	V	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 re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. This species' nest is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	5 – OEH	Low – no suitable habitat in the study area.
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	-	V	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in	92 – OEH	Moderate – records and suitable habitat widespread.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.		
<i>Rostratula australis</i>	Australian Painted Snipe	E, M	E	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. 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.	1 – OEH PMST	Low – wetland habitat in the study area is not considered suitable for this species.
<i>Sternula albifrons</i>	Little Tern	M	E	Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney. Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	1 – OEH	Unlikely – no suitable habitat in the study area.
<i>Tyto novaehollandiae</i>	Masked Owl	-	V	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. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	17 – OEH	Low – this species may fly through the study area on occasion but is unlikely to commonly use the habitat.
<i>Tyto tenebricosa</i>	Sooty Owl	-	V	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	5 – OEH	Unlikely – no suitable habitat in the study area.
Mammals						
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours	11 – OEH	Moderate – foraging habitat present.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	PMST	
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	E	V	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	4 – OEH PMST	Low – few records in locality. Species is known to traverse home ranges along creek lines. This species may pass through however there is very limited habitat features in the study area.
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V	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.	38 – OEH	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Micronomus norfolkensis</i>	Eastern Freetail-bat	-	V	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.	63 – OEH	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Miniopterus australis</i>	Little Bentwing-bat	-	V	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. 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.	132 – OEH	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	-	V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	71 – OEH	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
<i>Myotis macropus (Myotis adversus)</i>	Southern Myotis	-	V	Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	41 – OEH	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
<i>Petauroides Volans</i>	Greater Glider	V	-	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria. This species feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range. Occupy a relatively small home range with an average size of 1 to 3 ha.	8 – OEH PMST	Low – vegetation in study area is not considered ideal for this species.
<i>Petaurus australis</i>	Yellow-bellied Glider	-	V	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.	62 – OEH	Low – numerous records in the locality however there is no habitat in the study area for this species.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	60 – OEH	Low – numerous records in the locality however there is no habitat in the study area for this species.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	E	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. 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.	PMST	Low – no suitable habitat in the study area.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	-	V	Patchy distribution around the coast of Australia. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	4 – OEH	Low – no suitable habitat in the study area.
<i>Phascolarctos cinereus</i>	Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. 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.	9 – OEH PMST	Low – only two records in the last 10 years. One from 2015 is located between Black Hill and Buttai. There may be a low density population in the locality, and a low likelihood that koalas may occur in red gums around the study area. However there is a lack of suitable habitat in the part of the study area that will be impacted.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. 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. The fruit-bodies of hypogeous (underground-fruited) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.	PMST	Low – no suitable habitat in the study area.
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	-	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	5 – OEH PMST	Low – no suitable habitat in the study area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	252 – OEH PMST	High – foraging habitat widespread. Back hill camp 11km SE of the study area and a further 15 camps within 50km.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	9 – OEH	Moderate – foraging habitat widespread. Only one small branch hollow observed in a large Red Gum in the north east compound site.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V	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.	34 – OEH	Moderate – foraging habitat widespread. Only one small branch hollow

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
						observed in a large Red Gum in the north east compound site.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	-	V	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	23 – OEH	Moderate – foraging habitat widespread. Culvert is unlikely to provide roosting habitat due to the lack of cracks and holes and periods of complete inundation.
Amphibians						
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. 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 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	PMST	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	E	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. Ephemeral and permanent	8 – OEH PMST	Low – this species was once present as a key population in the Gillieston Heights / East Maitland / Ravensfield area. It has not been confirmed in the

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.		Middle Hunter since 2000. The habitat in the study area does not meet all the documented attributes for this species as described by Pyke and White (1996). This species has a low potential of occurring in the study area.
<i>Litoria brevipalmata</i>	Green-thighed Frog	-	V	Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland. Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland.	2 – OEH	Low –habitat in study area not considered ideal for this species.
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	1 – OEH PMST	Low –habitat in study area not considered ideal for this species.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. 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	Unlikely – no suitable habitat in study area. No known population nearby.
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	Forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at	PMST	Unlikely – no suitable habitat in study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer.		No known population nearby.
Fish						
<i>Mogurnda adspersa</i>	Purple Spotted Gudgeon	-	E (FM Act)	It occurs in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The western population was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling. The western population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. It is a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams.		Moderate – Wallis Creek is mapped by DPI as indicative habitat for this species. It may spread into Testers Hollow wetland during periods of high rainfall and inundation. The study area does not contain high quality habitat for this species.
Migratory Species (EPBC)						
<i>Actitis hypoleucos</i>	Common Sandpiper	M	-	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	PMST	Low – habitat in study area not considered ideal for this species.
<i>Apus pacificus</i>	Fork-tailed Swift	M	-	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	PMST	Moderate – may fly over the study area on occasion.
<i>Ardea ibis</i>	Cattle Egret	M	-	Widespread and common according to migration movements and breeding localities surveys. Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands.	26 – OEH	Unlikely – no suitable habitat in study area.
<i>Ardenna pacificus</i>	Wedge-tailed Shearwater	M	-	The Wedge-tailed Shearwater breeds on the east and west coasts of Australia and on off-shore islands. The Wedge-tailed	11 – OEH	Unlikely – no suitable habitat in study area.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				Shearwater is a pelagic, marine bird known from tropical and subtropical waters.		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	M	-	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation; this includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. Sometimes they occur on rocky shores and rarely on exposed reefs.	PMST	Unlikely – no suitable habitat in study area.
<i>Calidris melanotos</i>	Pectoral Sandpiper	M	-	In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	PMST	Unlikely – no suitable habitat in study area.
<i>Cuculus optatus</i>	Oriental Cuckoo	M	-	Migrates from Eurasia as far south as Indonesia, New Guinea and North Australia. Some remain through Australia in the winter. Inhabits rainforest margins, monsoon forest, vine scrub and mangroves.	PMST	Unlikely – no suitable habitat in study area.
<i>Gallinago hardwickii</i>	Latham's Snipe	M	-	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in	7 – OEH PMST	Moderate – may occur in wetlands after suitable rainfall.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
				permanent and ephemeral wetlands up to 2000 m above sea-level.		
<i>Limosa lapponica</i>	Bar-tailed Godwit	M	-	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sand flats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	PMST	Low – no suitable habitat in study area.
<i>Merops ornatus</i>	Rainbow Bee-eater	M	-	Distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	22 – OEH	Moderate – suitable habitat widespread.
<i>Monarcha melanopsis</i>	Black-faced Monarch	M	-	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.	PMST	Low – no suitable habitat in study area.
<i>Monarcha trivirgatus</i>	Spectacled Monarch	M	-	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges.	PMST	Low – no suitable habitat in study area.
<i>Motacilla flava</i>	Yellow Wagtail	M	-	Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	PMST	Low – no suitable habitat in study area.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	M	-	Widespread in eastern Australia and vagrant to New Zealand. 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.	PMST	Low – no suitable habitat in study area.
<i>Numerius minutus</i>	Little Curlew	M	-	Little Curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast. The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated.	2 – OEH	Moderate – may occur in wetlands after suitable rainfall.

Species name	Common name	Status		Distribution and habitat	No. records in locality	Likelihood of occurrence
		EPBC Act	BC Act			
<i>Rhipidura rufifrons</i>	Rufous Fantail	M	-	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E. regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>); usually with a dense shrubby understorey often including ferns.	PMST	Low – no suitable habitat in study area.
<i>Tringa nebularia</i>	Common Greenshank	M	-	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.	PMST	Low – no suitable habitat in study area.
<i>Tringa stagnatilis</i>	Marsh Sandpiper	M	-	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	1 – OEH	Moderate – may occur in wetlands after suitable rainfall.
<p>* Distribution and habitat requirement information adapted from: Australian Government Department of the Environment http://www.environment.gov.au/biodiversity/threatened/index.html NSW Office of Environment and Heritage http://www.environment.nsw.gov.au/threatenedspecies/ Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx + Data source includes Number of records from the NSW Office of Environment and Heritage Wildlife Atlas record data (Accessed November 2012); and Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Sustainability, Environment, Water, Populations and Community http://www.environment.gov.au/epbc/pmst/index.html <u>Key:</u> EP = endangered population CE = critically endangered E = endangered V = vulnerable M = migratory</p>						

Appendix B – Assessments of significance

Assessments of significance have been conducted for species, populations and communities that were recorded in the study area during field surveys or were identified as having a moderate or higher potential to occur in the proposal area based on the presence of habitat (see Appendix A).

The proposal will be assessed under Part 5 of the EP&A Act. For threatened biodiversity listed under the BC Act, Part 7 requires that a '5-part test' of significance is undertaken to assess the likelihood of significant impact upon threat-listed species, populations or ecological communities. Section 7.3 of the BC Act outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment.

For threatened biodiversity listed under the FM Act, significance assessments have been completed in accordance with the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007).

For threatened biodiversity listed under the EPBC Act, significance assessments are completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). 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 (Department of Environment, 2013). 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 (Department of Environment, 2013). No threatened species listed under the EPBC Act are considered to have a higher than low potential of occurrence within the study site (Appendix A). As such, no further assessment has been undertaken for these species.

The species subject to assessment are outlined in **Table C.1** along with the predicted impact from the proposal.

Table B.1 Threatened biodiversity subject to this assessment

Species	Status		Predicted impact (habitat in ha)
	BC Act	EPBC Act	
Threatened Ecological Communities			
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	-	0.91 hectares will be removed as part of the proposal.
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	-	0.55 hectares will be removed as part of the proposal.
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	E	-	0.003 hectares will be removed as part of the proposal.
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	E	-	0.06 hectares will be removed as part of the proposal.

Species	Status		Predicted impact (habitat in ha)
	BC Act	EPBC Act	
Threatened flora			
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	V	V	Up to 35 planted juvenile trees will be cleared by the proposal.
Cave-roosting bats			
Eastern Bentwing-bat	V	-	Removal of 1.56 hectares of foraging habitat. Culvert may offer one roosting opportunity at the western end. No expected impact to breeding habitat.
Eastern Cave Bat	V	-	
Large-eared Pied Bat	V	V	
Little Bentwing-bat	V	-	
Southern Myotis	V	-	
Hollow-roosting bats			
Eastern False Pipistrelle	V	-	Removal of 1.56 hectares of foraging habitat. No roosting/breeding habitat likely to be impacted.
Eastern Freetail-bat	V	-	
Greater Broad-nosed Bat	V	-	
Yellow-bellied Sheathtail-bat	V	-	
Mammals			
Grey-headed Flying Fox	V	V	Removal of 0.59 hectares of foraging habitat. No nesting/breeding habitat likely to be impacted.
Birds			
Grey-crowned Babbler	V	-	Removal of 0.59 hectares of foraging habitat. No nesting/breeding habitat likely to be impacted.
Swift Parrot	E	CE	Removal of 0.59 hectares of foraging habitat. No nesting/breeding habitat likely to be impacted.
White-bellied Sea Eagle	V	M	Removal of up to 1.52 hectares of potential foraging habitat. However much of this is likely only moderately suitable during periods of inundation. No nesting/breeding habitat likely to be impacted.
Migratory species			
Fork-tailed Swift	-	M	No expected impact apart from disturbance to individuals flying over.

Species	Status		Predicted impact (habitat in ha)
	BC Act	EPBC Act	
Latham's Snipe	-	M	Removal of 0.91 hectares of foraging habitat. No nesting/breeding habitat likely to be impacted.
Little Curlew	-	M	
Marsh Sandpiper	-	M	

Biodiversity Conservation Act 2016 and Fisheries Management Act 1994

Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (endangered ecological community)

This EEC is contiguous with PCT 1736 and present in various states of condition across the site depending on the current land use, but is generally characterised by a groundcover of native grasses including *Paspalum distichum* and *Cynodon dactylon*. The highest quality areas are in the constructed drain on the west side of Cessnock Road, which connects Testers Hollow with Wallis creek. Macrophyte vegetation in the drain includes *Eleocharis sphacelata*, *Baumea articulata*, *Bolboschoenus medianus* and *Typha orientalis*. To the south of the drain is a modified built up area with three constructed dams, lined with numerous isolated and small patches of *Casuarina glauca* and several *Eucalyptus robusta*. The dams have little macrophyte vegetation, however the smallest to the south contains dense *Typha orientalis* with *Ludwigia peploides*. The remaining areas of PCT 1736 are low lying and highly disturbed from cattle grazing. Despite the large amount of pugged bare ground, these areas are dominated by native grasses, graminoids and sedges. All condition variants of PCT 1736 within the study area have been included in the EEC listing.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened ecological communities or their habitats are outlined below:

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

Not applicable.

- In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:**
 - is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
 - is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

In addressing this question, the local occurrence of this threatened ecological community is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance (Department of Environment and Climate Change 2007)). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the

proposal. Composition refers to the assemblage of species and the physical structure of the community.

Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions is already at risk of extinction and the proposal would exacerbate this risk. However, the proposal is considered unlikely to result in the extinction of the local occurrence of this TEC. The proposal is predicted to remove about 0.91 hectares of this TEC, however this is restricted to mostly low condition areas (see Table C.2). There are larger high quality examples of this TEC to the west of the study area in Testers Hollow.

When the impacts outlined below in Table C.2 are considered in the local context (ie the extent of Testers Hollow wetland), the proportional impacts are very small. The proposal will result in the removal of 0.91 hectares of about 25 hectares (0.04%) of this TEC within Testers Hollow. Depending on where the local occurrence of this TEC stops (considering the proximity of Wallis Creek) this proportional impact could be even smaller. In terms of the impact to the occurrence of this TEC within the locality (ie 10 km), there is no accurate mapping therefore the calculation is based on the occurrence of mapped Key Fish Habitat. The proportional loss here is very low at less than 0.001%. Both the impacts to the local occurrence of this TEC and its occurrence in the locality are small.

Table C.2 Impact on the extent of the threatened ecological community

Threatened ecological community (BC Act)	Condition	Extent of local occurrence (ha)	Potential impact (ha)	Impact as % of local occurrence	Impact in the context of the locality (within 10 km)*
Freshwater wetlands on coastal floodplains of the NSW North Coast; Sydney Basin and South East Corner bioregions (endangered)	Moderate / good	25 (Testers Hollow)	0.09	0.003%	<0.001%
	Low condition		0.82	0.03%	<0.001%
Total				0.91	0.04%**

*3,746 ha of Key Fish Habitat mapped in the locality. No regional vegetation mapping is available for this PCT.

** Total is due to rounding.

The proposal is considered unlikely to substantially and adversely modify the composition of this TEC so that its local occurrence is placed at risk of extinction. There is some potential for the proposal to indirectly impact higher quality examples of this TEC to the west, however these can be managed during construction with appropriate mitigation measures. The local occurrence of this TEC has already been substantially and adversely modified by past land use practices. This TEC is currently suffering from altered composition caused by a reduction in ecological function.

The proposal is not considered likely to further modify the composition of any of the Freshwater wetlands on coastal floodplains within the study area such that the local occurrence is placed at risk of extinction. The composition of the threatened ecological community within the study area is predicted to remain intact after the implementation of the proposal. However, the remaining area would be smaller.

3. In relation to the habitat of a Threatened species, population or ecological community:

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

The extent of Freshwater wetlands on coastal floodplains to be removed because of the proposal is outlined in Table C.2. Overall, the proposal is considered to have a small proportional impact on the local occurrence of this TEC.

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

Fragmentation is unlikely to occur from the proposal as the work would only involve removing a strip of this TEC from the west side of the current road alignment. Importantly, the proposal would not result in the breaking apart of large blocks of high quality examples of Freshwater wetlands on coastal floodplains. The proposal would result in a small increase in the width of the road, however the east and west sides are likely to remain connected by the new culverts.

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

Due to the conservation significance of Freshwater wetlands on coastal floodplains, the remaining areas within NSW are likely to be important for its survival. However, the area of this TEC within the study area is small, largely modified and in generally poor condition. This is however the result of human intervention and this site would likely return to its natural state if undisturbed. The impact here is the removal of an area of floodplain such that it will likely never return to its natural state as freshwater wetlands. However, the impact of the proposal is small when the large areas of this TEC within the locality are considered. As such, areas of Freshwater wetlands on coastal floodplains within the study area can be considered less important than larger high quality examples of this TEC in the locality that retain high levels of ecological integrity and function.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for Freshwater wetlands on coastal floodplains.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs (see Table C.3).

Of the 38 listed KTPs under the BC Act, 11 are applicable to Freshwater wetlands on coastal floodplains. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Table C.3 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.

Key threatening process	Relevance to the proposal
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Yes. The proposal may result in the introduction or spread of amphibian chytrid. However, hygiene measures would be followed to prevent spread of this fungus.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Yes. The proposal may result in the introduction or spread of <i>Phytophthora cinnamomi</i> . However, hygiene measures would be followed to prevent spread of <i>Phytophthora cinnamomi</i> .
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	Yes. The proposal may result in the invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>). However, weed control measures would be followed to prevent invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>).
Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i>	Yes. The proposal may result in the invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i> . However, weed control measures would be followed to prevent invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>Cuspidata</i> .
Invasion, establishment and spread of <i>Lantana camara</i>	Yes. The proposal may result in the invasion and establishment of <i>Lantana camara</i> . However, weed control measures would be followed to prevent invasion and establishment of <i>Lantana camara</i> .
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed)	Yes. The proposal may result in the invasion and establishment of <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed). However, weed control measures would be followed to prevent invasion and establishment of <i>Chrysanthemoides monilifera</i> .
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Key threatening process	Relevance to the proposal
Removal of dead wood and dead trees	Yes. Some dead wood and dead trees may be removed as part of the proposal.

Conclusion

In summary, the proposal is considered unlikely to have an adverse effect on the extent of the Freshwater wetlands on coastal floodplains TEC such that its local occurrence is likely to be placed at further risk of extinction. The impact of the proposal is small when considered in the context of the actual impact in hectares and the extent of the TEC within the broader locality. The proposal is considered unlikely to substantially and adversely modify the composition of this TEC as its current composition within the study area is generally modified.

There is unlikely to be any further increase in fragmentation from the proposal. Areas of Freshwater wetlands on coastal floodplains within the study area are modified and generally in poor condition and are not recognised as important to the long-term survival of the TEC. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

Although it is likely that an ephemeral wetland was previously naturally occurring in this location, a history of land modification has likely increased the size of the wetlands for water retention and agricultural activities. Considering the context of the Freshwater wetlands on coastal floodplains TEC and intensity of the potential impacts from the proposal, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to this TEC.

Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered ecological community)

Casuarina glauca occurs in varying levels of abundance and age across the study area. Historically, it is likely that *Casuarina glauca* would have been the dominant canopy species around the fringes of the low-lying areas of the floodplain. Since the last construction of Cessnock Road, this species has regrown along the road corridor in numerous locations and around the constructed dams where there have been no land use practices to prevent it. All areas of *Casuarina glauca*, including a patch of *Melaleuca styphelioides* and *M. linariifolia*, have been mapped as Swamp Oak - Prickly Paperbark - Tall Sedge swamp forest on coastal lowlands of the Central Coast and Lower North Coast (PCT 1728).

The species complement of this PCT in the study area is typical of a more disturbed Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions which is listed as an endangered ecological community under the BC Act. *Casuarina glauca* is a pioneer species and has likely grown opportunistically along the road corridor and in Lot 949 DP1223319. However, the scientific determination for this TEC does not list any condition thresholds, therefore all condition variants of PCT 1728 within the study area are mapped as this BC Act listed TEC.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened ecological communities or their habitats are outlined below:

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

Not applicable.

2. In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

In addressing this question, the local occurrence of this threatened ecological community is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance (Department of Environment and Climate Change 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is already at risk of extinction and the proposal would exacerbate this risk. However, the proposal is considered unlikely to result in the extinction of the local occurrence of this TEC. The proposal is predicted to remove about 0.55 hectares of this TEC, however this is restricted to regenerating and low condition vegetation (see Table C.4).

Determining the impacts in proportion to the local occurrence of this TEC is somewhat difficult due to the fragmented nature of the landscape. As in the study area, this TEC can occur as isolated regrowth patches throughout the floodplain and as such (in most cases) is not contiguous. In order to determine proportional impacts, it is more appropriate to examine the impact in the context of the locality. Using regional vegetation mapping, the local occurrence of this TEC is either 26 hectares (Swamp Oak Rushland Forest – LHCCREMS) or 85,288 hectares (Swamp Oak / Weeping Grass grassy riparian forest of the Hunter Valley – Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855). This would equate to an impact up to 0.02% using LHCCREMS data, however this number may be smaller as this regional mapping is unlikely to include regrowth occurrences similar to what will be impacted by the proposal. The loss of this TEC is small when the impact in the context of the locality is considered.

Table C.4 Impact on the extent of the threatened ecological community

Threatened ecological community (BC Act)	Condition	Extent of local occurrence (ha)	Potential impact (ha)	Impact as % of local occurrence	Impact in the context of the locality (within 10 km)*
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (endangered)	Regenerating	Local occurrence is not contiguous	0.52	-	0.02%
	Low condition		0.04	-	<0.001%
Total			0.56	-	0.02%

*26 ha of Swamp Oak Rushland Forest (LHCCREMS) mapped in the locality.

The proposal is considered unlikely to substantially and adversely modify the composition of this TEC so that its local occurrence is placed at risk of extinction. The local occurrence of this TEC has already been substantially and adversely modified by past land use practices. This TEC is currently suffering from altered composition caused by a reduction in ecological function.

The proposal is not considered likely to further modify the composition of any of the Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions within the study area such that the local occurrence is placed at risk of extinction. The composition of the threatened ecological community within the study area is predicted to remain intact after the implementation of the proposal. However, the remaining patches would be smaller.

3. In relation to the habitat of a Threatened species, population or ecological community:

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

The extent of Swamp Oak Floodplain Forest to be removed because of the proposal is outlined in Table C.2. Overall, the proposal is considered to have a small proportional impact on the local occurrence of this TEC.

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

Fragmentation is unlikely to occur from the proposal as the work would largely involve removing vegetation from patch edges rather than breaking apart of large blocks of vegetation into many smaller patches. Importantly, the proposal would not result in the breaking apart of large blocks of high quality examples of threatened ecological communities. No further habitat fragmentation on a landscape scale would occur because of the proposal.

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

Due to the conservation significance of Swamp Oak Floodplain Forest, the remaining patches within NSW are likely to be important for its survival. However, the patches within the study area are small, are largely degraded and in moderate to poor condition and in many cases are the result of human intervention. Furthermore, no patches of vegetation in the study area have been recognised as priority conservation land or as part of core habitats or regional corridors by the OEH. As such, the TEC patches within the study area can be considered less important than larger high quality examples of this TEC in the locality that retain high levels of ecological integrity and function.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs (see Table C.5).

Of the 38 listed KTPs under the BC Act, 11 are applicable to Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Table C.5 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Yes. The proposal may result in the introduction or spread of amphibian chytrid. However, hygiene measures would be followed to prevent spread of this fungus.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Yes. The proposal may result in the introduction or spread of <i>Phytophthora cinnamomi</i> . However, hygiene measures would be followed to prevent spread of <i>Phytophthora cinnamomi</i> .
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	Yes. The proposal may result in the invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>). However, weed control measures would be followed to prevent invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>).
Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i>	Yes. The proposal may result in the invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i> . However, weed control measures would be followed to prevent invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>Cuspidata</i> .
Invasion, establishment and spread of <i>Lantana camara</i>	Yes. The proposal may result in the invasion and establishment of <i>Lantana camara</i> . However, weed control measures would be followed to prevent invasion and establishment of <i>Lantana camara</i> .

Key threatening process	Relevance to the proposal
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed)	Yes. The proposal may result in the invasion and establishment of <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed). However, weed control measures would be followed to prevent invasion and establishment of <i>Chrysanthemoides monilifera</i> .
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.
Removal of dead wood and dead trees	Yes. Some dead wood and dead trees may be removed as part of the proposal.

Conclusion

In summary, the proposal is considered unlikely to have an adverse effect on the extent of the Swamp Oak Floodplain Forest TEC such that its local occurrence is likely to be placed at further risk of extinction. The impact of the proposal is small when considered in the context of the actual impact in hectares and the extent of the TEC within the broader locality. The proposal is considered unlikely to substantially and adversely modify the composition of this TEC as its current composition within the study area is generally modified.

There is unlikely to be any further increase in fragmentation from the proposal. Vegetation within the study area is not recognised as important to the long-term survival of this TEC in the locality as the patches are small, in poor to moderate condition. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

Considering the context of the Swamp Oak Floodplain Forest TEC and intensity of the potential impacts from the proposal, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to this TEC.

Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion (endangered ecological community)

The occurrence of this TEC is in the form of isolated remnant trees and regenerating roadside vegetation. Since the last construction of Cessnock Road, vegetation has regrown back into the road corridor where there are no land use practices to prevent it. In the north of the study area this includes a very narrow strip of young trees dominated by *Corymbia maculata* and *Eucalyptus crebra* with no midstorey and limited groundcover vegetation. This vegetation is derived from the isolated and small patches of remnant trees in the cleared paddocks across the hillside. No detailed floristic analysis was undertaken within these thin patches, however they contain the canopy species diagnostic of the Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion endangered ecological community and have been mapped as a regenerating condition variant. Several large remnant trees within the north west compound site have also been assigned to this TEC as low condition.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened ecological communities or their habitats are outlined below:

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

Not applicable

2. **In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:**
 - i. **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
 - ii. **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

In addressing this question, the local occurrence of this threatened ecological community is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance (Department of Environment and Climate Change 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion is already at risk of extinction and the proposal would exacerbate this risk. However, the proposal is considered unlikely to result in the extinction of the local occurrence of this TEC. The proposal is predicted to remove about 0.003 hectares of this TEC, however this is restricted to low condition roadside vegetation.

The proposal is considered unlikely to substantially and adversely modify the composition of this TEC so that its local occurrence is placed at risk of extinction. The local occurrence of this TEC has already been substantially and adversely modified by past land use practices. This TEC is currently suffering from altered composition caused by a reduction in ecological function.

The proposal is not considered likely to further modify the composition of any of the Lower Hunter Spotted Gum - Ironbark Forest within the study area such that the local occurrence is placed at risk of extinction. The composition of the threatened ecological community within the study area is predicted to remain intact after the implementation of the proposal. However, the remaining patches would be smaller.

3. **In relation to the habitat of a Threatened species, population or ecological community:**
 - i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The extent of Lower Hunter Spotted Gum - Ironbark Forest to be removed because of the proposal is outlined in Table C.2. Overall, the proposal is considered to have a small proportional impact on the local occurrence of this TEC.

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

Fragmentation is unlikely to occur from the proposal as the work would only involve removing a thin strip of regenerating roadside vegetation. Importantly, the proposal would not result in the breaking apart of large blocks of high quality examples of Lower Hunter Spotted Gum - Ironbark Forest. No further habitat fragmentation on a landscape scale would occur because of the proposal. The remaining patch of this TEC however would be smaller as a result of the proposal.

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

Due to the conservation significance of Lower Hunter Spotted Gum - Ironbark Forest, the remaining patches within NSW are likely to be important for its survival. However, the patches within the study area are small, are largely degraded and in poor condition. Furthermore, no patches of vegetation in the study area have been recognised as priority conservation land or as part of core habitats or regional corridors by the OEH. As such, the TEC patches within the study area can be considered less important than larger high quality examples of this TEC in the locality that retain high levels of ecological integrity and function.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs (see Table C.5).

Of the 38 listed KTPs under the BC Act, 11 are applicable to Lower Hunter Spotted Gum - Ironbark Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Table C.5 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Yes. The proposal may result in the introduction or spread of amphibian chytrid. However, hygiene measures would be followed to prevent spread of this fungus.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Yes. The proposal may result in the introduction or spread of <i>Phytophthora cinnamomi</i> . However, hygiene measures would be followed to prevent spread of <i>Phytophthora cinnamomi</i> .

Key threatening process	Relevance to the proposal
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	Yes. The proposal may result in the invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>). However, weed control measures would be followed to prevent invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>).
Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i>	Yes. The proposal may result in the invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i> . However, weed control measures would be followed to prevent invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>Cuspidata</i> .
Invasion, establishment and spread of <i>Lantana camara</i>	Yes. The proposal may result in the invasion and establishment of <i>Lantana camara</i> . However, weed control measures would be followed to prevent invasion and establishment of <i>Lantana camara</i> .
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed)	Yes. The proposal may result in the invasion and establishment of <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed). However, weed control measures would be followed to prevent invasion and establishment of <i>Chrysanthemoides monilifera</i> .
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.
Removal of dead wood and dead trees	Yes. Some dead wood and dead trees may be removed as part of the proposal.

Conclusion

In summary, the proposal is considered unlikely to have an adverse effect on the extent of the Lower Hunter Spotted Gum - Ironbark Forest TEC such that its local occurrence is likely to be placed at further risk of extinction. The impact of the proposal is small when considered in the context of the

actual impact in hectares and the extent of the TEC within the broader locality. The proposal is considered unlikely to substantially and adversely modify the composition of this TEC as its current composition within the study area is generally modified.

There is unlikely to be any further increase in fragmentation from the proposal. Vegetation within the study area is not recognised as important to the long-term survival of this TEC in the locality as the patches are small, in poor condition. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

Considering the context of the Lower Hunter Spotted Gum - Ironbark Forest TEC and intensity of the potential impacts from the proposal, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to this TEC.

Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions (endangered ecological community)

The largest occurrence of this TEC is in the south west of the study area (Lot 22 DP785275). However, this vegetation was not able to be accessed during the field survey and therefore no detailed floristic surveys were undertaken. This block of woodland was only viewed from the road corridor as part of this assessment and the dominant and obvious species were noted including scattered large *Eucalyptus tereticornis* and a midstorey of *Casuarina glauca*, *Melaleuca styphelioides* and *M. sieberi*. Without undertaking a detailed floristic analysis, this classification as PCT 1598 should be considered a high-level assessment. However, this patch of woodland in Lot 22 DP785275 is not expected to be impacted by the works. Impact to this TEC will be clearing of large isolated trees (likely planted or natural regrowth).

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened ecological communities or their habitats are outlined below:

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

Not applicable.

- 2. In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:**
 - i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
 - ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

In addressing this question, the local occurrence of this threatened ecological community is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance (Department of Environment and Climate Change 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community will become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions is already at risk of extinction and the proposal would exacerbate this risk. However, the proposal is considered unlikely to result in the extinction of the local occurrence of this TEC. The proposal is predicted to remove a row of eight isolated large *Eucalyptus tereticornis* trees (around 0.06 hectares) within the existing road corridor that belong to this TEC. This vegetation is not contiguous with a larger patch.

The proposal is considered unlikely to substantially and adversely modify the composition of this TEC so that its local occurrence is placed at risk of extinction. The local occurrence of this TEC has already been substantially and adversely modified by past land use practices. This TEC is currently suffering from altered composition caused by a reduction in ecological function.

The proposal is not considered likely to further modify the composition of any of the Hunter Lowland Redgum Forest within the study area such that the local occurrence is placed at risk of extinction. Apart from the small patch of eight trees that will be removed, the composition of the threatened ecological community within the study area is predicted to remain intact after the implementation of the proposal.

3. In relation to the habitat of a Threatened species, population or ecological community:

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

The proposal will result in the removal of a row of eight large *Eucalyptus tereticornis* trees within the existing road corridor that belong to the Hunter Lowland Redgum Forest TEC. Overall, the proposal is considered to have a small proportional impact on the local occurrence of this TEC (Table C.8).

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

Fragmentation is unlikely to occur from the proposal as the work would only involve removing a thin strip of regrowth roadside vegetation. Importantly, the proposal would not result in the breaking apart of large blocks of high quality examples of Hunter Lowland Redgum Forest. No further habitat fragmentation on a landscape scale would occur because of the proposal.

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

Due to the conservation significance of Hunter Lowland Redgum Forest, the remaining patches within NSW are likely to be important for its survival. However, the examples of this TEC within the study area are small and modified. Furthermore, no patches of vegetation in the study area have been recognised as priority conservation land or as part of core habitats or regional corridors by the OEH. As such, the TEC patches within the study area can be considered less important than larger high quality examples of this TEC in the locality that retain high levels of ecological integrity and function.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for Hunter Lowland Redgum Forest.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs (see Table C.5).

Of the 38 listed KTPs under the BC Act, 10 are applicable to Hunter Lowland Redgum Forest. However, hygiene and weed control measures would reduce or avoid the impact of most KTPs with the exception of clearing of native vegetation and removal of dead wood and dead trees.

Table C.5 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the proposal
Clearing of native vegetation	Yes. The proposal would result in clearing of native vegetation.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Yes. The proposal may result in the introduction or spread of amphibian chytrid. However, hygiene measures would be followed to prevent spread of this fungus.
Infection of native plants by <i>Phytophthora cinnamomi</i>	Yes. The proposal may result in the introduction or spread of <i>Phytophthora cinnamomi</i> . However, hygiene measures would be followed to prevent spread of <i>Phytophthora cinnamomi</i> .
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Yes. The proposal may result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Yes. The proposal may result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	Yes. The proposal may result in the invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>). However, weed control measures would be followed to prevent invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>).
Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i>	Yes. The proposal may result in the invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i> . However, weed control measures would be followed to prevent invasion and establishment of African Olive <i>Olea europaea</i> L. subsp. <i>Cuspidata</i> .
Invasion, establishment and spread of <i>Lantana camara</i>	Yes. The proposal may result in the invasion and establishment of <i>Lantana camara</i> . However, weed control measures would be followed to prevent invasion and establishment of <i>Lantana camara</i> .

Key threatening process	Relevance to the proposal
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed)	Yes. The proposal may result in the invasion and establishment of <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed). However, weed control measures would be followed to prevent invasion and establishment of <i>Chrysanthemoides monilifera</i> .
Invasion of native plant communities by exotic perennial grasses	Yes. The proposal may result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to prevent invasion and establishment of exotic perennial grasses.

Conclusion

In summary, the proposal is considered unlikely to have an adverse effect on the extent of the Hunter Lowland Redgum Forest TEC such that its local occurrence is likely to be placed at further risk of extinction. The impact of the proposal is small and limited to the removal of eight isolated roadside trees. This impact is minimal when considered in the context of the extent of the TEC within the broader locality. The proposal is considered unlikely to substantially and adversely modify the composition of this TEC as its current composition within the study area is generally modified.

There will not be any further increase in fragmentation from the proposal. Vegetation within the study area is not recognised as important to the long-term survival of this TEC in the locality as the patches are small and modified. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation.

Considering the context of the Hunter Lowland Redgum Forest TEC and intensity of the potential impacts from the proposal, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to this TEC.

Eucalyptus parramattensis subsp. *decadens*

The eastern portion of Lot 949 DP1223319 located in the southern section of the proposal area contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). *Eucalyptus parramattensis* subsp. *decadens* is listed as vulnerable under the BC Act. It is unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most are surrounded by plastic tree guards. The offset for the residential subdivision in Cliftleigh required 300 individuals to be planted, and therefore there may be up to 300 individuals planted in Lot 949 DP1223319, including in areas not impacted by the proposal (Harper Somers O'Sullivan 2007) (refer to Chapter 6). Some of the trees in the study area do not have tree guards and may be either *Eucalyptus tereticornis* or *E. amplifolia*. Species identification is difficult at the juvenile stage and some tree guards may have been washed away in previous floods. Therefore, from an impact perspective, it is assumed that all the trees are *Eucalyptus parramattensis* subsp. *decadens*.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

The action will result in the removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees. These are part of up to 300 *Eucalyptus parramattensis* subsp. *decadens* trees that were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). These planted trees are only at a juvenile life stage and are not currently contributing to reproduction of the important population. It is possible that the chosen location for planting these *Eucalyptus parramattensis* subsp. *decadens* trees is not entirely suitable due to a long history of grazing. *Casuarina glauca* seedlings are growing around the planted trees, which may be the community that ultimately regenerates in this location. Considering this, the removal of these 35 trees is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of *Eucalyptus parramattensis* subsp. *decadens* is likely to be placed at risk of extinction, particularly if the trees are translocated prior to construction.

2. In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. In relation to the habitat of a Threatened species, population or ecological community:

- i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The action will result in the removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees. The action will result in a very small decrease in the availability of marginal habitat (i.e. cleared pasture) for *Eucalyptus parramattensis* subsp. *decadens*.

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

The 35 *Eucalyptus parramattensis* subsp. *decadens* planted trees which would be removed form an outlying part of this important population to the north of where the remaining mature trees are located in the subdivision. The removal of these trees would not fragment the important population, only reduce the number/area of planted trees from the eastern edge.

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

Critical habitats for *Eucalyptus parramattensis* subsp. *decadens* in the locality include the low nutrient soils, typically associated with the 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion' endangered ecological community. None of this community occurs within the proposed impact area and it is possible that the location where these trees have been planted is not totally suitable. Although it is unknown when the trees were planted, they appear to be potentially having trouble establishing due to the long history of disturbance on the site. Considering this, the paddock in Lot 949 DP1223319 where these trees have been planted is not considered to be habitat critical to the survival of this species.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act.

The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for *Eucalyptus parramattensis* subsp. *decadens*.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, three are relevant to the proposal and *Eucalyptus parramattensis* subsp. *decadens*:

- Clearing of native vegetation
- Infection of native plants by *Phytophthora cinnamomi*
- Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

Through the removal of vegetation and machinery activity, the proposal is part of these KTPs. However, given the minimal removal of vegetation, hygiene measures that would be followed to prevent spread disease, presence of areas of greater habitat in the locality and the high mobility of the species likely to be affected, the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

Up to 35 planted juvenile *Eucalyptus parramattensis* subsp. *decadens* trees from an isolated stand of up to 300 planted trees situated in roadside pasture will be removed by the action. These trees are intended to form part of the local important population, however do not currently contribute to reproduction of the species. The impact of removing these juvenile trees will represent a small reduction in the extent of the local important population, however it may be possible to translocate these trees prior to construction. The local occurrence of this species will persist after the action is built as the larger population will not be disturbed. Given the context and intensity of the potential impact and the impact magnitude, a significant impact to *Eucalyptus parramattensis* subsp. *decadens* is considered unlikely.

Cave-roosting bats

This assessment concerns the following threatened microbats species:

- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)
- Little Bentwing-bat (*Miniopterus australis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Southern Myotis (*Myotis macropus*).

These species of bat that are known to roost in caves, derelict mines, storm-water tunnels, culverts, bridges, buildings and other man-made structures. None of these species were observed during the field survey or recorded in the study area with the call detectors. However, they are known from the locality and there is potential habitat within the study area. Additionally, the Eastern Bentwing-bat and Little Bentwing Bat have been recorded on the site during previous surveys (Harper Somers

O'Sullivan 2005). Very limited roosting habitat is offered by the culvert though the wetlands and vegetation are suitable foraging habitat. As such these species are considered moderately likely to occur in the study area.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

The Eastern Bentwing-bat primarily roosts in caves, but will also use derelict mines, storm-water tunnels, buildings and other man-made structures. The Eastern Bentwing-bat forms populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 kilometre range of maternity caves. The Eastern Bentwing-bat hunts in forested areas.

The Little Bentwing-bat inhabits moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. It is 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. At night this species forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Eastern Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young. Both species are obligate cave breeders. Maternity colonies form in spring and birthing occurs in early summer. Males and juveniles disperse in summer. Only five nursery sites / maternity colonies are known in Australia (Office of Environment and Heritage, 2017).

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest.

The Southern Myotis generally roosts close to water in caves, mine shafts, hollow-bearing trees, storm-water channels, buildings, under bridges and in dense foliage. The Southern Myotis forages over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW, females have one young each year usually in November or December.

The Large-eared Pied Bat is considered moderately likely to occur within the study area based on the presence of suitable foraging habitat and nearby records.

These five species are known from the locality. Additionally, the Eastern Bentwing-bat and Little Bentwing Bat have been recorded on the site during previous surveys (Harper Somers O'Sullivan 2005). A targeted survey during the field survey did not identify any of these species however suitable foraging habitat is widespread. An inspection of the culvert identified only one marginal roosting opportunity in the culvert join near the western end of the culvert. All the other joins are sealed. As the culvert is prone to being completely inundated during periods of high rainfall it is unlikely to offer any high quality roosting opportunities, however roosting is still possible. The main impact to these species will be the small loss of foraging habitat.

The proposal would remove about 1.56 hectares of potential foraging habitat for these species, however habitat to be impacted primarily consists of low quality roadside vegetation and open areas around the wetland. The proposal will result in the replacement of the culvert under Cessnock Road and therefore loss of possible low quality roosting habitat, however the potential for roosting bats in the culvert is considered to be low. Foraging, movement and other life-cycle attributes would not be

impacted. Overall, the proposal is unlikely to reduce the population size of these bat species or decrease their reproductive success.

2. In the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. In relation to the habitat of a Threatened species, population or ecological community:

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

The proposal will remove 1.56 hectares of vegetation which provides foraging habitat for these species within the study area. This includes a small collection of regrowth roadside trees and open areas of low quality wetland. The proposal may also result in the removal of low condition roosting opportunities in the culvert. No significant high quality habitat features, such as maternal roosts, have been identified in the study area. Considerable foraging habitat can be found nearby in the locality for these species.

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

Vegetation within the study area is already sparse and largely fragmented due to historical disturbances such as agriculture and grazing. The minimal removal of vegetation as a result of the proposal, which comprises a small collection of regrowth roadside trees and open areas of low quality wetland, is unlikely to fragment or isolate the highly mobile species identified or likely to occur within the study area. These species will freely fly over long distances between habitats.

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

The vegetation in the study area would form a small component of a larger foraging range for these species. Testers Hollow and associated wetland habitats are likely to be a focal point of foraging activity, less so are the edges of study area. The loss of native vegetation from the study area would reduce the amount of foraging habitat available for these species by a small amount. However, when compared to the larger and higher quality vegetation remnants in the locality, the vegetation within the study area is not considered as important for the long-term survival of these species in the locality. There is low potential that the culvert is used for roosting given the amount of visible opportunities (eg cracks and holes). If the culvert does offer suitable roosting habitat, it may be used opportunistically by individuals passing through the locality. No high quality roosting habitat or maternity site would be impacted by the proposal.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for these bat species.

5. Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP.

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, two are relevant to the proposal and these insectivorous bat species:

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

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation, presence of areas of greater habitat in the locality and the high mobility of the species likely to be affected, the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal is likely to remove a small extent of foraging habitat for the discussed bat species. However, higher value foraging habitat can be found within the locality and the high mobility of these species means that that can easily move between habitat patches.

There is low potential that the culvert is used for roosting given the amount of visible opportunities (eg cracks and holes). If the culvert does offer suitable roosting habitat, it may be used opportunistically by individuals passing through the locality. No high quality roosting habitat or maternity site would be impacted by the proposal.

The proposal is unlikely to reduce the population size of these species in the locality or decrease their reproductive success. The proposal would not interfere with their recovery and would not contribute to the key threats to these species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to threatened cave roosting bats.

Hollow-roosting bats

This assessment concerns the following threatened microbat species:

- Eastern Freetail-bat (*Micronomus norfolkensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*).

These species are known to roost in tree hollows, under bark, or sometimes in man-made structures. None of these species were observed during the field survey or recorded in the study area with the call detectors. However, they are known from the locality and there is potential habitat within the study area. Additionally, the Eastern Freetail-bat has been recorded on the site during previous surveys (Harper Somers O'Sullivan 2005). Very limited roosting habitat is offered as only one hollow-bearing tree was identified in the north western compound site.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

1. in the case of a Threatened species, whether the action proposed is likely to

The Eastern Freetail-bat inhabits dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.

The Eastern False Pipistrelle prefers to inhabit moist habitats with mature trees taller than 20 m. This species generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. The Eastern False Pipistrelle hibernates in winter and females are pregnant in late spring to early summer.

The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. It 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 three to six metres. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.

The Yellow-bellied Sheathtail-bat roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. The Yellow-bellied Sheathtail-bat forages in most habitats including forested areas and open paddocks. Breeding has been recorded from December to mid-March, when a single young is born. The seasonal movements of this species are unknown but there is speculation about a migration to southern Australia in late summer and autumn.

The study area is likely to provide foraging habitat for these species, however roosting habitat is very limited. Suitable foraging habitat is present throughout the study area where vegetation is present and over open wetland areas (ie more insect prey available around the wetland). The Eastern Freetail-bat is a fast flyer and will exploit the edges of vegetation and open treeless areas for foraging. As such, potential foraging habitat for this species is widespread in the study area. Only one hollow bearing tree was identified during the field survey, however it is in the potential north west compound site and unlikely to be impacted by the works. No breeding habitat is likely to be impacted by the proposal.

The proposal would result in the removal of about 1.56 hectares of potential foraging habitat for these species. No hollow-bearing trees are likely to be impacted by the proposal. The local population of these species is likely to use the habitat resources within the study area as part of a larger habitat matrix. These species are capable of flying large distances and the removal of this small amount of vegetation is unlikely to impact these species when the amount of similar and better quality habitat in the locality is considered. It is unlikely that the proposal would have an adverse effect on the lifecycle of these species such that a viable local population is likely to be placed at risk of extinction.

2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. in relation to the habitat of a Threatened species, population or ecological community:

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

The proposal will remove 1.56 hectares of vegetation which provides foraging habitat for these species within the study area. This includes a small collection of regrowth roadside trees and open areas of low quality wetland. The proposal is unlikely to impact on any roosting or breeding habitat. Considerable foraging habitat can be found nearby in the locality for these species.

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

Vegetation within the study area is already sparse and largely fragmented due to historical disturbances such as agriculture and grazing. The minimal removal of vegetation as a result of the proposal, which comprises a small collection of regrowth roadside trees and open areas of low quality wetland, is unlikely to fragment or isolate the highly mobile species identified or likely to occur within the study area. These species will freely fly over long distances between habitats.

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

The vegetation in the study area would form a small component of a larger foraging range for these species. Testers Hollow and associated wetland habitats are likely to be a focal point of foraging activity, less so are the edges of study area. The loss of native vegetation from the study area would reduce the amount of foraging habitat available for these species by a small amount. However, when compared to the larger and higher quality vegetation remnants in the locality, the vegetation within the study area is not considered as important for the long-term survival of these species in the locality. No roosting habitat or maternity site is likely to be impacted by the proposal.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs has been listed for these bat species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, two are relevant to the proposal and this insectivorous bat species:

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

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation, presence of areas of greater habitat in the locality and the high mobility of the species likely to be affected, the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal is likely to remove a small extent of foraging habitat for these five bat species as a result of the proposal. However, higher value foraging habitat can be found directly adjacent to the study area and further away in the locality. The high mobility of these species means that they can easily move between habitat patches. No roosting habitat or maternity site is likely to be impacted by the proposal.

The proposal is unlikely to reduce the population size of these species in the locality or decrease their reproductive success. The proposal would not interfere with their recovery and would not contribute to the key threats to these species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to threatened cave roosting bats.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

While the Grey-headed Flying-fox was not recorded in the study area during the field survey it is considered likely to occur based on the presence of suitable foraging habitat and the nearby location of a known roosting camp at Black Hill (11 kilometres SE of the study area) and a further 15 camps within 50km.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

The Grey-headed Flying-fox is widespread throughout their range in summer, whilst in autumn it occupies coastal lowlands and is uncommon inland. In winter, the species congregates in coastal lowlands north of the Hunter Valley and is occasionally found on the south coast of NSW (associated with flowering *Corymbia maculata*) and on the northwest slopes (generally associated with flowering White Box *Eucalyptus albens* or Mugga Ironbark *E. sideroxylon*) (NSW DECCW 2010). The Grey-headed Flying-fox roosts in aggregations of various sizes on exposed branches. Roost sites are typically located within 20 km of a regular food source and near water, such as lakes, rivers or the coast (van der Ree et al. 2005).

There are no roost camps located in the study area and at the time of this assessment the proposal would not directly impact on any known breeding / maternity site. There are sixteen camps within 50 kilometres of the study area, including the Back Hill camp which is 11 kilometres southeast of the study area. As such, the impacts of the proposal to the Grey-headed Flying-fox will be limited to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

Eucalyptus tereticornis and *Corymbia maculata* have been identified as an important winter food source and critical foraging habitat for the species (DECCW 2009). Therefore, the presence of these trees on the site represents critical foraging habitat for the species. The proposal will remove up to 0.59 hectares of important foraging habitat. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the relative

widespread nature of similar vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species.

2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. in relation to the habitat of a Threatened species, population or ecological community:

- i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal would remove about 0.59 hectares of important foraging habitat for the Grey-headed Flying Fox however habitat to be impacted primarily consists of low quality roadside vegetation and remnant paddock trees, including winter flowering species *Eucalyptus tereticornis* and *Corymbia maculata*. There are no roost camps located in the study area and at the time of this assessment the proposal would not directly impact on any known breeding / maternity site. The proposed removal of foraging habitat is small when the amount of available foraging habitat within the foraging range of this species is considered.

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

Importantly, the proposal will not result in fragmentation of habitat for the Grey-headed Flying Fox. No large blocks of high quality habitat for this species will be fragmented by the proposal. The study area is already fragmented by clearing for agricultural practices and by the existing road corridor. The proposal will only result in a slight widening of this. The Grey-headed Flying Fox is highly mobile and capable of existing in a fragmented landscape. The proposal will not result in any barriers that will restrict movement. The proposal will not affect the movement of this species between habitat patches.

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

Eucalyptus tereticornis and *Corymbia maculata* have been identified as an important winter food source and critical foraging habitat for the species (DECCW 2009). Therefore, the presence of these trees on the site represents critical foraging habitat for the species. However, this area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the high mobility of this species and the proximity of large areas of native vegetation in the locality, the small area of habitat to be removed is unlikely to be important to the long-term survival of a local population of the Grey-headed Flying Fox.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act.

The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs have been listed for this species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- Adversely affects threatened species, populations of a species or ecological communities
- Could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and Grey-headed Flying Fox.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The Grey-headed Flying-fox will suffer a small reduction in extent of suitable foraging habitat from the proposal. No camps or other important habitat will be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Grey-headed Flying-fox and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

The Grey-crowned Babbler is considered highly likely to utilise the habitats in the study area for foraging based on the presence of close records.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

In NSW, the eastern sub-species of the Grey-crowned Babbler occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as south and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. The species builds conspicuous dome-shaped nests and breeds co-operatively in sedentary family groups of 2-13 birds (Davidson and Robinson 1992). Nests are maintained year round, and old nests are often dismantled to build new ones. Grey-crowned Babblers are insectivorous and forage in leaf litter and on bark of trees.

The proposal would result in the removal of about 0.59 hectares of potential habitat for the Grey-crowned Babbler, however habitat to be impacted primarily consists of low quality roadside vegetation. Most of the impact will be to planted trees. Shelter and food resources in the study area

are likely to be important for the life cycle of a local population of these species, however there is a low potential that the proposal would adversely affect the life-cycle the species to be impacted given the widespread occurrence of suitable foraging habitat. No evidence of breeding was observed. The proposal is not expected to impact on a population of these woodland birds given the limited amount of vegetation requiring clearing for the proposal. The vegetation clearing as a result of the proposal would not result in a viable local population of Grey-crowned Babblers being at risk of extinction.

2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. in relation to the habitat of a Threatened species, population or ecological community:

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal would remove about 0.59 hectares of potential foraging habitat for the Grey-crowned Babbler, however habitat to be impacted primarily consists of low quality roadside vegetation. Most of the impact will be to planted trees. The proposed removal of habitat is small when the amount of available foraging habitat within foraging range of this species is considered.

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

Importantly, the proposal will not result in fragmentation of habitat for the Grey-crowned Babbler. No large blocks of high quality habitat for this species will be fragmented by the proposal. The study area is already fragmented by clearing for agricultural practices and by the existing road corridor. The proposal will only result in a slight widening of this. The Grey-crowned Babbler is highly mobile and capable of existing in a fragmented landscape. The proposal will not result in any barriers that will restrict movement. The proposal will not affect the movement of this species between habitat patches.

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

The proposal would remove foraging habitat containing invertebrates and seeds. Potential nesting trees will be impacted, however there was no evidence of breeding during the field survey. Large areas of high-quality foraging habitat are present within the locality. Given the high mobility of this species and the proximity of large areas of native vegetation in the locality, the habitat to be removed is unlikely to be important to the long-term survival of a local population of the Grey-crowned Babbler.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs have been listed for this species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and Grey-crowned Babbler.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal would remove about 0.59 hectares of potential foraging habitat for the Grey-crowned Babbler. No breeding or nesting habitat is likely to be impacted. The extent of potential habitat removal is not considered likely to result in an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction. The study area is considered likely to form part of a larger home range for a local population of the Grey-crowned Babbler. However, the study area is not considered to form any core high quality habitat. The proposal is considered unlikely to reduce the size of a local population of this species or decrease its reproductive success. The proposal would not interfere with recovery actions for the Grey-crowned Babbler. The proposal would however contribute to some KTPs that are known to affect this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to any of the Grey-crowned Babbler.

Swift Parrot (*Lathamus discolor*)

The Swift Parrot is considered moderately likely to utilise the habitats in the study area for foraging based on the presence of close records.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

The Swift Parrot is endemic to south-eastern Australia and breeds only in Tasmania, and migrates to mainland Australia in autumn. This species is semi-nomadic during winter, foraging in dry woodlands mainly in Victoria and New South Wales. Key habitats for the species on the coast and coastal plains of New South Wales include Spotted Gum (*Corymbia maculata*), Swamp Mahogany (*Eucalyptus robusta*), Red Bloodwood (*C. gummifera*) and Forest Red Gum (*E. tereticornis*) forests. These tree species provide foraging and roosting habitat for the species. The Swift Parrot feeds mostly on nectar, mainly from eucalypts, but also eats psyllid insects and lerps, seeds and fruit. Coastal Grey Box (*E. moluccana*) and Red Bloodwood (*C. gummifera*) are important nectar sources in coastal parts of the non-breeding range. As a specialist nectarivore, dependent on flowering eucalypts in both breeding and non-breeding parts of its range, Swift Parrots are vulnerable to the loss of quantity and quality of key forage tree species. As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat, but continued habitat loss and disturbance processes threaten the Swift Parrot's survival.

The Swift Parrot was not observed during the field survey, however has been recorded previously in the locality. Most records are from west of Kurri Kurri where this species is known to reoccur each year in winter. Habitat for this species is widespread in the area, however confined to foraging habitat in the form of a small number of *Eucalyptus tereticornis* and *Corymbia maculata*, two winter flowering species, in the study area. No hollow-bearing trees were identified, except one small branch hollow in the north east compound site. The Swift Parrot is not considered to be a frequent visitor in the study area.

The proposal would result in the removal of about 0.64 hectares of potential foraging habitat for this species, however habitat to be impacted primarily consists of low quality roadside vegetation. Shelter and food resources in the study area are likely to be important for the life cycle of Swift Parrots migrating into and through the locality in winter. However, there is a low potential that the proposal would adversely affect the life-cycle the species to be impacted given the widespread occurrence of suitable foraging habitat. The proposal is not expected to impact on a population of the Swift Parrot given the limited amount of vegetation requiring clearing for the proposal. The vegetation clearing as a result of the proposal would not result in a viable local population of the Swift Parrot being placed at risk of extinction.

2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. in relation to the habitat of a Threatened species, population or ecological community:

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal would remove about 0.64 hectares of potential foraging habitat for the Swift Parrot, however habitat to be impacted primarily consists of low quality roadside vegetation and remnant paddock trees, including winter flowering species *Eucalyptus tereticornis* and *Corymbia maculata*. No key breeding areas will be impacted. The proposed removal of habitat is small when the amount of available foraging habitat within the foraging range of this species is considered.

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

Importantly, the proposal will not result in fragmentation of habitat for the Swift Parrot. No large blocks of high quality habitat for this species will be fragmented by the proposal. The study area is already fragmented by clearing for agricultural practices and by the existing road corridor. The proposal will only result in a slight widening of this. The Swift Parrot is highly mobile and capable of existing in a fragmented landscape. The proposal will not result in any barriers that will restrict movement. The proposal will not affect the movement of this species between habitat patches.

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

The proposal would remove foraging habitat containing nectar, invertebrates and seeds. Two winter flowering species, *Eucalyptus tereticornis* and *Corymbia maculata*, are present in the study area and widespread throughout the locality. The Swift Parrot is only likely to pass through the study area in search of foraging resources and therefore the habitat to be removed is not considered important. Large areas of high-quality foraging habitat are present within the locality. Given the high mobility of this species and the proximity of large areas of native vegetation in the locality, the small area of habitat to be removed is unlikely to be important to the long-term survival of a local population of the Swift Parrot.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs have been listed for this species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and Swift Parrot.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal would remove about 0.64 hectares of potential foraging habitat for the Swift Parrot. No breeding or nesting habitat is likely to be impacted. The extent of potential habitat removal is not considered likely to result in an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction. Shelter and food resources in the study area are likely to be important for the life cycle of Swift Parrots migrating into and through the locality in winter. However, the study area is not considered to form any core high quality habitat. The proposal is considered unlikely to reduce the size of a local population of this species or decrease its reproductive success. The proposal would not interfere with recovery actions for the Swift Parrot. The proposal would however contribute to some KTPs that are known to affect this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to any of the Swift Parrot.

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

The White-bellied Sea Eagle is considered highly likely to utilise the habitats in the study area for perching and foraging based on the observation of this species flying over the study area during survey.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

White-bellied Sea Eagle are distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). 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'. Nests are large structures built from sticks and lined with leaves or grass. This species feeds mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion and hunts its prey from a perch or whilst in flight (by circling slowly, or by sailing along 10–20 m above the shore).

Suitable perching and foraging habitat for White-bellied Sea Eagle is present in the study area within the wetland and woodland areas. This species may hunt in the wetland and opens areas. No nests were observed in the study area during the field survey. This species is likely to breed in patches of eucalypt woodland around the locality with large trees suitable for nesting. The vegetation to be removed as part of the proposal will comprise of up to 1.52 hectares of habitat for this species. However most of this is likely only suitable during periods of inundation. Given the minimal vegetation removal proposed and the likelihood of this species to also use adjacent habitats around Testers Hollow, Wallis Creek and the Hunter River that are of higher quality, the proposal is considered unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

3. in relation to the habitat of a Threatened species, population or ecological community:

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal would remove about 1.52 hectares of potential foraging habitat for the White-bellied Sea Eagle, however habitat to be impacted primarily consists of low quality roadside vegetation. Most of the impact will be to roadside trees. The proposed removal of habitat is small when the amount of available higher quality habitat within foraging range of this species is considered.

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

Importantly, the proposal will not result in fragmentation of habitat for the White-bellied Sea Eagle. No large blocks of high quality habitat for this species will be fragmented by the proposal. The study area is already fragmented by clearing for agricultural practices and by the existing road corridor. The proposal will only result in a slight widening of this. The White-bellied Sea Eagle is highly mobile and capable of existing in a fragmented landscape. The proposal will not result in any barriers that will restrict movement. The proposal will not affect the movement of this species between habitat patches.

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

Vegetation and habitat within the study area would form a small component of a larger foraging range for this species. Testers Hollow is likely to be a focal point of foraging activity, however wetland

habitat in the study area is of lower quality. The loss of native vegetation from the study area would reduce the amount of foraging habitat available for this species by a small amount. However, when compared to the larger and higher quality vegetation remnants in the locality, the vegetation within the study area is not considered important for the long-term survival of the White-bellied Sea Eagle in the locality.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs have been listed for this species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and White-bellied Sea Eagle.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal will result in the removal of up to 1.52 hectares of foraging and perching habitat for the White-bellied Sea Eagle. However, higher value habitat can be found within the locality and the habitat that will be impacted is unlikely to be important to the survival of this species in the locality. Much of this habitat is likely only suitable during periods of inundation. The proposal is unlikely to impact any breeding habitat for this species. The action is unlikely to reduce the population size of the White-bellied Sea Eagle or decrease the reproductive success of this species. Based on the factors above it is concluded that the proposal is unlikely to result in a significant effect on White-bellied Sea Eagle.

Black-neck Stork (*Ephippiorhynchus asiaticus*)

The Black-necked Stork is considered moderately likely to utilise the habitats in the study area for foraging based on the presence of a nearby record.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

The Black-necked Stork is widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW. 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 Hexham. 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. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). 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).

Suitable foraging habitat for Black-necked Stork is present in the study area within the wetland areas. This species is considered to be uncommon in the Hunter with one recently recorded breeding pair in the Hunter Wetlands. The study area is likely to provide suitable foraging habitat for individuals that may pass through the area, however it is unlikely to present important habitat, considering the presence of higher quality habitat in the Testers Hollow wetland. No nests were observed during the field survey and the study area is unlikely to present suitable breeding habitat given its proximity to Cessnock Road. The vegetation to be removed as part of the proposal will comprise of 0.91 hectares of habitat that may be used by transient birds taking temporary refuge or travelling to large better quality habitats. Given the minimal vegetation removal proposed and the likelihood of this species to also use adjacent habitats around Testers Hollow, Wallis Creek and the Hunter River that are of higher quality, the proposal is considered unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

- 2. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:**

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

Not applicable.

- 3. in relation to the habitat of a Threatened species, population or ecological community:**

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal would remove about 0.91 hectares of potential foraging habitat for the Black-necked Stork, however habitat to be impacted primarily consists of low quality roadside vegetation. The proposed removal of habitat is small when the amount of available higher quality habitat within the locality is considered.

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

Importantly, the proposal will not result in fragmentation of habitat for the Black-necked Stork. No large blocks of high quality habitat for this species will be fragmented by the proposal. The study area is already fragmented by clearing for agricultural practices and by the existing road corridor. The proposal will only result in a slight widening of this. The Black-necked Stork is highly mobile and capable of existing in a fragmented landscape. The proposal will not result in any barriers that will restrict movement. The proposal will not affect the movement of this species between habitat patches.

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

Vegetation and habitat within the study area would form a small component of a larger foraging range for this species. Testers Hollow is likely to be a focal point of foraging activity, however wetland habitat in the study area is of lower quality. The loss of native vegetation from the study area would reduce the amount of foraging habitat available for this species by a small amount. However, when compared to the larger and higher quality vegetation remnants in the locality, the vegetation within the study area is not considered important for the long-term survival of the Black-necked Stork in the locality.

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

Areas of Outstanding Biodiversity Value (AOBVs) are special areas that contain irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. AOBVs will be a priority for investment in private land conservation.

Areas previously declared as critical habitat under the *Threatened Species Conservation Act 1995*, have become the first AOBVs in NSW with the commencement of the Biodiversity Conservation Act. The Biodiversity Conservation Regulation 2017 establishes the criteria for declaring AOBVs. The criteria have been designed to identify the most valuable sites for biodiversity conservation in NSW.

No AOBVs have been listed for this species.

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

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and Black-necked Stork.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

The proposal will result in the removal of 0.91 hectares of foraging habitat for Black-necked Stork. However, higher value habitat can be found within the locality. The proposal is unlikely to impact any breeding habitat for this species. The action is unlikely to reduce the population size of the Black-necked Stork or decrease the reproductive success of this species. Based on the factors above it is concluded that the proposal is unlikely to result in a significant effect on Black-necked Stork.

Purple Spotted Gudgeon (*Mogurnda adspersa*)

The Purple Spotted Gudgeon was not identified in the study area during field surveys, however no targeted surveys were undertaken. The only mapped indicative habitat around the study area by DPI is Wallis Creek. During periods of high rainfall, Wallis Creek overflows and much of the study area can become inundated during which time Purple Spotted Gudgeon may be transported into Testers Hollow wetland. As such there may be individuals of this species currently inhabiting Testers Hollow wetland. Habitat in the study area is generally unsuitable for this species outside of these periods of

inundation, particularly the artificial ponds on the western side of Cessnock Road which are stagnant and have little vegetation or refuge.

Under the FM Act, the factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below:

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

Purple spotted Gudgeon are found in slow moving or still waters of rivers, creeks and billabongs, often amongst weeds, rocks and snags. The species is restricted to aquatic habitats with suitable physiochemical water quality conditions, specifically waters with a pH ranging from 5.6 to 8.8, conductivity of 72 to 4,295µS/cm, dissolved oxygen between 0.6 and 12.8mg/L and low turbidity. They feed mainly on insect larvae, but also consume worms, tadpoles, small fish and some plant matter. Female Purple spotted Gudgeon may lay several batches of eggs per season (30-1,300 per batch). The eggs are deposited in clusters on solid objects such as rocks, wood or broad-leaved plants. The male guards and fans the eggs until hatching (3-8 days).

The causes of the decline in the two populations of Purple spotted Gudgeon may include: predation by introduced fish such as Gambusia and redfin perch; habitat loss; rapid fluctuations in water levels (due to water regulation) that have deleterious effects on successful reproduction and recruitment.

The proposal will result in a small area of habitat around the unnamed creek that connects Testers Hollow Wetland with Wallis Creek being removed and disturbed. Disturbance may result in changes to vegetation and water holding capacity of pools thereby altering their habitat value. This habitat is likely only overflow habitat used during periods of inundation of the floodplain. A reduction in habitat quality of Testers Hollow wetland is possible due to turbidity and sedimentation from the works and tannins from mulch. The intensity of water quality impacts can be mitigated through adequate stormwater and sediment management.

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

Not applicable.

3. in the case of an Endangered ecological community or Critically Endangered ecological community, whether the action proposed:

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

Not applicable.

4. in relation to the habitat of a Threatened species, population or ecological community:

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed**

The proposal will result in the removal of 0.09 hectares of aquatic habitat (moderate/good freshwater wetlands) which is within the modelling potential distribution of the species. However, this species has not been confirmed at this location. Disturbance may result in changes to vegetation and water holding capacity of the study area thereby altering its habitat value. A reduction in habitat quality is possible due to turbidity and sedimentation from the works and tannins from mulch. The intensity of water quality impacts can be mitigated through adequate stormwater and sediment management.

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

The proposal will not fragment or isolate any habitat for these two species. There may be some temporary barriers to fish passage as a result of sedimentation controls, however the unnamed creek running through the study area only flows very intermittently so passage is normally obstructed. The new culvert should increase fish passage between Testers Hollow wetland and Wallis Creek.

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

Testers Hollow wetland and Wallis Creeks may provide the best quality habitat for this species. Habitat in the study area is likely only suitable after periods of high rainfall. The unnamed creek offers little opportunity for refuge and no other fish species were observed in the shallow clear water during the field survey. It is unlikely that the aquatic habitat in the study area is highly important to the long term survival of these species.

5. whether the proposed development is likely to have an adverse effect on critical habitat (either directly or indirectly)

The proposal will not impact on any declared area of critical habitat.

6. Whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan.

There is currently no recovery plan or threat abatement plan for the Purple Spotted Gudgeon.

7. whether the proposed development or activity is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Key Threatening Processes (KTPs) are listed under Schedule 4 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A threat may be listed as a key threatening process under the BC Act if it:

- adversely affects threatened species, populations of a species or ecological communities
- could cause species, populations of a species or ecological communities to become threatened.

Key threatening processes are managed under the Biodiversity Conservation Program or with threat abatement plans under the *Saving our Species* program. There are currently 38 listed KTPs. Of the 38 listed KTPs, 'Clearing of native vegetation' is relevant to the proposal and Purple Spotted Gudgeon.

Through the removal of vegetation, the proposal is part of these KTPs however, given the minimal removal of vegetation and the presence of areas of greater habitat in the locality the contribution of the proposal to these KTPs is not considered to be significant.

Conclusion

There is moderate potential for Purple Spotted Gudgeon to occur in the waterways in the study area, however this species is only likely to occur after high rainfall and is more likely to occur in Testers Hollow wetland and Wallis Creek. Habitat that may be impacted by the proposal is unlikely to be important to the long-term survival of this species.

The proposal will likely result in a small area of habitat around the unnamed creek being removed and disturbed. Disturbance may result in changes to vegetation and water holding capacity of the creek thereby altering its habitat value. A reduction in habitat quality is possible due to turbidity and sedimentation from the works and tannins from mulch. The intensity of water quality impacts can be mitigated through adequate stormwater and sediment management.

Considering the likely marginal impact of the proposal on aquatic habitat and the extent of higher quality habitat in the locality, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to the Purple Spotted Gudgeon.

Environment Protection and Biodiversity Conservation Act 1999

One White-bellied Sea Eagle, listed as a marine species under the EPBC Act was observed flying over the study area during field survey. This species is not listed as migratory or threatened under the EPBC Act and as such an assessment of significance is not required.

The following information regarding 'important populations' and is taken from the Significant Impact Guidelines 1.1.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

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

In reference to question four, 'habitat critical to the survival of a species' refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

Large-eared Pied Bat (*Chalinolobus dwyeri*) - vulnerable

The Large-eared Pied Bat is considered moderately likely to occur within the study area based on the presence of suitable foraging habitat. In NSW, the largest known important population of this species appears to be within the sandstone escarpments of the Sydney Basin and north west slopes, which would include the locality around the study area. 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

There is no evidence to suggest that an important population exists in the study area. The proposal will remove about 1.56 hectares of potential foraging habitat for the Large-eared Pied Bat. The proposal will also result in temporary disturbance to low quality roosting habitat (ie culvert).

The size of a local population is not known, although the study area is likely used as part of a large home range of individuals that roost in Cessnock State Forest, Lower Hunter National Park and Part State Forest. Potential foraging habitat in the study area is presented by all woody vegetation, however higher quality areas would be around the wetland. Impacts to these habitats would impact on the potential breeding habitat for prey species (invertebrates), however any potential overall reductions to the abundance of prey species is likely to be minimal, considering the widespread nature of these habitats in the locality. The proposal will result in the replacement of the culvert under Cessnock Road and therefore loss of possible low quality roosting habitat, however the potential for roosting bats in the culvert is considered to be low.

As no breeding habitat will be impacted, and considering the abundance of suitable foraging habitat in the locality, the proposal is considered unlikely to lead to a long-term decrease in the size of an important population of this species.

2. reduce the area of occupancy of an important population

The proposal will remove about 1.56 hectares of potential foraging habitat for the Large-eared Pied Bat. The proposal will result in the replacement of the culvert under Cessnock Road and therefore

loss of possible low quality roosting habitat, however the potential for roosting bats in the culvert is considered to be low. No breeding habitat will be impacted. As such, the Large-eared Pied Bat can be expected to remain in the locality after completion of the proposal. The proposal is considered unlikely to reduce the area of occupancy of an important population of this species. The area of occupancy for this species will remain at about 9,120 square kilometres.

3. fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the study area. Highly mobile species such as bats are expected to be less impacted by fragmentation. The proposal would not fragment an important population of this species.

4. adversely affect habitat critical to the survival of a species

The *National Recovery Plan for the Large-eared Pied Bat* (OEH, 2011) states that habitat critical to the survival of this species is diurnal roost sites. Other habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The proposal would have some level of impact to up to 1.56 hectares of foraging habitat. The proposal will result in the replacement of the culvert under Cessnock Road and therefore loss of possible low quality roosting habitat, however the potential for roosting bats in the culvert is considered to be low. The proposed area of disturbance represents a very small fraction of the potential foraging habitat for the Large-eared Pied-bat. As such, the proposal is unlikely to impact habitat critical to the survival of the species.

5. disrupt the breeding cycle of an important population

The proposed area of disturbance represents a very small fraction of the potential foraging habitat available in the locality for the Large-eared Pied-bat. The proposal would not directly impact on a known roost or maternity site and such as unlikely to disrupt the breeding cycle of this species.

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

The proposal would have an impact of up to 1.56 hectares of foraging habitat for the Large-eared Pied-bat. The proposed area of disturbance represents a very small fraction of the potential foraging habitat available in the locality for this species. This species is expected to continue using the habitats in the study area and the proposal is unlikely to 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 vulnerable species becoming established in the Vulnerable species' habitat

The action is unlikely to result in an invasive species harmful to the Large-eared Pied-bat becoming established in the habitat. The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls are required during construction and operation of the road to reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the highway using best practice methods as outlined in RTA (2011).

8. introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as detailed in RTA (2011) on this proposal as part of the CEMP to prevent the introduction or spread of pathogens.

9. interfere substantially with the recovery of the species.

The *National Recovery Plan for the Large-eared Pied Bat* (OEH 2011) identifies the following objectives for recovery of this species:

- Identify priority roost and maternity sites for protection.
- Implement conservation and management strategies for priority sites.
- Educate the community and industry to understand and participate in the conservation of the Large-eared Pied bat.
- Research the large-eared pied bat to augment biological and ecological data to enable conservation management.
- Determine the meta-population dynamics throughout the distribution of the large-eared pied bat.

The proposal will not interfere with any of the objectives identified in the National Recovery Plan for the Large-eared Pied Bat.

Conclusion

The Large-eared Pied Bat will suffer a small reduction in extent of foraging habitat from the proposal. The proposal will result in the replacement of the culvert under Cessnock Road and therefore loss of possible low quality roosting habitat, however the potential for roosting bats in the culvert is considered to be low. No breeding habitat is likely to be impacted. The proposal is unlikely to reduce the population size of this species or decrease its reproductive success. The proposal will not interfere with the recovery of this species and will not contribute to the key threats to these species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Large-eared Pied Bat.

Grey-headed Flying Fox (*Pteropus poliocephalus*) - vulnerable

While the Grey-headed Flying-fox was not recorded in the study area during the field survey it is considered likely to occur based on the presence of suitable foraging habitat and the nearby location of a known roosting camp at Black Hill (11 kilometres southeast of the study area) and a further 15 camps within 50 kilometres.

- An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
- lead to a long-term decrease in the size of an important population of a species

- There have been no roost camps identified in the project boundary to date and at the time of the REF the project would not directly impact on any known breeding / maternity site. Therefore, it is likely that the impacts of construction and operation of the project would be confined to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

The project would directly remove up to 0.59 hectares of potential foraging habitat however vegetation will be avoided where possible. Foraging habitat mainly comprises nectar resources from regrowth and roadside native trees, particularly *Eucalyptus tereticornis* and *Corymbia maculata* which are winter flowering. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the relative widespread nature of similar vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to lead to a long-term decrease in the size of an important population.

1. reduce the area of occupancy of an important population

The project would directly remove up to 0.59 hectares of foraging habitat however vegetation will be avoided where possible. Foraging habitat mainly comprises nectar resources from regrowth and roadside native trees, particularly *Eucalyptus tereticornis* and *Corymbia maculata* which are winter flowering. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The project will reduce the area of habitat available to the species; however, the area occupied by this species will remain the same.

2. fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the study area. Highly mobile species such as bats are expected to be less impacted by fragmentation and the grey-headed flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. The project would not fragment an important population of the Grey-headed Flying-fox.

3. adversely affect habitat critical to the survival of a species

The proposed area of habitat loss represents a small percentage of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of the project boundary and known roost camps in the region. This species typically exhibits very large home ranges and Grey-headed Flying-fox are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby 1996). No evidence of a camp site has been identified from the footprint of the upgrade.

The draft recovery plan for the (DECCW 2009) identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50 kilometre radius
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site.

The project would directly remove up to 0.59 hectares of foraging habitat. Considering the close proximity of several roost camps and presence of important winter feed trees, the habitats are consistent with the classification for critical foraging habitat (DECCW 2009). The affected area of

foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to adversely affect habitat critical to the survival of the species.

4. disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat identified as important during the breeding cycle of the species. The upgrade would not directly impact on a known roost camp / breeding or maternity site.

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

No evidence of a roost camp has been identified from the study area. Further, there would be a relatively minor impact on critical foraging habitat. This impact is not expected to lead to a decline in the species in this region.

6. result in invasive species that are harmful to a vulnerable species becoming established in the Vulnerable species' habitat

The action is unlikely to result in an invasive species harmful to the Grey-headed Flying Fox becoming established in the habitat. The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls are required during construction and operation of the road to reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the highway using best practice methods as outlined in RTA (2011).

7. introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as detailed in RTA (2011) on this proposal as part of the CEMP to prevent the introduction or spread of pathogens.

8. interfere substantially with the recovery of the species.

The Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) (DECCW 2009) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes

- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan.

The recovery actions listed above are largely not applicable to the proposal as they focus on priority conservation lands which are outside of the study area.

Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to interfere substantially with the recovery of the species.

Conclusion

The Grey-headed Flying Fox will suffer a small reduction in extent of suitable foraging habitat from the proposal. No breeding camps or other important habitat will be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying Fox or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Grey-headed Flying Fox and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Grey-headed Flying Fox.

Swift Parrot (*Lathamus discolor*) – critically endangered

The Swift Parrot is considered to potentially occur solely based on the presence of suitable foraging habitat and nearby records.

Habitat for this species is widespread in the area, however confined to foraging habitat in the form of a small number of *Eucalyptus tereticornis* and *Corymbia maculata*, two winter flowering species, in the study area. No hollow-bearing trees were identified, except one small branch hollow in the north east compound site. The Swift Parrot is not considered to be a frequent visitor in the study area. Vegetation in the study area is likely to form part of this species foraging range.

An action is likely to have a significant impact on an endangered or critically 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

The proposal would remove foraging habitat containing nectar, invertebrates and seeds. Two winter flowering species, *Eucalyptus tereticornis* and *Corymbia maculata*, are present in the study area and widespread throughout the locality. The Swift Parrot is only likely to pass through the study area in search of foraging resources. Large areas of high-quality foraging habitat are present within the locality. The loss of potential feed trees would directly affect the species opportunity to feed in the area. The action would remove about 0.64 hectares of potential foraging habitat.

The Swift Parrot does not breed in the study area and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation, such that the action is unlikely to lead to a long-term decrease in the size of the Australian population.

2. reduce the area of occupancy of the species

As a specialist nectarivore dependent on flowering eucalypts, Swift Parrots are vulnerable to the loss of quantity and quality of key forage tree species. As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging.

The proposal would contribute to the loss of potential foraging habitat that would reduce the area of habitat available. However, the proposal would not reduce the area of occupancy of this species, which is estimated at 4,000 square kilometres.

3. fragment an existing population into two or more populations

Importantly, the proposal would not result in fragmentation of habitat for the Swift Parrot. This species is highly mobile and will freely fly long distances over open areas to move between habitats. The proposal would not affect the movement of the Swift Parrot between habitat patches.

4. adversely affect habitat critical to the survival of a species

Key habitats for this species on the coast and coastal plains of New South Wales include large stands of *Corymbia maculata*, *E. robusta*, *Eucalyptus gummifera* and *E. tereticornis* forests. The proposal would remove about 0.64 hectares of potential foraging habitat for the Swift Parrot, which includes winter flowering species *Eucalyptus tereticornis* and *Corymbia maculata*. However, habitat to be impacted primarily consists of low quality roadside vegetation and remnant paddock trees and is likely only to be used on occasion by migrating individuals. No large stands of key foraging habitat will be impacted.

5. disrupt the breeding cycle of a population

The Swift Parrot is endemic to south-eastern Australia and breeds only in Tasmania, and migrates to mainland Australia in autumn. As such, the proposal would not affect breeding habitat for this species. The proposal would remove about 0.64 hectares of potential foraging habitat for the Swift Parrot, which includes winter flowering species *Eucalyptus tereticornis* and *Corymbia maculata*. However, considering the amount of higher quality foraging resources in the locality, the removal of this vegetation is unlikely to impact the breeding cycle of the Swift Parrot.

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

Foraging habitat for this species would be reduced by about 0.64 hectares. As a large-scale migrant, it has the ability to cover vast areas of its winter range, seeking suitable flowering eucalypt habitat. The species is an occasional visitor to the region and may utilise trees in the study area for foraging intermittently when no other suitable resources are available. The action is unlikely to 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 Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

The action is unlikely to result in an invasive species harmful to the Swift Parrot becoming established in the habitat. The potential for weed invasion was considered possible with a proposal of this nature and appropriate controls are required during construction and operation of the road to

reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the highway using best practice methods as outlined in RTA (2011).

8. introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as detailed in RTA (2011) on this proposal as part of the CEMP to prevent the introduction or spread of pathogens.

The proposal mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease causing agents such as bacteria and fungi.

9. interfere with the recovery of the species.

The National Recovery Plan for the Swift Parrot (Swift Parrot Recovery Team 2001) identifies the following actions for recovery of this species:

- 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.

The recovery actions listed above to help recover the Swift Parrot are largely not applicable to the proposal as they are actions for the OEH to complete and focus on priority conservation lands which are outside of the study area. The proposal would not interfere with the recovery of the Swift Parrot.

Conclusion

The Swift Parrot would suffer a small reduction in extent of foraging habitat from the action. The action is unlikely to reduce the population size of the Swift Parrot or decrease the reproductive success of this species. The action would not interfere with the recovery of the Swift Parrot. After consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Swift Parrot.

***Eucalyptus parramattensis* subsp. *decadens* – vulnerable**

The eastern portion of Lot 949 DP1223319 located in the southern section of the proposal area contains juvenile *Eucalyptus parramattensis* subsp. *decadens* which were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). It is unknown when the trees were planted, however they range from about 0.3 – 2 metres tall and most are surrounded by plastic tree guards. The offset for the residential subdivision in Cliftleigh required 300 individuals to be planted, and therefore there may be up to 300 individuals planted in

Lot 949 DP1223319, including in areas not impacted by the proposal (Harper Somers O'Sullivan 2007) (refer to Chapter 6). The planted trees were likely intended to replace the trees impacted by the residential subdivision, that formed part of the larger local population. It is unknown how large this local population is, though *Eucalyptus parramattensis* subsp. *decadens* is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BC Act. This EEC is likely widespread throughout the locality and has been previously identified in the nearby Hunter Economic Zone (Bell 2004), therefore the *Eucalyptus parramattensis* subsp. *decadens* local population is also likely widespread. All occurrences of this species are likely to be important to its survival and the local population is considered to be an important population for the purpose of this assessment.

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

The action will result in the removal of up to 35 juvenile planted *Eucalyptus parramattensis* subsp. *decadens* trees. These are part of up to 300 *Eucalyptus parramattensis* subsp. *decadens* trees that were planted as an offset for the construction of the residential subdivision in Cliftleigh (Harper Somers O'Sullivan 2007). These planted trees are only at a juvenile life stage and are not currently contributing to reproduction of the important population. It is possible that the chosen location for planting these *Eucalyptus parramattensis* subsp. *decadens* trees is not entirely suitable due to a long history of grazing. *Casuarina glauca* seedlings are growing around the planted trees, which may be the community that ultimately regenerates in this location. Considering this, the removal of these 35 trees is unlikely to lead to a long-term decrease in the size of this important *Eucalyptus parramattensis* subsp. *decadens*, particularly if the trees are translocated prior to construction.

2. reduce the area of occupancy of an important population

The 35 *Eucalyptus parramattensis* subsp. *decadens* planted trees which would be removed form an outlying part of this important population to the north of where the remaining mature trees are located in the subdivision. The removal of these plants would reduce the area of occupancy of an important population, however this area is likely a very small portion of the overall area of occupancy of the local important population. Additionally, it may be possible to translocate these plants prior to construction to avoid this reduction in the area of occupancy.

3. fragment an existing important population into two or more populations

The 35 *Eucalyptus parramattensis* subsp. *decadens* planted trees which would be removed form an outlying part of this important population to the north of where the remaining mature trees are located in the subdivision. The removal of these trees would not fragment the important population, only reduce the number/area of planted trees from the eastern edge.

4. adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

Critical habitats for *Eucalyptus parramattensis* subsp. *decadens* in the locality include the low nutrient soils, typically associated with the 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion' endangered ecological community. None of this community occurs within the proposed impact area and it is possible that the location where these trees have been planted is not totally suitable. Although it is unknown when the trees were planted, they appear to be potentially having trouble establishing due to the long history of disturbance on the site. Considering this, the paddock in Lot 949 DP1223319 where these trees have been planted is not considered to be habitat critical to the survival of this species.

5. disrupt the breeding cycle of an important population

These planted trees are only at a juvenile life stage and are not currently contributing to the reproduction of the important population. The action will not disrupt the breeding cycle of the *Eucalyptus parramattensis* subsp. *decadens* important population in this location.

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

The action will result in a very small decrease in the availability of marginal habitat for *Eucalyptus parramattensis* subsp. *decadens*. This impact is primarily to the cleared pasture where the trees have been planted. This impact unlikely to be so detrimental as to cause this species to decline.

7. result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat

The potential for weed invasion is considered possible with a project of this nature and appropriate controls are required during construction and operation of the road to reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the highway using best practice methods as outlined in RTA (2011). The small isolated fragment of vegetation is currently experiencing weed invasion, particularly invasive grasses and shrubs such as a Lantana; this is likely to continue along the edge of the new road.

8. introduce disease that may cause the species to decline, or

Infection of native plants by *Phytophthora cinnamomi* (Root Rot Fungus) and Myrtle Rust has been identified as being spread by construction machinery. This water-borne mould infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the road. This can be mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene and is unlikely to have a significant impact. It is the intention to use current best practice hygiene protocols as detailed in RTA (2011) on this proposal as part of the CEMP to prevent the introduction or spread of pathogens.

The proposal mitigation strategy and environmental management procedures would include guidance for preventing the introduction and/or spread of disease-causing agents such as bacteria and fungi.

9. interfere with the recovery of the species.

There is no recovery plan for *Eucalyptus parramattensis* subsp. *decadens*. However, the OEH have identified three priority actions to help recover this species as follows:

- Prevent frequent fires from impacting on the populations

- Habitat rehabilitation through weed removal
- Protect known habitat from clearing, fragmentation, disturbance and modifications to drainage patterns

As the action will only remove marginal habitat where the trees have been planted, it is not considered to be inconsistent with the priority actions identified for this species.

Conclusion

Up to 35 planted juvenile *Eucalyptus parramattensis* subsp. *decadens* trees from an isolated stand of up to 300 planted trees situated in roadside pasture will be removed by the action. These trees are intended to form part of the local important population, however do not currently contribute to reproduction of the species. The impact of removing these juvenile trees will represent a small reduction in the extent of the local important population, however it may be possible to translocate these trees prior to construction. The local occurrence of this species will persist after the action is built as the larger population will not be disturbed. Given the context and intensity of the potential impact and the impact magnitude, a significant impact to *Eucalyptus parramattensis* subsp. *decadens* is considered unlikely.



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