

## 6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on MNES under the EPBC Act
- The factors specified in the guidelines *Is an EIS required?* (DUAP 1995/1996) as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the *Roads and Related Facilities EIS Guideline (DUAP 1996)*. The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in **Appendix E**.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

### 6.1 Biodiversity

The potential impacts of the proposal on biodiversity are assessed in the *Hexham Straight Widening Biodiversity Assessment Report (BAR)* refer to **Appendix H**. The potential impacts and safeguards to mitigate impacts, are summarised in this section.

#### 6.1.1 Methodology

A detailed methodology for the biodiversity assessment is provided in the BAR in **Appendix H**. The following provides a summary of the methodology used which included:

- Field surveys for the proposal were completed by WSP (2020) and provided to Jacobs in the form of survey results, spatial data and a brief report
- A background review of biodiversity information was undertaken to identify the existing environment of the proposal within a search area of 10 kilometres
- A desktop review of relevant database records and previous studies within the locality to identify Commonwealth and State listed threatened species, populations and ecological communities
- A habitat assessment and likelihood of occurrence was undertaken for threatened and migratory species and endangered populations occurring in the study area
- Field surveys were conducted by WSP over 2019 and 2020. Several targeted surveys were completed within the study area including threatened and migratory bird surveys, hollow bearing tree assessment, passive microbat surveys (Anabats), habitat assessments, culvert inspections, targeted seasonal flora surveys, targeted Green and Golden Bell Frog surveys and inspection for Southern Myotis roost locations under Ironbark Creek Bridge
- The plot-based vegetation survey of the study area was completed using field survey methods in line with Chapter 5 of the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a)
- Targeted searches were undertaken for threatened plant species during February and March 2019 and followed the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016) using parallel transects
- Targeted search for Green and Golden Bell Frog was undertaken in March 2021
- Preliminary diurnal inspections of all existing bridges and culverts along the study area were inspected during daylight hours by a zoologist to determine whether suitable roosting habitat

for threatened microbats were present. Where suitable habitat was identified, a follow up exit survey with an Anabat was completed

- Hollow bearing trees within the study area were mapped
- Diurnal dawn and dusk surveys were completed within potential threatened and Migratory bird habitat across the study area. Surveys were completed in accordance with the *NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (Department of Environment and Conservation, 2004) and *Survey Guidelines for Australia's Threatened Birds* (Department of the Environment Water Heritage and the Arts, 2010)
- An aquatic desktop assessment was conducted to assess the Hunter River, the Hunter Wetlands and Ironbark Creek against the NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management* (2013 update) (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003)
- An assessment of significance for threatened species and ecological communities positively identified during surveys and inspections or that are considered to have a moderate or high likelihood of occurring in the study area
- Identification of impacts and associated mitigation measures to reduce and manage impacts.

### Literature and database review

The biodiversity assessment was based on a desktop review of existing information and field survey. Government databases were reviewed to identify potential threatened species, populations and ecological communities within the study area. The following databases were reviewed in April 2020 and again in August 2020:

- BioNet - Atlas of NSW Wildlife and Threatened Biodiversity Data Collection (Environment, Energy and Science Group 2020a)
- DPI Fisheries Spatial Data Portal
- Commonwealth Department of Environment's Protected Matters Search Tool
- BioNet Vegetation Classification Database (Environment, Energy and Science Group 2020b)
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)
- Department of Environment's Directory of Important Wetlands in Australia
- Department of Planning and Environment's SEPP (Coastal Management) 2018 maps
- PlantNet – (NSW Flora online - <https://plantnet.rbgsyd.nsw.gov.au/floraonline.htm>). Royal Botanic Gardens. 10 kilometre radius search of the study area.

The study area for this assessment comprised the REF area with a 50 metre buffer.

### 6.1.2 Existing environment

#### Environmental context

The study area is located within the Hunter sub-region of the Sydney Basin Bioregion as defined by Thackway and Cresswell (1995) and the Lower Hunter Channels and Floodplains Landscape as mapped by the NPWS (2002a) and described by the NSW Department of Environment and Climate Change (2008).

The study area is located within a disturbed landscape dominated by urban development and associated infrastructure interspaced with fragmented and modified remnants of floodplain vegetation associated with the Hunter River.

The REF area is located next to the main channel of the Hunter River and the South Channel Hunter River, refer to **Figure 1.2**. Ironbark Creek is located within the REF area towards the southern end of the proposal. Ironbark Creek is connected to Hexham Swamp Nature Reserve in the west and runs perpendicular to the proposal passing under Ironbark Creek Bridge and Maitland Road before flowing into the South Channel Hunter River to the east. Hexham Swamp Nature Reserve is located about 200 metres to the west of the proposal at its nearest point near Sparkes Creek and is separated by the Main North Rail Line. Kooragang Nature Reserve is located about one kilometre to the east of the proposal and is separated by the South Channel Hunter River.

The study area is located immediately to the west of the Hunter Wetlands National Park in several locations at the southern end of the proposal until Ironbark Creek. To the north of Ironbark Creek, the proposal is separated from the national park boundaries by the South Channel Hunter River.

There are also some areas identified as Coastal Wetlands under the CM SEPP and some areas of vegetation identified as freshwater wetlands located within study area.

### Plant community types

Four Plant Community Types (PCTs) were identified within the REF area and these are summarised in **Table 6.1**.

Table 6.1 PCTs in the REF area of the proposal

Plant Community Type	Condition class	Area (ha) in REF area	BC Act	EPBC Act	FM Act
Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)	Moderate (EPBC Act and BC Act)	0.41	Yes	Yes	-
	Moderate (not TEC suitable)	0.04	-	-	-
	Low (BC Act)	0.99	Yes	-	-
	Poor (not TEC suitable)	0.09	-	-	-
<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)	Moderate (BC Act)	1.06	Yes	-	-
Grey Mangrove low closed forest (PCT 1747)	Good (FM Act)	0.72	-	-	Yes
Saltmarsh Estuarine Complex (PCT 1746)	Good (EPBC Act, BC Act and FM Act)	0.51	Yes	Yes	Yes

Note 1 TEC = Threatened ecological community

The REF area is mostly cleared and dominated by exotic grasslands, and a mix of native and non-native plantings, however native vegetation is scattered across the study area varying from small intact patches to isolated trees. The remaining areas of vegetation cover are classified as native plantings, or urban/exotic plantings that were not able to be matched to a PCT.

Refer to **Appendix H** for figures showing the location of PCTs within the study area.

## Threatened ecological communities

### ***NSW Biodiversity Conservation Act, 2016***

There are three TECs listed under the BC Act that occur in the study area and which correspond to PCT 1234, PCT 1071 and PCT 1746 respectively (refer to **Table 6.1** and **Figure 6.1**):

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) - 1.44 hectares
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered) - 1.06 hectares
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered) - 0.51 hectares.

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

#### *Coastal Swamp Oak (Casuarina glauca) Forest of the New South Wales and South East Queensland Ecological Community*

WSP (2020) considered PCT 1234 a candidate to form part of the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community.

WSP (2020) used field-based vegetation condition types to assess PCT 1234 against the EPBC Act condition thresholds.

WSP (2020) concludes that, only moderate condition patches of PCT 1234 (0.41 hectares) are consistent with the EPBC Act listing for Coastal Swamp Oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland ecological community as they met both the key diagnostic characteristics and the condition thresholds. All low condition patches of PCT 1234 failed to either meet the key diagnostic characteristics and/or condition thresholds for the EPBC Act listing. Refer to Section 4.3.2 of the BAR (**Appendix H**) for condition thresholds.

#### *Subtropical and Temperate Coastal Saltmarsh*

Two PCTs recorded within the REF area were considered candidates which have potential to meet the EPBC Act listing:

- PCT 1746 Saltmarsh Estuarine Complex
- PCT 1747 Grey Mangrove low closed forest.

The assessment concluded that only PCT 1746 meets the key diagnostic characteristics for the EPBC Act listing. PCT 1747 did not meet the EPBC Act key characteristics as it contains a canopy dominated by Mangroves (*Avicennia marina subsp. australasica* and *Aegiceras corniculatum*) and Casuarina (*Casuarina glauca*) with a cover greater than 50 per cent. Refer to Section 4.3.2 of the BAR (**Appendix H**) for condition thresholds.



Date: 9/11/2021 Filename: IA301100\_REF\_F003\_ThreatenedEcologicalCommunities\_v1

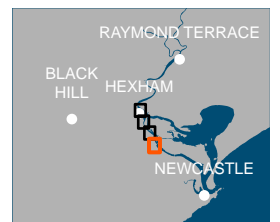
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REF area

**BC Act**  
 Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

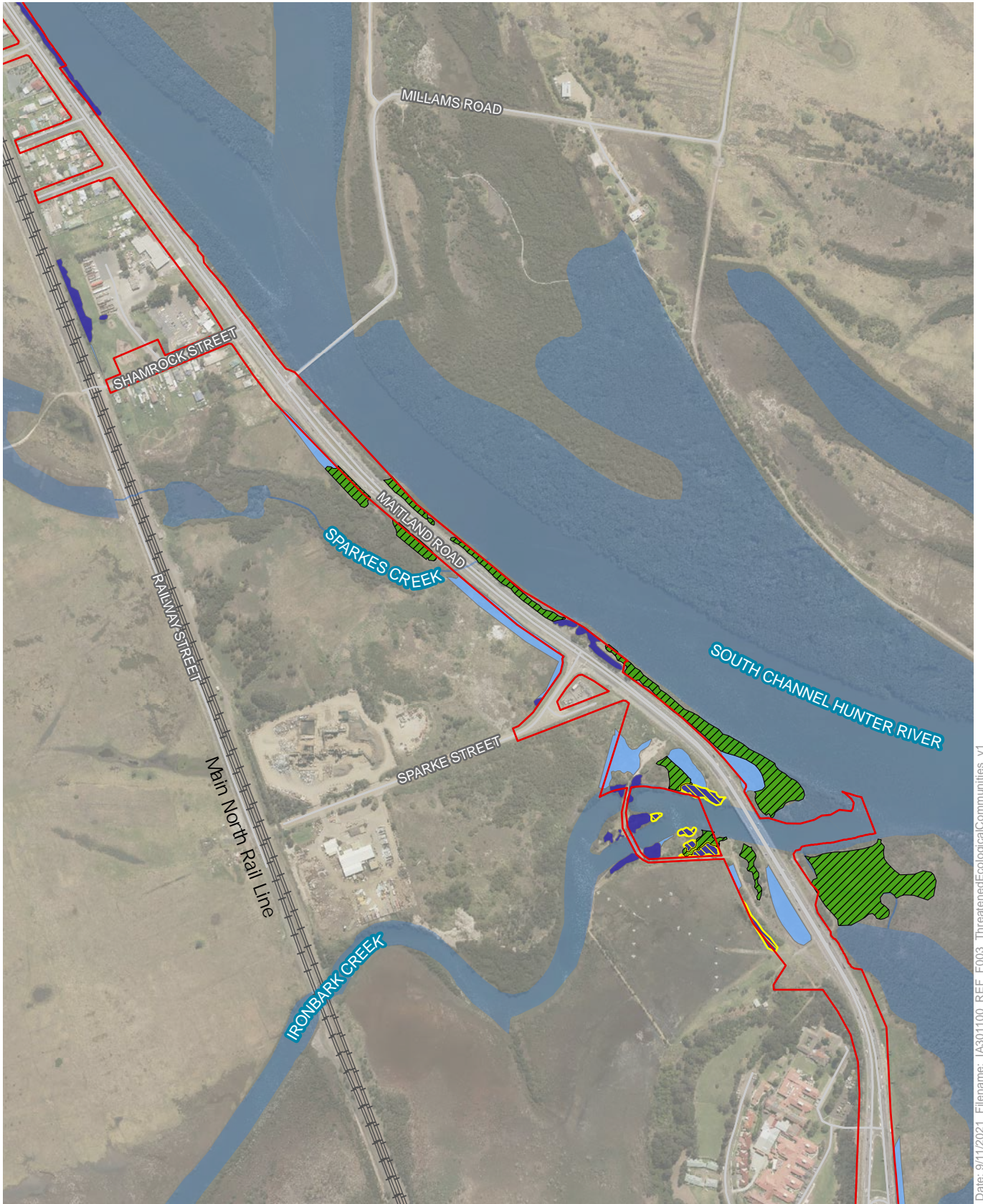
Railway  
 Road  
 Waterway

Scale 1:8,000 at A4  
 GDA94 MGA56



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**Data sources:**  
 Jacobs 2020  
 Department Finance,  
 Services and Innovation 2020

**Figure 6.1a** Threatened ecological communities  
 Hexham Straight Widening



Date: 9/11/2021 Filename: IA301100\_REF\_F003\_ThreatenedEcologicalCommunities\_v1

**Legend**

REF area

EPBC Act

Coastal Swamp Oak (*Casuarina glauca*)

Forest of the New South Wales and South East Queensland Ecological Community (Endangered)

Subtropical and Temperate Coastal Saltmarsh (Vulnerable)

BC Act

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

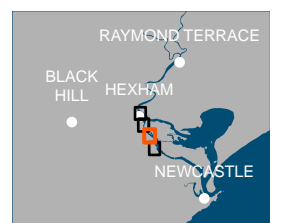
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Road

Waterway



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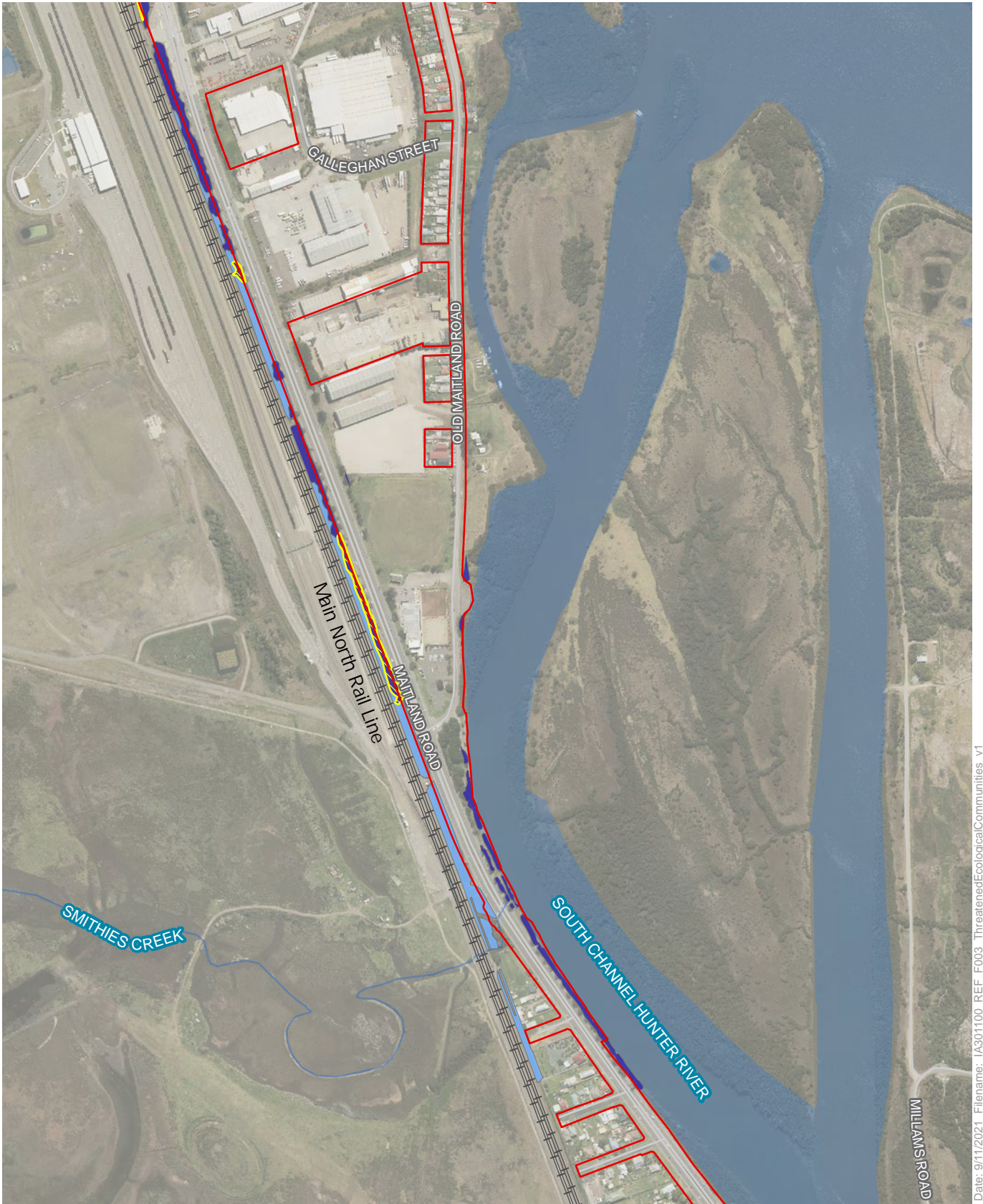
Page 2 of 4

Data sources:

Jacobs 2020  
Department Finance,  
Services and Innovation 2020

**Figure 6.1b** Threatened ecological communities

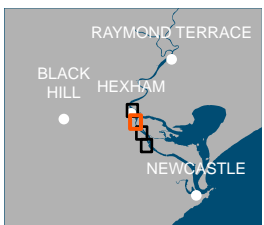
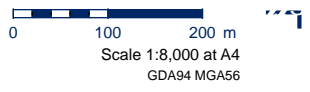
Hexham Straight Widening



Date: 9/11/2021 Filename: IA301100\_REF\_F003\_ThreatenedEcologicalCommunities\_v1

**Legend**

- REF area
- EPBC Act
  - Coastal Swamp Oak (*Casuarina glauca*)
  - Forest of the New South Wales and South East Queensland Ecological Community (Endangered)
- BC Act
  - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
  - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)
- Railway
- Road
- Waterway



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 Data sources:  
 Jacobs 2020  
 Department Finance,  
 Services and Innovation 2020

**Figure 6.1c** Threatened ecological communities  
 Hexham Straight Widening



Date: 9/11/2021 Filename: IA301100\_REF\_F003\_ThreatenedEcologicalCommunities\_v1

**Legend**

REF area

EPBC Act

Coastal Swamp Oak (*Casuarina glauca*)

Forest of the New South Wales and South East Queensland Ecological Community (Endangered)

Subtropical and Temperate Coastal Saltmarsh (Vulnerable)

BC Act

Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered)

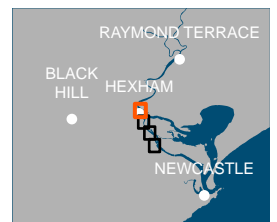
Railway

Road

Waterway



Scale 1:8,000 at A4  
GDA94 MGA56



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Data sources:

Jacobs 2020  
Department Finance,  
Services and Innovation 2020

**Figure 6.1d** Threatened ecological communities

Hexham Straight Widening



## Threatened flora

Twenty-nine threatened flora species have previously been recorded or modelled as having potential to occur in the proposal local area (**Appendix H**). 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 localities or are presumed extinct.

Five threatened flora species were initially considered moderately likely to occur within the study area and were identified as candidate species for targeted threatened flora surveys (refer to **Table 6.2**). None of these species identified were recorded during targeted surveys completed (WSP 2020). As such, these species are now considered to have a low likelihood of occurring within the study area.

Table 6.2 Threatened flora considered to have potential to occur within the study area

Scientific name	Common name	BC Act	EPBC Act
<i>Maundia triglochoides</i>	-	Vulnerable	-
<i>Zannichellia palustris</i>	-	Endangered	-
<i>Persicaria elatior</i>	Tall Knotweed	Vulnerable	Vulnerable
<i>Lindernia alsinoides</i>	Noah's False Chickweed	Endangered	-
<i>Commersonia prostrata</i>	Netted Bottle Brush	Endangered	Endangered

## Threatened fauna

Based on regional records and the presence of suitable habitat, 81 threatened fauna species have been identified in the proposal local area (**Appendix H**) or have modelled habitat. Of these, seventeen threatened fauna species were initially assessed as having a moderate or higher likelihood of occurring in the study area based on the available habitat assessed from field surveys and known occurrences in associated habitats across the Hunter River flood plain (refer to Table 4.12 of **Appendix H**). These species were identified as candidate species for targeted threatened fauna surveys, however only six were recorded within the study area (refer to **Table 6.3**).

Table 6.3 Targeted fauna species recorded in the study area

Scientific name	Common name	BC Act	EPBC Act	Recorded within study area?
<i>Litoria aurea</i>	Green and Golden Bell Frog	Endangered	Vulnerable	-
<i>Circus assimilis</i>	Spotted Harrier	Vulnerable	-	-
<i>Ixobrychus flavicollis</i>	Black Bittern	Vulnerable	-	-
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable	-	Yes
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Vulnerable	Ma	Yes
<i>Hieraaetus morphnoides</i>	Little Eagle	Vulnerable	-	-
<i>Pandion cristatus</i> (syn. <i>P. haliaetus</i> )	Eastern Osprey	Vulnerable	Ma, M	-

Scientific name	Common name	BC Act	EPBC Act	Recorded within study area?
<i>Calidris ferruginea</i>	Curlew Sandpiper	Endangered	Critically endangered	-
<i>Xenus cinereus</i>	Terek Sandpiper	-	Vulnerable	-
<i>Limosa limosa</i>	Black-tailed Godwit	Vulnerable	-	-
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Vulnerable	-	-
<i>Miniopterus australis</i>	Little Bent-winged Bat	Vulnerable	-	Yes
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bent-winged Bat	Vulnerable	-	-
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	Vulnerable	-	Yes
<i>Myotis Macropus</i>	Southern Myotis, Large-footed Myotis	Vulnerable	-	Yes
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Vulnerable	Vulnerable	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vulnerable	-	-

Note 1 M = Migratory, Ma = Marine

The study area does not contain suitable habitat for some species listed in Attachment C of the BAR (**Appendix H**). No suitable habitat for threatened fish is present in the study area.

### ***Southern Myotis (Myotis macropus)***

Southern Myotis is considered highly likely to occur around the REF area based on recent records in the proposal local area and the presence of suitable habitat along Ironbark Creek.

The water-based survey identified a total of five scuppers were being used by Southern Myotis for roosting and/or breeding purposes. Scuppers being utilised were observed in all the over-water spans underneath the middle/central section of the bridge (median), with varying numbers of bats using each of the structures. All bats observed roosting and/or breeding in the bridge scuppers were Southern Myotis.

A total of 20 Southern Myotis were recorded within habitat provided by Ironbark Creek Bridge. Two distinct age/size classes (i.e. adult and juvenile) of bat were recorded within two separate scupper locations within Ironbark Creek Bridge as seen in **Plate 6.1** and **Plate 6.2**.



Plate 6.1 Group of Southern Myotis recorded within Ironbark Creek scuppers 5 March 2021 (WSP 2020)



Plate 6.2 Four Southern Myotis recorded within Ironbark Creek scuppers 5 March 2020 (WSP 2020)

From the results returned on the 5 March 2020 survey, it is considered very likely all scuppers observed, may be used for breeding purposes by Southern Myotis. This is supported by the occurrence of immature bats in many of the occupied scuppers.

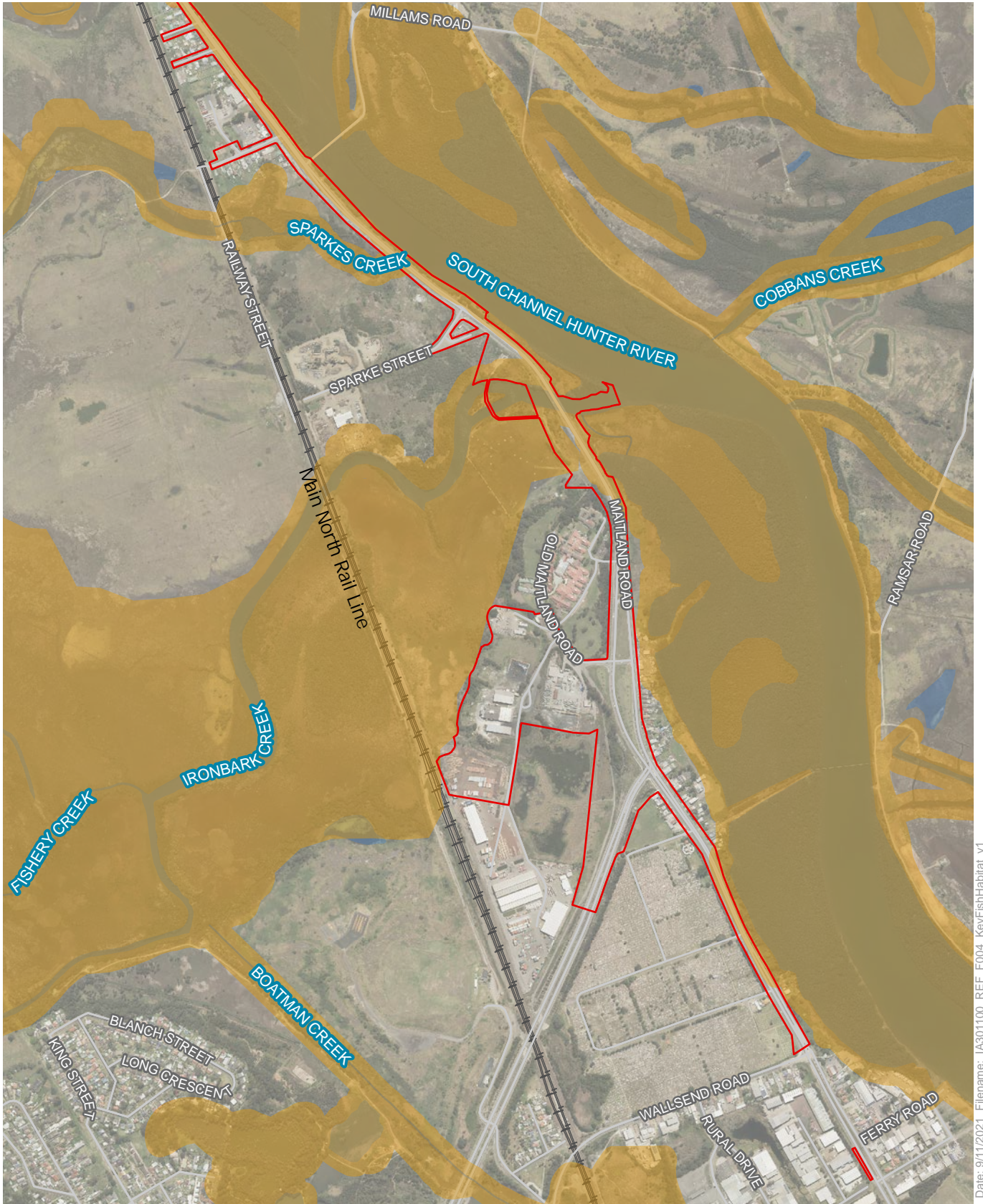
#### ***Other threatened fauna***

The study area also provides suitable habitat features for a range of threatened species that have been previously recorded in the proposal local area, including insectivorous bats (Little Bent-winged Bat, Large-eared Pied Bat, Eastern Bent-winged Bat, Eastern Coastal Free-tailed Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and the Yellow-bellied Sheathtail-bat), woodland birds (Dusky Woodswallow, Rufous Fantail and Varied Sittella) nectarivorous birds (Little Lorikeet and Swift Parrot), the Grey-headed Flying Fox, large predatory birds (Little Eagle, White-bellied Sea-Eagle, Spotted Harrier, Eastern Osprey), wetland birds (Black Bittern) and migratory shorebirds (Black-tailed Godwit, Curlew Sandpiper, Eastern Curlew, Terek Sandpiper, Red Knot, Bar-tailed Godwit (refer to Table 4.13 of the BAR included as **Appendix H**).

#### ***Threatened fish species and key fish habitat***

The aquatic habitat within the surrounding landscape buffer includes the Hunter River Estuary, Ironbark Creek, as well as wetland environments within the Hunter Wetlands National Park including Hexham Swamp Nature Reserve and Kooragang Nature Reserve. The location of 'key fish habitats' in the study area has been mapped on **Figure 6.2**. Importantly, barriers to fish passage currently exist on Ironbark Creek as there are one-way flow floodgates installed at the confluence with the South Channel of the Hunter River.

The Hunter River Estuary supports a substantial fishery, particularly for School Prawn (*Metapenaeus macleayi*) and is known to provide habitat for juvenile Eastern King Prawn (*Melicertus plebejus*). Hexham Swamp is an important tidal connection to the breeding grounds for the Eastern King Prawn. The lower estuary also has abundant mangrove and saltmarsh habitats which provide important nursery habitat for marine organisms and shorebird species.



Date: 9/11/2021 Filename: IA301100\_REF\_F004\_KeyFishHabitat\_V1

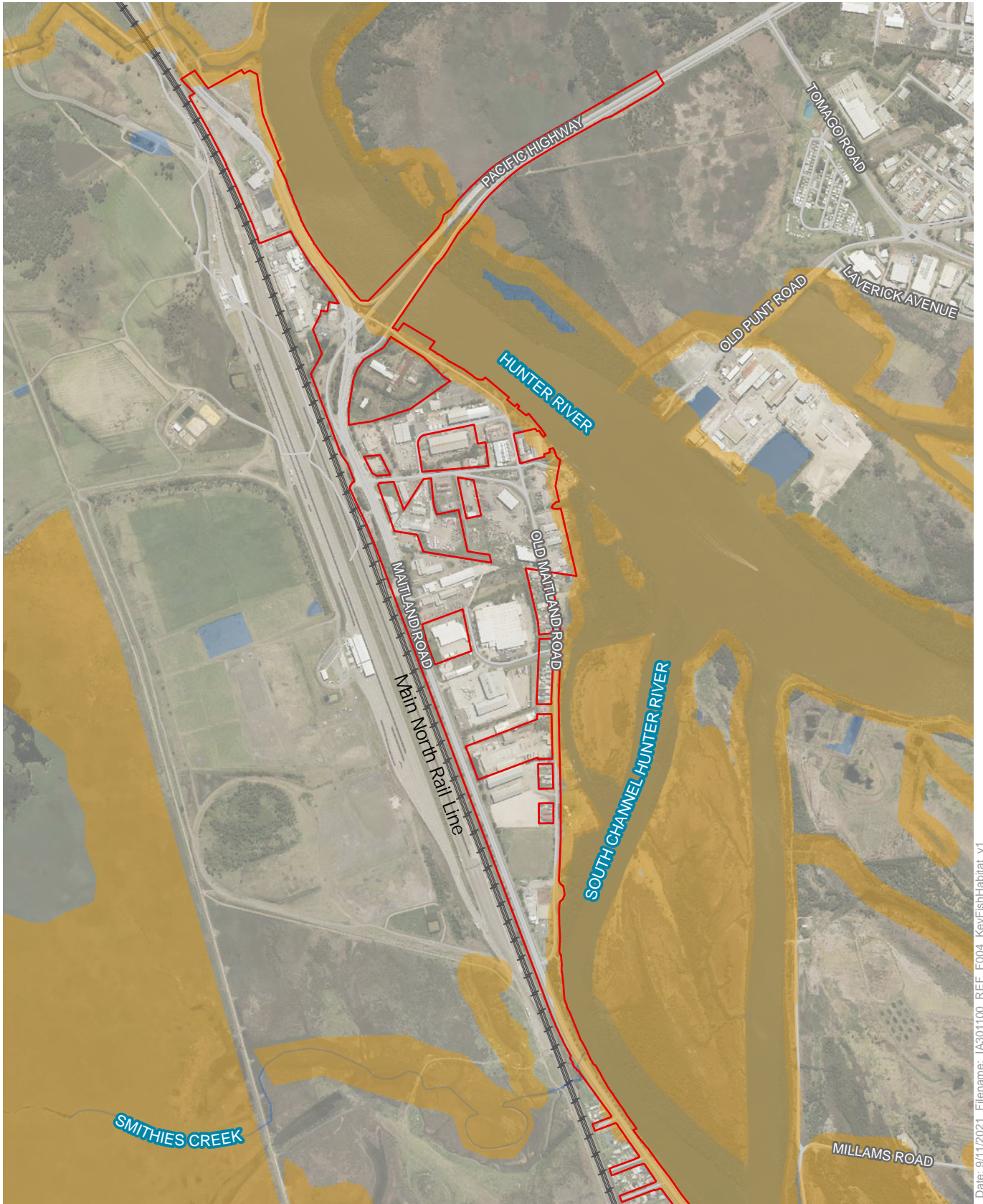
**Legend**

- REF area
- Key fish habitat
- Railway
- Road
- Waterway



Page 1 of 2  
**Data sources:**  
 Jacobs 2020  
 Department Finance,  
 Services and Innovation 2020  
 DPI 2020

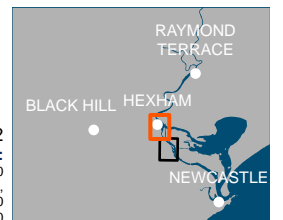
**Figure 6.2a** Key fish habitat mapped by the NSW Department of Primary Industries



Date: 9/11/2021 Filename: IA301100\_REF\_F004\_KeyFishHabitat\_V1

**Legend**

- REF area
- Key fish habitat
- Railway
- Road
- Waterway



Page 2 of 2  
**Data sources:**  
 Jacobs 2020  
 Department Finance,  
 Services and Innovation 2020  
 DPI 2020

**Figure 6.2b** Key fish habitat mapped by the NSW Department of Primary Industries  
 Hexham Straight Widening

The estuary exhibits large expansive shallow embayments that are connected to the north arm and Kooragang Nature Reserve on Kooragang Island which make up a portion of the Hunter Estuary Wetland Ramsar site. These embayments and island also have extensive mangrove and saltmarsh habitat. No seagrass is present within the estuary.

### Threatened aquatic species

No targeted threatened fish surveys were conducted as part of this assessment. Database review of threatened fish species habitat and distribution identified three species with potential to occur in the study area.

Purple Spotted Gudgeon (*Mogurnda adspersa*) is listed as endangered under FM Act. Due to the highly disturbed and largely saline conditions of the Hunter River and Ironbark Creek, it is considered unlikely that the Purple Spotted Gudgeon inhabits these waterways within vicinity of the proposal.

Green Sawfish (*Pristis zijsron*) is listed as vulnerable under EPBC Act, though presumed extinct in NSW. Based on habitat present, no protected or threatened fish species are expected to occur within the construction footprint.

The Black Rock Cod (*Epinephelus daemeli*) is listed as vulnerable under the FM Act and EPBC Act. The NSW coastline forms the Black Rock Cod's main range, both in Australia and internationally. Despite the Black Rock Cod being previously recorded within the Hunter River catchment area, the habitat and water quality in the study area is not considered suitable for this species.

### Aquatic habitat assessment

Aquatic habitat within waterways and wetlands around the REF area have been assessed in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), whereby assessment sites have been classified into KFH "Type" (DPI, 2013) and waterway "Class" (Fairfull and Witheridge et al. 2003). Outcomes of this assessment are detailed in **Table 6.4**.

Table 6.4 Fish habitat classification

Waterway	Strahler stream order (Strahler, 1952)	Mapped as KFH (DPI, 2007)	Threatened aquatic species predicted to occur (DPI, 2016)	KFH type and sensitivity (DPI, 2013)	Waterway class (Fairfull and Witheridge, 2003)	Key considerations
South Channel Hunter River and Main Channel Hunter River	Nine	Yes	Yes – although not expected in this section of the Hunter River	Type 1 – Highly sensitive KFH	Class 1 – Major fish habitat	<ul style="list-style-type: none"> <li>Major waterway and estuarine system</li> <li>Mangroves and saltmarsh present in the intertidal zone</li> <li>Mapped as 'Coastal Wetland' under CM SEPP</li> <li>Adjacent to Kooragang Island (part of Kooragang Nature Reserve).</li> </ul>
Ironbark Creek	Five	Yes	Yes – Although not expected to occur due to barriers to fish passage	Type 1 – Highly sensitive KFH	Class 2 – Moderate fish habitat	<ul style="list-style-type: none"> <li>Connected to Hunter Estuary Ramsar Wetland site (Shortland Wetlands)</li> <li>Connected to Hexham Swamp Nature Reserve</li> <li>Mapped as 'Coastal Wetland' under CM SEPP</li> <li>Floodgates installed at downstream extent at the confluence with the South Channel of Hunter River.</li> </ul>
Hexham Swamp Nature Reserve	N/A	Yes	Yes – Although not expected to occur due to barriers to fish passage	Type 1 – Highly sensitive KFH	Class 2 – Moderate fish habitat	<ul style="list-style-type: none"> <li>Mapped as 'Coastal Wetland' under CM SEPP</li> <li>Important freshwater wetland habitat.</li> <li>Tributaries within Hexham Swamp discharge to Ironbark Creek.</li> </ul>
Unnamed Tributary to Hunter River	Two	Yes	No	Type 1 – Highly sensitive KFH	Class 3 – Minimal fish habitat	<ul style="list-style-type: none"> <li>Connected to Hexham Swamp Nature Reserve</li> <li>Mapped as 'Coastal Wetland' under CM SEPP</li> <li>Floodgates installed at downstream extent at the confluence with the South Channel of Hunter River.</li> </ul>

Waterway	Strahler stream order (Strahler, 1952)	Mapped as KFH (DPI, 2007)	Threatened aquatic species predicted to occur (DPI, 2016)	KFH type and sensitivity (DPI, 2013)	Waterway class (Fairfull and Witheridge, 2003)	Key considerations
Smithies Creek	Two	Yes	No	Type 1 – Highly sensitive KFH	Class 2 – Moderate fish habitat	<ul style="list-style-type: none"> <li>• Connected to Hexham Swamp Nature Reserve</li> <li>• Mapped as 'Coastal Wetland' under the CM SEPP</li> <li>• There are no floodgates installed on Smithies Creek.</li> </ul>
Sparkes Creek	Two	Yes	No	Type 1 – Highly sensitive KFH	Class 2 – Moderate fish habitat	<ul style="list-style-type: none"> <li>• Connected to Hexham Swamp Nature Reserve</li> <li>• Mapped as 'Coastal Wetland' under the CM SEPP</li> <li>• There are no floodgates installed on Smithies Creek.</li> </ul>



## Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of Groundwater Dependent Ecosystems (GDEs) (Bureau of Meteorology, 2021) and the High Priority GDE (HPGDE) mapping in the WSP for the North Coast Coastal Sands Groundwater Sources 2016 (NSW Government, 2016b), which maps HPGDEs in areas covered by Water Sharing Plans (WSP) as well as alluvial GDEs outside of WSP coverage.

There are three mapped aquatic and seven mapped terrestrial GDEs within the REF area or immediate surrounding landscape. Further field work was undertaken in March 2021 to determine potential for groundwater dependent terrestrial vegetation types to be present. The following plant community types were identified during field surveys:

- Grey Mangrove low closed forest (PCT 1747)
- Saltmarsh Estuarine Complex (PCT 1746)
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)

These PCTs are considered with a high likelihood to be terrestrial GDEs. However, these PCTs are not entirely dependent on groundwater and would most likely depend on the higher subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) which is likely to occur in the REF area. This capillary water may be accessed by the plants where an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. As the plants within these PCTs may at times rely on capillary water in the soil that rises from the water table, any lowering of the water table may result in a reduction in groundwater availability and declining vegetation health during low rainfall periods.

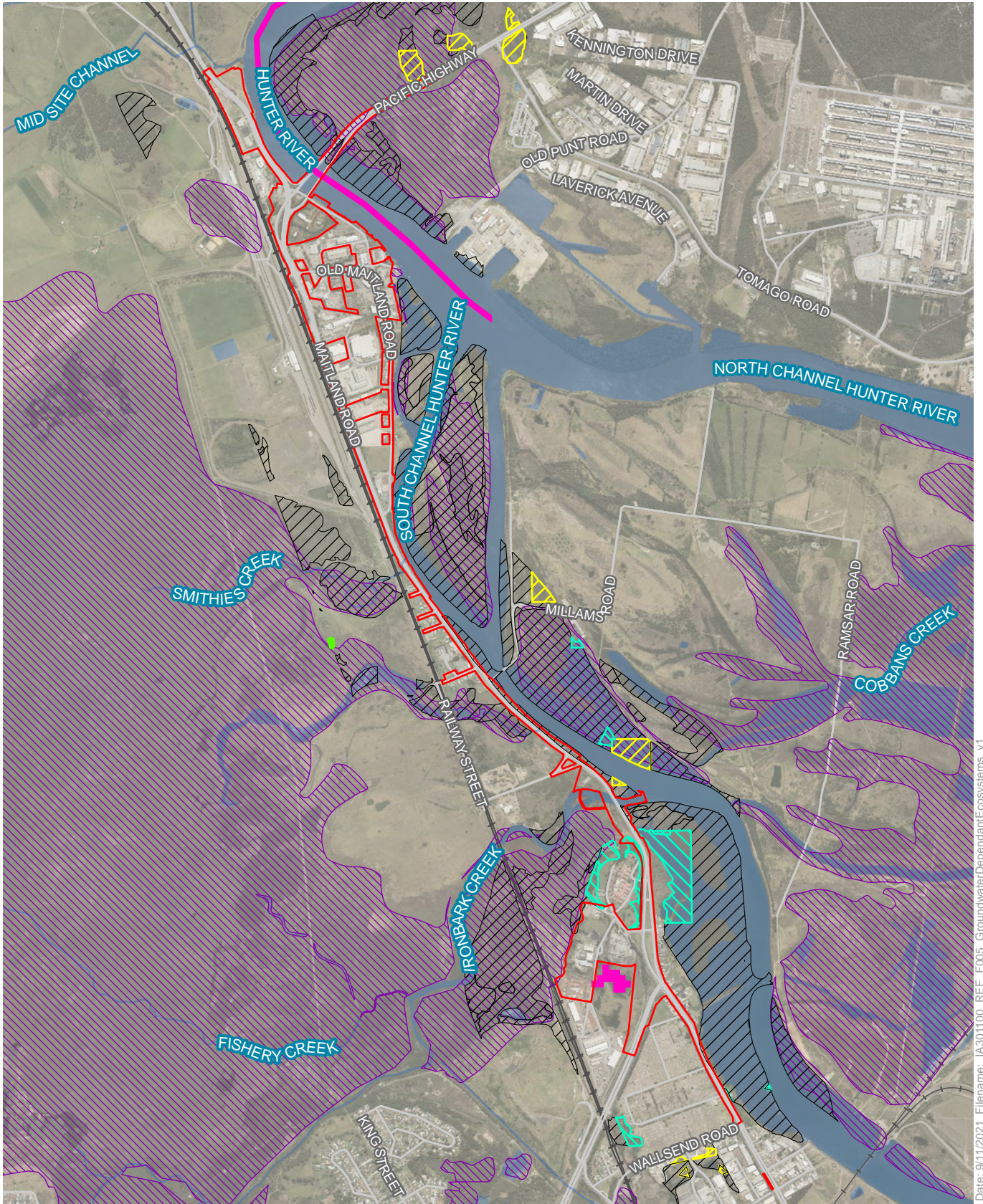
HPGDEs are mapped generally outside of the proposal and within the study area (refer to **Figure 6.3**).

## Wildlife connectivity corridors

In terms of habitat connectivity, the REF area is located within a highly disturbed landscape where the majority of habitats have been cleared. The habitats that do remain are fragmented and isolated. The REF area, however, is connected to the Hunter Wetlands National Park for most of the REF area as the national park boundary is located both to the east and west of the proposal with the section to the west also identified as Hexham Swamp Nature Reserve.

Waterways within the proposal and study area provide habitat connectivity for wildlife in the area and to the areas of national park and nature reserve located alongside the REF area.

The REF area contains vegetated areas along its margins that may allow movement for some highly mobile species. Functional connectivity for many species would exist between the study area and habitats to the west and east despite the level of fragmentation that has occurred across the landscape.



Date: 9/11/2021 File name: IA301100\_REF\_F005\_GroundwaterDependantEcosystems\_V1

**Legend**

- |   |   |  |          |
|---|---|--|----------|
| REF area                                      | High Priority GDEs                            | Terrestrial GDE                                | Railway  |
| Aquatic GDE                                   | High potential GDE - from national assessment | High potential GDE - from regional studies     | Road     |
| High potential GDE - from national assessment | Low potential GDE - from regional studies     | Moderate potential GDE - from regional studies | Waterway |
| Known GDE - from regional studies             |   |  |          |

0 250 500 m  
Scale 1:30,000 at A4  
GDA94 MGA56



**Data sources:**  
Jacobs 2020  
Department Finance,  
Services and Innovation 2020

**Figure 6.3** Groundwater dependent ecosystems

Hexham Straight Widening

## Coastal Wetlands

The study area occurs within and immediately next to areas mapped as 'Coastal Wetlands' and within and immediately next to 'Coastal Wetlands Proximity Areas (100 metre buffer)' as determined by the CM SEPP. An overview of the extent of these wetlands with reference to the study area is provided in **Figure 4.2**.

The Hexham Swamp Nature Reserve, and the surrounding wetland area that adjoins the Hexham Swamp Nature Reserve, is classified as Coastal Wetland under the CM SEPP. The wetland receives water from tributaries and drainage channels situated to the south-west of the Hunter River and is maintained by rainfall, although flow is minimal. Hexham Swamp Nature Reserve drains to the South Channel of Hunter River via Ironbark Creek which flows north under Maitland Road. To manage floodwater incursions, flood gates are present near the confluence of Ironbark Creek and the Hunter River however these are open to allow tidal flushing and improve water quality for Hexham Swamp Nature Reserve (NCC 2020). These gates are only closed during flood events.

## Migratory bird habitat

Migratory bird species, including the Black-tailed Godwit (*Limosa limosa*), Curlew Sandpiper (*Calidris ferruginea*), Eastern Curlew (*Numenius madagascariensis*), Terek Sandpiper (*Xenus cinereus*), Bar-tailed Godwit (*Limosa lapponica baueri*) and Red Knot (*Calidris canutus*), have been identified as having 'important habitat' over the southern extent of the REF area. The Important Areas Mapping (DPIE 2020d), is a classification provided under the BAM, and is only being used as a reference for this assessment. As such, for the purpose of the BAR, the REF area has been assessed for impacts to migratory species. Further information on potential impacts associated with the Important Areas Mapping (DPIE 2020d) in relation to migratory species is provided in the BDAR completed for the EIS area including a detailed EPBC Act Assessment of Significance for the relevant species.

Targeted surveys in 2020 (WSP) and 2021 (Jacobs) did not record any of these migratory species, given the proximity to vast estuarine habitats of the Hunter Wetlands, these species, along with Lesser Sand-plover, Greater sand-plover, Great Knot, Australian Painted Snipe may potentially utilise the study area and locality on occasion. The proposal would require removal of some areas of PCT 1747 (Grey Mangrove low closed forest) and PCT 1747 (Salt Marsh Estuarine complex). It is unlikely that individuals or a nationally significant proportion of the population of any migratory wader or shorebird would be reliant on the small areas of habitat with the REF area. This has been determined due to the high disturbance from the highway and the more suitable habitats located within the locality of the REF area, such as Stockton Sandspit. These habitats within the REF area are not large enough or of high enough quality. Such species may use the land during dispersal between larger areas of habitat in the Hunter Estuary. Therefore, the proposal would not substantially modify, destroy or isolate an area of important habitat for these species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of these birds.

## Matters of National Environmental Significance

This section identifies the MNES that are of relevance to the study area (**Table 6.5**). An Assessment of Significance for each of these is provided in the BAR (**Appendix H**).

Subtropical and Temperate Coastal Saltmarsh TEC is listed as a Vulnerable Ecological Community under the EPBC act however it is not considered a MNES. As per the Matters of National Environmental Significance, *Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Department of Environment, 2013), ecological communities in the vulnerable category of ecological communities listed under the EPBC Act, are not MNES for the purposes of Part 3 of the EPBC Act.

Table 6.5 MNES identified within the study area

MNES identified in study area	MNES type	Condition thresholds met
TECs	Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community, listed as an Endangered Ecological Community	Only moderate condition patches of PCT 1234 (0.41 hectares) were assessed as being consistent with the EPBC Act listing for Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of the New South Wales and South East Queensland ecological community.
Threatened species	Green and Golden Bell Frog (listed as endangered)	Based on the results of targeted surveys, the study area is considered unlikely to provide habitat for the Green and Golden Bell Frog. As such, an assessment of significance was not provided.
	Swift Parrot (listed as critically endangered)	The Swift Parrot (listed as endangered under the BC Act and critically endangered EPBC Act) has shown five recent records in the proposal local area, however there is marginal habitat within the study area for this species. This species may pass through the study area during seasonal movements between larger foraging where it may rest and forage when blossom resources are in abundance. Although no significant areas of foraging habitat are present, the Swift Parrot is considered moderately likely to occur in the study area on occasion.
	Grey-headed Flying-fox (listed as vulnerable).	The Grey-headed Flying-fox (listed as vulnerable under the BC Act and EPBC Act) is considered moderately likely to forage in the trees within the study area, including planted trees, particularly <i>Ficus</i> spp. No roost camps are present in the study area but the bats from the Nationally Important Raymond Terrace camp and the East Cessnock Camp are likely to forage in the study area.
No threatened plants listed under the EPBC Act are considered to have a moderate or higher likelihood of occurring.		
Migratory species	Eastern Osprey	Although 22 migratory bird species were identified in the EPBC Act Protected Matters Search Tool as potentially occurring in the proposal local area, only two are considered moderately likely to fly over the study area and use potential foraging habitat within the study area in association with the mangroves, Hunter River and tributaries. The Rufous Fantail, was recorded in a couple of locations in the study area.
	Rufous Fantail	

### 6.1.3 Potential impacts

The potential for indirect impacts on biodiversity values is considered low given that much of the study area is highly fragmented, subject to existing edge effects, and surrounded by existing roads and development.

## Construction

### Removal of native vegetation

The proposal would have direct impacts on native vegetation involving removal to allow for construction. The estimated clearing of PCTs is about 3.82 hectares. This area has been calculated based on a five metre buffer on the proposal design to allow for construction activities.

The areas of direct clearing required for the proposal are summarised in **Table 6.6**.

Table 6.6 Direct impacts to PCTs

PCT	Condition	Impacted area (ha)
Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)	Moderate (EPBC/BC Act listed)	0.41
	Moderate (not TEC suitable)	0.04
	Low (BC Act listed)	0.99
	Poor (not TEC suitable)	0.09
<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)	Moderate (BC Act listed)	1.06
Grey Mangrove low closed forest (PCT 1747)	Good (FM Act listed)	0.72
Saltmarsh Estuarine Complex (PCT 1746)	Good (EPBC/BC/FM Act listed)	0.51
<b>Total</b>		<b>3.82</b>

The proposal would also result in the removal and disturbance of around 13.91 hectares of non-native vegetation, which comprises native plantings, urban and exotic plantings and highly disturbed areas with limited or no native vegetation. From this, the 2.27 hectares of native plantings may provide habitat for a small number of threatened fauna species, particularly Grey-headed Flying-fox.

Much of the native vegetation within the study area exists as small, fragmented patches along the existing road verge or parklands areas along the waterways.

Some of the PCTs listed in **Table 6.6** correspond to TECs listed under the BC Act and EPBC Act. The TECs identified in the REF area are summarised in **Table 6.7**. Two of the PCTs recorded are listed as Protected under the FM Act as they contain mangroves and/or saltmarsh, including:

- PCT 1747 - Grey Mangrove low closed forest: 0.72 hectares recorded within the REF area
- PCT 1746 - Saltmarsh Estuarine Complex: 0.51 hectares recorded within the REF area.

Table 6.7 Direct impacts to TEC's

Condition	Impacted area (ha)
<b>BC Act listed TECs</b>	
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act)	1.44
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act)	1.06
Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered BC Act)	0.51
<b>EPBC Act Listed TECs</b>	
Coastal Swamp Oak ( <i>Casuarina glauca</i> ) Forest of New South Wales and South East Queensland ecological community (Endangered)	0.41
Subtropical and Temperate Coastal Saltmarsh (Vulnerable)	0.51

### Coastal Wetlands and key fish habitat

Potential impacts of the proposal on aquatic habitats is discussed in **Table 6.8**.

Table 6.8 Potential impacts of proposal construction on aquatic habitats

Impact	Description
Coastal wetlands	<p>Local indirect effects of removal of riparian vegetation potentially include degraded water quality due to increased sediment-laden runoff, long term bank erosion, mobilisation of potential acid sulphate soils, decrease in food availability for aquatic biota and water birds and loss of bank-associated aquatic habitat such as overhangs and shade. This has potential to result in direct or indirect impacts and degradation of wetland habitats in the proposal local area. The proposal impacts on 38.3 hectares of coastal wetland proximity areas (which are identified as the areas within a 100 metre buffer of areas identified as coastal wetlands under the CM SEPP). The buffer area includes areas of cleared land, industrial and residential development. While the REF area of the proposal is within the 38.3 hectares of coastal proximity wetlands it would only require clearing of 8.91 hectares of land identified as coastal wetlands proximity areas as there would be no clearing of vegetation in the construction compound areas.</p> <p>The impacts to the Ramsar wetland areas are considered unlikely as Shortland Wetlands (including Hunter Wetlands Centre Australia) is located about 800 metres west and Kooragang Nature Reserve is located about one kilometre to the east of the proposal and dilution of any sedimentation or poor water quality during construction is likely to be diluted over that distance.</p>
Aquatic habitat	<p>High aquatic biodiversity values are associated with the riparian vegetation present along most of the study area. Mangrove, saltmarsh and wetlands habitat present represent a significant natural aquatic feature of high conservation value.</p>

Impact	Description
	<p>Construction activities with the highest risk are those within waterways, such as bridge work (construction and demolition) and drainage works as they can potentially result in numerous water quality impacts including erosion and sedimentation. Temporary impacts may occur affecting the Eastern King Prawn, however with the implementation of the environmental management measures during bridge construction and demolition, there is not likely to be a significant impact to water quality (refer further to <b>Section 6.3.3</b>) and therefore the Eastern King Prawn population.</p> <p>As described in <b>Section 6.1.2</b>, no threatened species are expected to be present within waterways in the study area due to unsuitable habitat and water quality, as such, no threatened aquatic species are likely to be impacted by the proposal</p>
Erosion and sedimentation	<p>Potential impacts may be caused by:</p> <ul style="list-style-type: none"> <li>• Removal of aquatic habitat features such as large woody debris, overhanging or trailing vegetation, in-stream mangroves, aquatic vegetation and gravel streambeds</li> <li>• Mobilisation of exposed sediment during piling or dredging activities</li> <li>• Exposure of acid sulphate soils (ASS) to the air, causing a reaction with the iron sulphides in the soil to make sulphuric acid</li> <li>• Displacement of groundwater during preloading for soft soil treatment as a ground improvement technique</li> <li>• Bank destabilisation and subsequent transport of sediment due to vegetation clearing and movement across exposed earth</li> <li>• Transportation of concrete dust, concrete slurries or washout water associated with concrete works</li> <li>• Transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment</li> <li>• Transportation of litter and other pollutants associated with construction works.</li> </ul> <p>As a result, the following potential impacts, if unmitigated, may occur:</p> <ul style="list-style-type: none"> <li>• Fish kills due to clogging fish gills</li> <li>• Fish kills due to changes in water quality</li> <li>• Fish kills due to interaction with equipment or machinery</li> <li>• Noise and vibration impacts to fish during piling</li> <li>• Contamination of waterways by acidic runoff from ASS exposure</li> <li>• Contamination of waterways from groundwater displacement</li> <li>• Loss of habitat or reduced suitability of habitat for native fauna that are sensitive to water quality</li> <li>• Potential reduction in the abundance or distribution of native fauna species and increase in pest species which may be able to tolerate poorer water quality</li> <li>• Potential temporary barriers to fish passage from temporary in-stream structures</li> <li>• Smothering of aquatic vegetation</li> <li>• Deposition of sediment within aquatic habitat such as deep holes</li> <li>• A decrease in trophic interactions due to decreased visibility</li> <li>• Reduced light penetration which can limit the growth of aquatic/estuarine vegetation.</li> </ul>
Key fish habitat	<p>The most sensitive fish habitats (Type 1) (other than the Hunter River Estuary) are located in Hexham Swamp and would not be directly impacted by the proposal, but which may be indirectly impacted through changes to water quality from nearby construction activities. The Hexham Swamp is considered Highly Sensitive Key Fish Habitat.</p>
New Ironbark Creek Bridge	<p>Construction and operation of the new Ironbark Creek Bridge could have significant impacts upon the passage of fish. Short term impacts include localised disturbance to riparian and in-stream habitats, such as increased sedimentation and shading. Long term impacts include the impediment of fish movements within their natural range,</p>

Impact	Description
	<p>habitat changes or the potential for pollution. Construction activity around watercourses has potential to result in temporary changes to natural flow and loss of aquatic habitat associated with the removal of woody snags, changes to in-stream substrate and loss of aquatic plants (macrophytes). Inappropriate design or type of water crossing can impede or prevent fish from travelling within their natural range. Furthermore, barriers to fish passage can prevent breeding or re-population of waterways through restricting access of fish to spawning grounds (Fairfull &amp; Witheridge 2003). To avoid barriers, the new Ironbark Creek Bridge crossing has been designed to provide maintenance of fish passage and natural flow velocities in accordance with NSW Fisheries' guidelines.</p> <p>Following the completion of construction, all temporary in-stream structures would be removed, riparian and aquatic habitat would be rehabilitated as required, and disturbed soils in REF areas would be stabilised. Potential impacts to aquatic ecosystems would therefore be limited to the permanent in-stream footprint and additional stormwater runoff that may occur as a result of the proposal.</p>

### ***Removal of threatened species and habitat***

The extent of native vegetation clearing estimated to result from the proposal is outlined above in **Table 6.6**. This vegetation, with the addition of planted trees, provides suitable habitat for a range of threatened fauna species listed under the BC Act and EPBC Act. As such, direct impacts through loss of habitat for threatened fauna species (although it is only moderate to low quality) would occur during construction.

No threatened plant species were identified from the targeted survey and the proposal would not directly impact on threatened plant species or potential habitat. A detailed summary of the direct impacts of the proposal to the habitat for threatened fauna is provided in Table 5.4 of **Appendix H**.

### ***Injury and mortality***

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would take place. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microbat species), may find it difficult to rapidly move away from the clearing activities when disturbed. The study area is only likely to contain a limited number of arboreal species (e.g. possums) and nesting birds that may be injured or killed during vegetation removal. Reptiles, frogs and invertebrates may also be injured or killed during construction as habitat is cleared.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

There is a chance of fauna mortality occurring during the construction phase of the proposal through vehicle collision (i.e. roadkill). Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike. The impact on threatened species is expected to be minimal. Based on evidence from other roadways in the proposal local area most vehicle strike impacts can be expected to occur to common mammals such as birds and possums and exotic animals including foxes.

### ***Southern Myotis roosting /breeding habitat***

Injury or death to microbat species has the potential to occur during the works carried out in relation to Ironbark Creek Bridge. The Southern Myotis was recorded by WSP (2020) within the scuppers, predominantly underneath the median section of the bridge, and in all over-water spans, providing foraging, roosting and breeding opportunities. The decommission and dismantling of the



Ironbark Creek Bridge would remove structures currently used for roosting / breeding and has potential to result in direct mortality of bats if present in the structure.

### ***Invasion and spread of weeds***

Within the study area, nine exotic species were listed as Priority Weeds under the Biosecurity Act for the Greater Hunter Local Land Service region. Eight of these species are also listed as Weeds of National Significance (WONs). The weeds of national concern recorded within the study area include:

- Madeira Vine (*Anredera cordifolia*)
- Ground Asparagus (*Asparagus aethiopicus*)
- Bridal Creeper (*Asparagus asparagoides*)
- Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*)
- Lantana (*Lantana camara*)
- Drooping Pear (*Opuntia monacantha*)
- Blackberry (*Rubus fruticosus* species aggregate)
- Fireweed (*Senecio madagascariensis*).

Proliferation of weeds is likely to occur during construction, although impacts would be greatest due to vegetation clearing during the construction phase. 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. The study area contains significant weed growth, as such, weeds must be managed during construction.

### ***Invasion and spread of pests***

The study area and proposal local area are likely occupied by a range of pest species including the European Red Fox, Rabbit and Black Rat. Proposal activities have the potential to disperse pest species out of the REF area across the surrounding landscape, however the magnitude of this impact would be low and mitigation measures are not deemed necessary.

### ***Invasion and spread of pathogens and disease***

Several pathogens known from NSW have potential to impact on biodiversity as a result 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. The most likely causes of pathogen dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all proposal phases (construction and operation). Pathogens would be managed within the REF area in accordance with the *Biosecurity Act 2015*.

## ***Noise and vibration, dust and contaminated pollution***

Noise, vibration, dust, light and contaminant pollution are direct but temporary impacts that are likely to result from proposal activities. These impacts have the potential to have cumulative effects during construction and operation. These impacts are discussed in **Section 6.9**, **Section 6.12** and **Section 6.13**.

### ***Groundwater dependent ecosystems***

The construction and operation of the proposal has the potential to impact GDEs (refer to **Figure 6.3**) by direct clearing, as well as potential localised ground-water drawdown during construction.

The predicted groundwater level reduction associated with the dewatering for construction of water quality basin B3 is very close to areas mapped as HPGDE. Despite this, the reductions are small and would only occur for a period of about one month before commencement of recovering water levels. Such a short duration of water level change is not anticipated to impact the viability of the HPGDE.

The PCTs within the study area, including PCT 1234, 1071, 1747 and 1746, are likely to be opportunistic facultative GDEs which depend on the subsurface presence of groundwater (often accessed via the capillary fringe – subsurface water just above the water table) when an alternative source of water (i.e. rainfall) cannot be accessed to maintain ecological function. Given the proximity of the associated PCTs to the Hunter River, South Channel Hunter River and Ironbark Creek and the relatively short period of dewatering and drawdown, there is unlikely to be any impact from the temporary drawdown.

The proposal has potential to directly or indirectly interfere with subsurface or groundwater flows associated with the Hunter River and its tributaries. The new Ironbark Creek Bridge would require detailed assessment of potential impacts on the existing surface and groundwater hydrology and upstream environments associated with the Hexham Wetland National Park. If the groundwater table is shallow where the potential GDE occurs, and there is no perched aquifer above the water table (separated from the water table by a layer of impermeable rock or sediment), then impacts on vegetation health may occur.

The demolition of Ironbark Creek Bridge in the REF area could result in disturbance of sediments that could be contaminated with lead based paint, metals and contaminants from runoff from heavy industrial activities that have occurred historically in the area, including land reclamation on foreshore of Ironbark Creek. Dust associated with demolition of Ironbark Creek Bridge may contain contaminants such as concrete, asbestos, lead or other pollutants which may be harmful to aquatic ecosystems if mobilised to downstream environments.

## **Operation**

### ***Wetlands and aquatic habitat***

Following completion of construction, disturbed soils in REF areas would be stabilised and riparian vegetation would be rehabilitated as required. Potential impacts to aquatic systems would therefore be limited to permanent clearance of riparian vegetation, as well as road runoff and associated increased vehicle traffic in future. Increased road runoff may result in localised release of contaminants (i.e. hydrocarbons, oils and grease, sediments, nutrients, heavy metals, gross pollutants and litter) into the surrounding environment (including drainage lines) may accidentally occur. This may result in reduced suitability of habitat for native fauna that are sensitive to changes in water quality, as well as potential reduction in the abundance or distribution of native fauna species and increase in pest species which may be able to tolerate poorer water quality. Accidental release of contaminants is likely to be localised.

Potential impacts on aquatic ecology are mainly due to the proposal's proximity to Ironbark Creek which is crossed by the proposal and the Hunter River and the South Channel Hunter River which run parallel and /or adjacent to Maitland Road between Sandgate and Hexham.

**Wildlife connectivity and habitat fragmentation**

The proposal would not break apart continuous habitats into separate smaller 'fragments'. It is considered that given the proposal's location, adjoining an existing road travel lanes, and the relatively small, linear and fragmented area of habitat to be impacted, compared to the available similar quality habitats within the proposal local area, the proposal is unlikely to have significant impact on any threatened species or ecological communities.

This impact would be of low magnitude and mitigation measures are not deemed necessary.

**Edge effects on adjacent native vegetation and habitat**

There is unlikely to be any further impacts from edge effects resulting from the proposal as all vegetation is suffering from edge effects in the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations. No new edge habitats would be created as the study area is already connected to an existing road and currently experiences edge effects.

This impact would be of low magnitude and mitigation measures are not deemed necessary.

**Groundwater dependent ecosystems**

The operation of the proposal is unlikely to exacerbate impacts to GDEs given that the existing GDEs are already affected by Maitland Road at this location, with an altered surface water drainage associated with the existing road surfaces and man-made drainage features. An increase in hard surface areas associated with the proposal would further alter surface water and drainage to a small extent in the future, although the areas of GDEs which would remain in-situ would still receive surface water runoff from hard surface areas. Given no major new excavation is required for the proposal, the ongoing impacts to GDEs are unlikely to be significant.

**6.1.4 Safeguards and management measures**

The environmental management measures that will be implemented to minimise biodiversity impacts of the proposal within the REF area, along with the responsibility and timing for those measures, are presented in **Table 6.9**.

Table 6.9 Safeguards and management measures – biodiversity

Impact	Environmental safeguards	Responsibility	Timing
Impact to surrounding vegetation and threatened ecological communities	<p>A Flora and Fauna Management Plan will be prepared in accordance with the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011a) and implemented as part of the CEMP. The FFMP will provide specific management for flora and fauna species (including threatened species) that will include but not limited to:</p> <ul style="list-style-type: none"> <li>• Construction personnel are to be informed of the environmentally sensitive aspects of the site</li> <li>• Construction crews will be made aware that any native fauna species encountered must be allowed to leave site without being harassed</li> </ul>	Contractor	Prior to construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>and a local wildlife rescue organisation must be called for assistance where necessary</p> <ul style="list-style-type: none"> <li>• Delineation of work zones, areas for parking and turning of vehicles and plant equipment prior to commencement of works</li> <li>• Establishment of exclusion zones around high-quality vegetation</li> <li>• Materials, plant, equipment, work vehicles and stockpiles will be placed to avoid damage to surrounding vegetation and will be outside tree drip-lines.</li> <li>• Periodic monitoring will be undertaken to ensure all controls are in place and no inadvertent impacts are occurring.</li> <li>• If any damage occurs to vegetation outside of the nominated work area, Transport will be notified so that appropriate remediation strategies can be developed.</li> </ul>		
<p>Impact to native plants and animals including threatened species</p>	<p>A pre-clearing inspection will be carried out in accordance with <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a).</p> <p>A post clearance report, including any relevant Geographical Information System files, would also be produced that validates the type and area of vegetation cleared including confirmation of the number of hollows impacted and the corresponding nest box requirements to offset these impacts.</p>	Contractor	Construction
	<p>Clearing of vegetation would follow the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Guide 1: Pre-clearing process) (Roads and Traffic Authority, 2011a).</p>	Contractor	Construction
	<p>Where possible, hollows would be cut out of hollow-bearing trees and re-established in large trees to mitigate the loss of hollow habitat on fauna. Re-establishing existing hollows into trees is more likely to encourage uptake than use of artificial nest boxes.</p>	Contractor	Construction
	<p>The unexpected species find procedure under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects</i> (Roads and Traffic Authority, 2011a) will be implemented if TECs or threatened fauna, not assessed in the biodiversity assessment, are identified in the construction area of the proposal.</p>	Contractor	Construction
<p>Impacts to the Southern Myotis</p>	<p>Microbat Management Plan (MMP) will be prepared as part of the FFMP. The MMP will outline specific mitigation measures to be undertaken during construction of the proposal to minimise impacts on threatened microbat species including:</p> <ul style="list-style-type: none"> <li>• Details on timing of construction and demolition activities that are likely to impact. The proposed works likely to impact must occur</li> </ul>	Transport	Prior to construction

Impact	Environmental safeguards	Responsibility	Timing
	<p>outside of the Southern Myotis breeding season (September- December) and will also avoid winter months when bats may be in torpor due to cold conditions</p> <ul style="list-style-type: none"> <li>• Roost exclusion and/or translocation methodology</li> <li>• Ecological supervision and survey</li> <li>• Compensatory roost installation in suitable location in the immediate surrounds and/or within the new proposed structure as compensation for the loss of existing roosting habitat</li> <li>• Reporting and monitoring.</li> </ul>		
Impacts from introduction and spread of weeds	Weed species will be managed in accordance with <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011a) (Guide 6: Weed management) and the <i>Biosecurity Act 2015</i>	Contractor	Construction
Impacts from introduction and spread of plant pathogens and amphibian chytrid fungus	A hygiene protocol to be included as part of the FFMP for construction vehicles and equipment to prevent the spread or introduction of weeds, pest and pathogens.	Contractor	Construction
Impacts to aquatic habitat including Key Fish Habitat	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (NSW Roads and Traffic Authority 2011a) and Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and guidelines for fish habitat conservation and management</i> (Department of Primary Industries 2013).	Contractor	Construction
	A Biodiversity Offset Strategy (BOS) will be prepared in accordance with the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI, 2013), for impacts to key fish habitat, in consultation with DPI (Fisheries).	Transport/ Contractor	Prior to construction
	Large woody debris will be retained for creek crossing works where practicable. All large woody debris or snags will be relocated instream by a suitably qualified ecologist.	Contractor	Construction
	Underwater piling controls will include (but not be limited too) soft starts.	Contractor	Construction
Impacts to aquatic habitat including Key Fish Habitat	<p>Relevant approvals and permits under Part 7 of the <i>Fisheries Management Act 1994</i> to be obtained prior to impact of mangroves and or saltmarsh.</p> <p>Transport will consult with DPI (Fisheries) under Part 7 of the FM act on the clearing of saltmarsh and mangroves.</p>	Transport/ Contractor	Prior to construction

Impact	Environmental safeguards	Responsibility	Timing
Temporary obstruction to fish	Temporary obstruction of fish passage may require a NSW Fisheries Permit, subject to assessment by the Department of Planning, Industry and Environment.	Contractor	Construction
National Parks	No unauthorised works will be undertaken within land managed by the National Parks and Wildlife.	Contractor	Prior to construction

### 6.1.5 Biodiversity offsets

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur including the loss of 3.82 hectares of low to good condition vegetation. This biodiversity assessment identifies that the proposal is not likely to have a significant impact on any threatened biodiversity listed under the BC Act or EPBC Act (see Section 5.1.4 and Attachment D of the BAR, refer to **Appendix H**). In this instance, and due to the Commonwealth Strategic Assessment, the EPBC Act environmental offsets policy does not apply.

The proposal would require the removal of the following PCTs:

- Around 1.53 hectares of Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1234)
- Around 1.06 hectares of *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin Bioregion (PCT 1071)
- Around 0.72 hectares of Grey Mangrove low closed forest (PCT 1747)
- Around 0.51 hectares of Saltmarsh Estuarine Complex (PCT 1746).

In accordance with Transport's *Biodiversity Offset Policy* (Roads and Maritime Services, 2016), Transport would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds as detailed in Table 7.1 of the BAR (**Appendix H**).

The clearing totals for this REF area are minor and generally do not reach the thresholds requiring offsets. However, the impact on Coastal Saltmarsh (Threatened Ecological Community – EPBC Act and BC Act) would occur. Proposed offsets for this community are described below. Further to this, the loss of breeding/roosting habitat for the Southern Myotis will require compensatory habitat measures and should be addressed in the MMP.

### Offsets for impacts to aquatic impacts

There are two PCTs which would be impacted by this proposal that are saline wetland formations and will require offsets:

- Saltmarsh estuarine complex (PCT 1746) (TYPE 1 Key Fish Habitat) – removal of about 0.51 hectares in the REF area
- Grey Mangrove low closed forest (1747) (TYPE 2 Key Fish Habitat) – removal of about 0.72 hectares in the REF area.

NSW DPI enforces a 'no net loss' habitat policy as a condition of consent (DPI, 2013). The policy and guidelines for fish habitat conservation and management (DPI, 2013) identifies habitat compensation on a minimum 2:1 basis for all key fish habitat (TYPE1-3). The policy and guidelines (DPIE, 2013) also allow habitat restoration, therefore, efforts to restore areas of KFH in the local area would be in consultation with DPIE Fisheries.

The offset requirements for aquatic communities are described in **Table 6.10**. These are indicative values and offset obligations are to be confirmed in the detailed design and in consultation with DPIE Fisheries.

Table 6.10 Offset contribution option for impacts to aquatic impacts (DPI 2013)

Key Fish Habitat	Impact	Offset ratio
Saltmarsh Estuarine Complex (PCT 1746)	0.51 ha (5,100 m <sup>2</sup> )	2:1
Grey Mangrove Low Closed Forest (PCT 1747)	0.72 ha (7,200 m <sup>2</sup> )	2:1