APPENDIX Q.

Ecological Assessment

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South Rockhampton Flood Levee Implementation
Rockhampton Regional Council
18-Apr-2019
Doc No. 60589157:REP-007

South Rockhampton Flood Levee

Ecological Assessment Report

South Rockhampton Flood Levee

Ecological Assessment Report

Client: Rockhampton Regional Council

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Table of Contents

List of Tables

List of Figures

Executive Summary

The South Rockhampton Flood Levee represents one of the most significant regional flood mitigation projects currently proposed in Queensland. The SRFL was identified as a Priority 1 Structural Mitigation Measure in the 1992 Rockhampton Flood Management Study (CMPS&F, 1992). Construction of the levee will significantly reduce flood damage and social impacts for a large portion of the urban area in South Rockhampton.

The SRFL will be approximately 8.74 kilometres (km) long, running from the Rockhampton central business district (CBD) in the north (Fitzroy Street and Quay Street), to Jellicoe Street and Port Curtis Road in the south, and Upper Dawson Road (Yeppen North) in the west. It will consist of sections of earth embankment, crib wall, vertical flood wall and temporary demountable levee structures.

An initial ecological assessment of the Project site was undertaken in 2014 and a marine plant assessment in 2018. The studies provided preliminary site information to support further design of the Project.

The aim of the current study was to build on the previous ecological assessments and to document the terrestrial flora and fauna species and vegetation communities within and adjacent to the Project site, with particular reference to the occurrence of conservation significant and migratory species.

The terrestrial ecology assessment was a two stage process involving a desktop assessment followed by a flora and fauna survey in November 2018. A subsequent targeted fauna survey for the ornamental snake (*Denisonia maculata*) and migratory shorebirds was undertaken in January 2019.

Key findings of the ecology assessment include the following:

- The Project site largely consists of non-remnant vegetation; however one area of remnant vegetation was identified. The clearing extent of remnant vegetation includes:
  - 0.95 hectares (ha) of Regional Ecosystem (RE) 11.3.4 within the SRFL alignment.
- A total of 41 flora species from 21 families were identified. No conservation significant flora species were identified during the field assessment and none are considered to have a moderate or high likelihood of occurring within the Project site.
- Marine plants were identified during the field survey at one location within the SRFL alignment in a tributary to Gavial Creek. The total clearing extent of marine plants includes:
  - 0.20 ha of mangroves (*Aegiceras corniculatum* and *Excoecaria agallocha*)
  - 0.13 ha of *Phragmites australis*.
- Five introduced flora species listed under the *Biosecurity Act 2014* were identified:
  - *Cryptostegia grandiflora* (rubber vine) (Category 3, WoNS)
  - *Harrisia martini* (Harrisia cactus) (Category 3)
  - *Vachellia farnesiana* (Mimosa) (Category 3)
  - *Parthenium hysterophorus* (Parthenium) (Category 3, WoNS)
  - *Vachellia nilotica* (Prickly acacia) (Category 3, WoNS).
- A total of 97 fauna species were recorded during the field surveys, comprising 88 bird, 3 mammal, 4 reptile and 2 amphibian species.
- Four migratory species were identified within the Project site during the field surveys:
  - Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act
  - Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act
  - Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act
  - Eastern osprey (*Pandion cristatus*); Migratory under the EPBC Act (recorded in 2014).

- The fauna surveys identified a range of habitat values suitable to support both conservation significant and Least Concern species. Three habitat types were recorded within the Project site.
- The habitat that was accessed during the field survey was not considered to be suitable habitat for the ornament snake. However, the property that was unable to be accessed during the field survey contains a large area of mapped essential habitat for the ornamental snake and may contain suitable habitat during times of rainfall.
- Seven conservation significant and 10 migratory species are considered to have a moderate or high likelihood of occurring in the Project site based on the habitat assessed during the field surveys.
- A number of potential impacts to flora and fauna may occur as a result of the Project. Mitigation and management measures are recommended to ensure the potential impact on ecological values are minimised or avoided.
- The significant impact assessment determined that the Project is unlikely to result in a significant impact on conservation significant and migratory species.

1.0 Introduction

1.1 Overview

In October 2018, Rockhampton Regional Council (RRC) re-engaged AECOM Australia Pty Ltd (AECOM) to deliver concept, detailed design updates and support the obtainment of Statutory Approvals for the South Rockhampton Flood Levee (SRFL) project.

1.2 Location and Context

Rockhampton is a large regional city located on the Fitzroy River approximately 640 kilometres (km) north of Brisbane. The RCC area has a population of some 80,000 people and is a major service centre for the wider Central Queensland region. In addition to serving a range of industries including agriculture and mining, Rockhampton provides a full range of retail, education, health, social, government and professional services to a broad catchment.

The wider Central Queensland region that Rockhampton services and supports is experiencing continuing growth in mining and resources sectors, including Liquid Natural Gas and coal mining in particular. As a consequence, interruptions to logistics and services resulting from flooding in Rockhampton impact to varying degrees on the broader region and its industries.

The Central Queensland region is a world ranked producer and exporter of black coal and a major centre for mineral processing. The region hosts the coal-bearing Bowen and Galilee basins and also produces gold, silver, limestone, coal seam gas, magnesite and gemstones. There are currently 50 coal mines, 25 mineral mines and 30 medium to large (>50,000 tonnes per year) extractive quarries operating in Central Queensland.

1.3 Flooding from Fitzroy River Events

The Fitzroy River, which flows through the city of Rockhampton in the state of Queensland, drains a catchment of approximately 142,000 km^2 and is one of the largest catchments on the east coast of Australia. The catchment extends from the Carnarvon Gorge National Park in the West to Rockhampton on the central Queensland coast and is predominantly dominated by agriculture (grazing, dry land cropping, irrigated cotton and horticulture) and by mining (coal, magnesite, nickel and historically gold and silver).

Due to its immense size and fan-like shape, the Fitzroy River catchment is capable of producing severe flooding following heavy rainfall events in any of its major tributaries. These are the Dawson, Nogoa-Mackenzie and Connors-Isaacs Rivers which rise in the eastern coastal ranges and the Great Dividing Range and join together about 100 km west of Rockhampton. Major floods can result from either the Dawson or the Connors-Mackenzie River catchments. Significant flooding in the Rockhampton area can also occur from heavy rain in the local area below Riverslea.

Rockhampton is the largest urban centre in Central Queensland and is located approximately 60 km from the mouth of the Fitzroy River at Keppel Bay. The Fitzroy River at Rockhampton and adjacent townships has a long and well documented history of flooding with flood records dating back to 1859. The highest recorded flood occurred in January 1918 and reached 10.11 metres (m) (8.65 m Australian Height Datum (AHD)) on the Rockhampton flood gauge.

It must be noted that extensive social and economic impacts are also experienced in more frequent, flood events. As examples:

- Low lying areas of Port Curtis and Depot Hill are inundated at a gauge height of 7.0 m which is equivalent to the Minor Classification given by the Bureau of Meteorology (BoM).
- The Depot Hill community is isolated at a gauge height of 7.5 m which is equivalent to the Moderate Classification given by BoM.
- The Bruce Highway at Lower Dawson Road is cut at a gauge height of approximately 8.4 m.
- Low lying areas of Allenstown are inundated at a gauge height of 8.5 m which is equivalent to the Major Classification given by BoM.

- Depot Hill and Port Curtis have been impacted by 33 historical flood events over 7.0 m in gauge height since records commenced in 1859.
- There have been 17 historical flood events over a gauge height of 8.0 m in which the Bruce Highway (Lower Dawson Road) has been cut.

1.4 The South Rockhampton Flood Levee

The SRFL project represents one of the most significant regional flood mitigation projects currently proposed in Queensland. The SRFL was identified as a Priority 1 Structural Mitigation Measure in the 1992 Rockhampton Flood Management Study (CMPS&F, 1992). Construction of the levee will significantly reduce flood damage and social impacts for a large portion of the urban area in South Rockhampton.

The SRFL will be approximately 8.74 km long, running from the Rockhampton central business district (CBD) in the north (Fitzroy Street and Quay Street), to Jellicoe Street and Port Curtis Road in the south, and Upper Dawson Road (Yeppen North) in the west (refer to Figure 1). It will consist of sections of earth embankment, crib wall, vertical flood wall and temporary demountable levee structures (component lengths are summarised in Table 1).

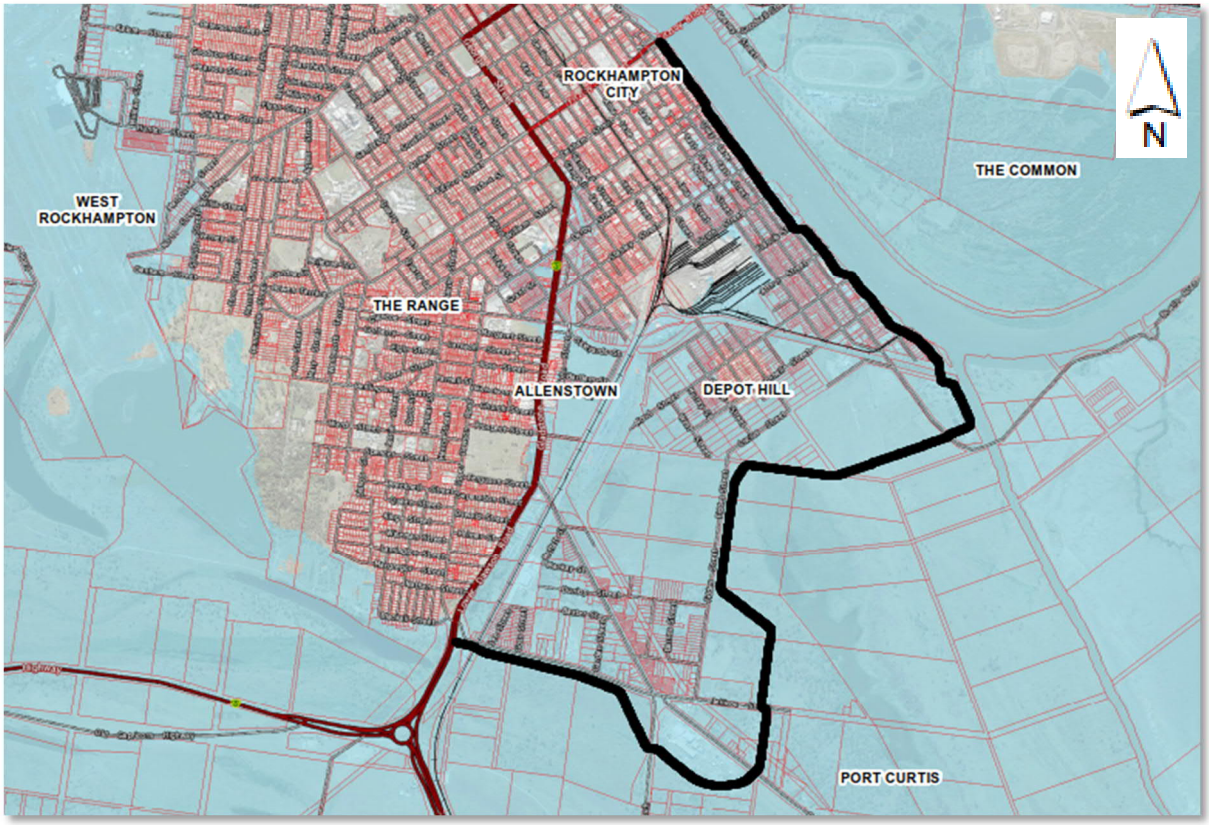

Figure 1 Location of the Proposed SRFL (Baseline Fitzroy River 1% AEP Flood Extents Shown)

The levee will be constructed to 1% Average Exceedance Probability (AEP) or 100 year Average Recurrence Interval (ARI) flood immunity with 600 millimetres (mm) freeboard. This will be equivalent to a 9.89 m gauge level (post SRFL construction).

The levee will incorporate flood gates on the major drainage channels and existing piped drainage networks that discharge outside the levee will be fitted with non-return devices to prevent river back-up. A system of landside drainage channels and three interior pump stations will discharge local catchment runoff should local rainfall events coincide with a regional Fitzroy River flood event.

Table 1 SRFL component lengths

Levee Type	Length (m)
Temporary Fully Demountable Wall	732
Composite Demountable / Permanent Levee Wall	967
Levee Emergency Spillway	420
Earth Embankment (incl. road ramps and gates)	5,892
Crib Retaining Wall	729
Total Levee Length	**8,740**

1.5 Project Delivery

The SRFL project is being delivered in two distinct stages, as detailed below.

1.5.1 Stage 1: Early Works (Pre-construction services)

Prior to construction starting on the SRFL project, early works will be completed. The works include land acquisition, stormwater, water and sewage relocations, river bank protection works and drainage works. Early works are anticipated to commence in 2019, and will be undertaken progressively throughout the year.

1.5.2 Stage 2: Main Contract

Council is committed to finalising the consultation, environmental and planning approvals, technical investigations and design of the SRFL project, to facilitate tendering and construction. The SRFL construction works are anticipated to start in late 2019.

The SRFL project has been declared a prescribed project by the Minister for State Development, Manufacturing, Infrastructure and Planning. Approvals for the project are yet to be obtained, and will be facilitated through the Infrastructure Designation process under the *Planning Act 2016*. This will include the preparation and exhibition of an Environment Assessment Report (EAR).

1.6 Project Site

The SRFL alignment borders the southern and eastern aspects of the South Rockhampton suburbs of Port Curtis and Depot Hill which are within the Yeppen Floodplain. For the purpose of the ecological site investigations, the Project site is illustrated in Figure 2.

The SRFL alignment traverses through grazing land, industrial and residential areas, along the Fitzroy River and through the Rockhampton Central CBD along Quay Street.

1.7 Study Aim and Scope

An initial ecological assessment of the Project site was undertaken in 2014 (AECOM, 2014a). The study provided preliminary site information to support further design of the Project and included field assessments in February and April 2014. Additionally, a marine plant assessment was undertaken in 2018 and included a field assessment for marine plants along the Fitzroy River (AECOM, 2018).

The aim of the current study was to build on the information provided by AECOM, (2014a) and AECOM, (2018), and to document the terrestrial flora and fauna species and vegetation communities within and adjacent to the Project site, with particular reference to the occurrence of conservation significant and migratory species. In meeting this aim, the scope of the assessment was as follows.

- Review existing terrestrial ecology data for the Project site and surrounding areas.
- Describe the diversity of terrestrial fauna and flora found in the Project site.
- Provide baseline data on Regional Ecosystems (REs) and Threatened Ecological Communities (TECs) occurring in the Project site.
- Identify and map marine plants that occur outside areas surveyed in 2018.

- Identify the occurrence or potential occurrence of conservation significant and migratory species.
- Assess the potential significance of impacts from the Project on ecological values in the context of relevant legislation.
- Provide measures to avoid or mitigate adverse impacts on significant ecological values at the construction and operational phases of the Project.

The field survey identified a number potential habitat areas for conservation significant and migratory species within or immediately adjacent to the Project site. As a result, a second site investigation was conducted which was designed to further investigate the likelihood of occurrence of conservation significant and migratory species. The scope of the assessment was to:

- Identify and characterise the status of conservation significant and migratory species within the Project site and associated catchments.
- Undertake targeted surveys for ornamental snake within areas of mapped essential habitat.
- Identify potential impacts associated with the Project on conservation significant and migratory species, including significant impacts under the EPBC Act.

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N

DATUM GDA 1994, PROJECTION MGA ZONE XX

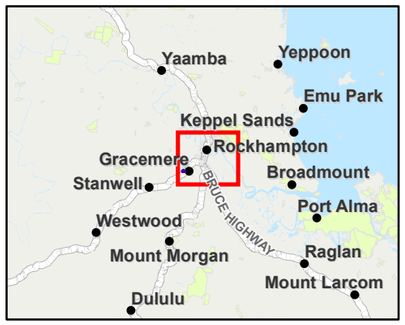
0 750 1,500 3,000

Metres

1:60,000 (when printed at A3)

LEGEND

- Major Roads
- Minor Roads
- SRFL Alignment



Data sources:

Base Data: (c) 20XX (data source)
(additional data)

South Rockhampton Flood Levee Project

PROJECT SITE

PROJECT ID	60589157
CREATED BY	WeirW
LAST MODIFIED	11-Apr-2019
VERSION	<version number>

Figure 2

A3 size

Filename: O:\Bus_Lines\WIS\Team - T&DS\1_Business_Development\60589157_SRFL\02_MXDs\60589157_F1_ProjectSite_20190212_v1_A3.mxd

2.0 Regulatory Framework

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a process for environmental assessment and approval of proposed actions that have, will have or are likely to have a significant impact on Matters of National Environmental Significance (MNES) or on Commonwealth land.

MNES are outlined in the EPBC Act to include:

- World Heritage Properties
- National Heritage Places
- Wetlands of International Importance (listed under the Ramsar Convention)
- Listed Threatened Species and Ecological Communities
- Migratory Species (listed under international agreements)
- Commonwealth Marine Areas
- Great Barrier Reef Marine Park
- A Water Resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, a referral to the Department of the Environment and Energy (DoEE) would be required if the Project had the potential to cause a 'significant impact' on MNES. The determination is made with reference to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (DoE, 2013) and other EPBC Act policy statements including significant impact guidelines for individual threatened species, groups of species and threatened ecological communities.

2.1.2 Weeds of National Significance

Thirty two (32) Weeds of National Significance (WoNS) have been agreed by Australian governments using an assessment process that prioritised these weeds based on their invasiveness, potential for spread and environmental, social and economic impacts. For the existing 32 WoNS, customised and targeted plans have been developed.

2.2 Queensland

2.2.1 Nature Conservation Act 1992

The object of the *Nature Conservation Act 1992* (NC Act) is "the conservation of nature" (Section 4, NC Act). In support of the NC Act, the Nature Conservation (Wildlife) Regulation 2006 lists 'protected wildlife' (flora and fauna species), which are considered to be 'Extinct in the Wild', 'Endangered', 'Vulnerable', 'Near Threatened' and 'Least Concern' wildlife. Under Sections 88 and 89 of the NC Act, it is an offense to take or use protected wildlife, which is outside a 'protected area', unless exemptions apply or an approval (e.g. clearing permit) is obtained from the Department of Environment and Science (DES).

2.2.1.1 Protected Plants Flora Survey Trigger Map

In Queensland, all plants that are native to Australia are protected plants under the NC Act to prevent whole plants or protected plant parts from being illegally removed from the wild or illegally traded. The protected plants flora survey trigger map shows high risk areas for protected plants and is used to help determine flora survey and clearing permit requirements for a particular location. High risk areas represent areas where Endangered, Vulnerable or Near Threatened plants are known to exist or are likely to exist.

Where clearing occurs within a high risk area, a flora survey is required to determine the presence of protected plants within the clearing impact area. The flora survey must then be lodged with DES to either obtain an approval, or an exemption notice (if none present).

2.2.2 Environmental Protection Act 1994

The object of the *Environmental Protection Act 1994* (EP Act) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development) (refer Section 3, EP Act).

The EP Act provides the key legislative framework for the protection of the environment in Queensland. Section 319 of the EP Act imposes a 'general environmental duty', which specifies that a person must not undertake any activity that may harm the environment without taking reasonable and practical measures to prevent or minimise the harm.

2.2.3 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of native vegetation in Queensland. The purpose of the VM Act is to regulate the clearing of vegetation in a way that:

(a) conserves remnant vegetation;

(b) conserves vegetation in declared areas;

(c) ensures that clearing does not cause land degradation;

(d) prevents the loss of biodiversity;

(e) maintains ecological processes;

(f) manages the environmental effects of the clearing to achieve the matters mentioned in paragraphs (a) to (e); and

(g) reduces greenhouse gas emissions (refer Section 3(1) of the VM Act).

The VM Act protects and regulates the clearing of native vegetation including 'remnant' and 'high value regrowth' (HVR) vegetation (shown as Category B and C on the Regulated Vegetation Management Map) on freehold land, Indigenous land and State tenures.

The VM Act also protects Category R vegetation; that is native woody vegetation on freehold land, Indigenous land or leasehold land granted for agriculture or grazing purposes, located within 50 m of a watercourse in the Burdekin, Mackay, Whitsunday and Wet Tropics Great Barrier Reef catchments.

2.2.3.1 Essential Habitat

Essential habitat is regulated under the VM Act and is vegetation in which threatened species listed under the NC Act have been known to occur. Clearing of essential habitat is assessed through the development assessment process under the *Planning Act 2016*. Where clearing cannot be reasonably avoided or minimised, an offset may occur.

2.2.4 Biosecurity Act 2014

The *Biosecurity Act 2014* is administered by the Department of Agriculture and Fisheries (DAF). The Act provides management measures to protect agricultural and tourism industries and the environment from pests, diseases and contaminants.

Under the Act, invasive plants and animals are categorised as either a 'Prohibited Matter' or a 'Restricted Matter' and replace the 'Declared' status under the superseded *Land Protection (Pest and Stock Route Management) Act 2002*.The *Biosecurity Act 2014* also requires every local government in Queensland to develop a biosecurity plan for their area.

2.2.5 Fisheries Act 1994

Marine plants in Queensland are protected under the *Fisheries Act 1994* (Fisheries Act), which includes the protection of all marine plants, including mangroves, seagrass, salt couch, salt marshes etc. This act also controls activities such as the collection of dead wood and algae for aquariums hobby use. Marine plants are defined in Section 8 of the Fisheries Act as stated below.

1. *'Marine plant' includes the following –*
    a. *a plant (a 'tidal plant') that usually grows on, or adjacent to, tidal land, whether it is living, dead, standing or fallen;*
    b. *material of a tidal plant, or other plant material on tidal land;*
    c. *a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.*
2. *'Marine plant' does not include a plant that is –*
    a. *prohibited matter or restricted matter under the Biosecurity Act 2014; or*
    b. *controlled biosecurity matter or regulated biosecurity matter under the Biosecurity Act 2014.*

Marine plant protection applies irrespective of the tenure (e.g. unallocated state land and all state tenured lands, including private freehold and leasehold lands) of the land on which the plant occurs, the time the plant has been growing at the location, or the degree of or purpose of the disturbance.

2.3 Classifications of Conservation Values

2.3.1 Conservation Significant Species and Communities

Conservation significant flora and fauna are assigned status according to Queensland or Commonwealth legislation as described in the:

- NC Act and the subordinate Nature Conservation (Wildlife) Regulation 2006
- EPBC Act.

Conservation significant species are listed under the NC Act in the following categories:

- Extinct in the Wild
- Endangered
- Vulnerable
- Near Threatened
- Special Least Concern (Least Concern species of special cultural significance: the short-beaked echidna (*Tachyglossus aculeatus*) and the platypus (*Ornithorhynchus anatinus*)).

Conservation significant species are listed under the EPBC Act in the following categories:

- Extinct
- Extinct in the Wild
- Critically Endangered
- Endangered
- Vulnerable.

The EPBC Act also identifies and protects Threatened Ecological Communities (TECs). Types of TECs listed under the EPBC Act include woodlands, grasslands, shrublands, forests, wetlands, marine, ground springs and cave communities.

2.3.2 Migratory Species

Australia is located within the East-Asian Australasian Flyway for migratory shorebirds. These species breed as far north as Siberia and Alaska during the northern hemisphere summer and migrate to non-breeding grounds in Australia and New Zealand to avoid the northern winter and take advantage of energy rich food sources in the southern hemisphere. Migrating shorebirds arrive in northern Australia between late August and early November.

The EPBC Act includes a list of migratory species, comprising the following.

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention.
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).
- Native, migratory species identified in a list established under an international agreement such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

3.0 Methodology

3.1 Desktop Assessment

To determine potential environmental constraints for the Project, a desktop review of environmental values was undertaken. The desktop assessment included a literature review of previous studies undertaken, including:

- *South Rockhampton Flood Levee: Preliminary Ecological Assessment* (AECOM, 2014a)
- *South Rockhampton Flood Levee: Environmental Summary Report* (AECOM, 2014b)
- *South Rockhampton Flood Levee: Marine Plant Assessment* (AECOM, 2018).

Searches of publicly available datasets and online mapping were completed to a 25 km search area around the Project site. A review of the following databases was completed on 24 October 2018:

- EPBC Act Protected Matters Search Tool (PMST)
- DES Wildlife Online database to identify flora and fauna species recorded from or surrounding the Project site.
- Atlas of Living Australia database to identify locations of previously recorded flora and fauna species within and adjacent to the Project site
- eBird Australia database for bird records within and adjacent to the Project site
- Birdlife International Important Bird Areas
- Department of Natural Resources, Mines and Energy (DNRME) Regulated Vegetation Management Map
- The Queensland Herbarium Vegetation Management Regional Ecosystems (RE) map
- DES Protected Plants Flora Survey Trigger Map
- DES wetland protection area mapping
- The Queensland Herbarium Regional Ecosystem Description Database (REDD, Version 11)
- Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) Development Application mapping
- Rockhampton Regional Council Planning Scheme 2017 mapping
- Queensland Globe
- Species distribution maps from various current field guides.

Aerial photography was reviewed to investigate the nature and extent of vegetation communities and suitable habitat within and adjacent to the Project site, and to develop an understanding of site context as part of the surrounding environment.

Information collected as part of the desktop assessment was reviewed and used in the preparation of the field surveys, to identify flora and fauna species potentially found within and/or utilising the Project site and to determine appropriate survey techniques.

3.2 Field Surveys

3.2.1 November 2018

3.2.1.1 Flora

The flora survey was conducted to classify, map and verify REs within the Project site and to identify flora species, including conservation significant species and marine plants. This survey employed an assessment of the REs and flora in accordance with the methodology developed by the Queensland Herbarium, *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al.*, 2017).

The vegetation was sampled at one tertiary and seven quaternary level sites across the Project site, selected to sample the variation in vegetation observed, including both remnant and non-remnant areas, and targeting each RE identified across the Project site.

At each tertiary site a full species list and vegetation structural description was recorded, including strata, height and cover values for each species. At each quaternary site, the dominant species were recorded including a vegetation structural description of the dominant overstorey species. For each area of marine plants identified, the species present were recorded, as well as the extent and condition (e.g. presence of weeds, rubbish, evidence of fire etc.).

Each site was attributed to an RE based on the land zone and dominant species data, using the Queensland Herbarium RE classification (Neldner *et al.*, 2017). RE mapping boundaries were adjusted based on field verification. During the course of the field survey, opportunistic flora species not observed at the tertiary and quaternary sites were also recorded. Between sites, random meander searches were performed for threatened flora.

The flora survey sites are illustrated on Figure 3.

3.2.1.2 Fauna

The assessment of fauna habitat values within the Project site was limited to observations of terrestrial vertebrate fauna assemblages (birds, mammals, reptiles and amphibians) and habitat. Survey tasks included:

- daytime bird census
- fauna habitat assessments
- scans of the canopy and shrub layer for nests, hollows and arboreal fauna.

3.2.1.2.1 Habitat Assessments

Habitat assessments which characterised fauna habitat values were undertaken at eight locations in the Project site. The assessment locations coincided with all tertiary and quaternary flora assessments. Given the limited temporal boundaries of the field survey and absence of a trapping program, these assessments are particularly valuable. Habitat assessments can provide an indication of fauna and habitat suitability for threatened fauna.

Habitat assessments involved identifying available habitat for a range of taxonomic groups including birds, reptiles, amphibians and mammals (both ground dwelling and arboreal). Complexity of the understory, availability of woody debris, hollows, stags, fallen logs, cracking clay soils, leaf and exfoliating bark were all noted. Scans of the canopy and shrub layer for nests and arboreal fauna were also undertaken and all incidental fauna sightings were recorded.

The fauna survey sites are illustrated on Figure 3.

3.2.1.3 Limitations

3.2.1.3.1 Flora

A flora field survey has inherent limitations associated with the variability of vegetation communities across a survey location, and changes to the detectability and presence of species over time. Survey locations were strategically located to capture representative samples of all communities, and the seasonal conditions during which these surveys were undertaken were conducive to a relatively high degree of detectable floral diversity. However, it is recognised that field studies undertaken over just

one season cannot always account for 100% of potential floral diversity present across a survey location. In addition, large areas of the Project site were heavily grazed which significantly reduced the ability of the field team to positively identify grass species.

3.2.1.3.2 Fauna

The detection of fauna species during habitat assessments is limited, given the cryptic and nocturnal nature of many fauna. The species directly observed during this survey are opportunistic sightings only and not considered exhaustive. However, habitat assessment is an accepted method to identify the potential species within the Project site, specifically conservation significant and migratory species.

3.2.2 January 2019

3.2.2.1 Targeted Migratory Bird Survey

Migratory shorebird species use a variety of different wetland habitats for foraging, typically in or near water, wading up to a depth of around 15 cm for long-legged species. Shorebirds occur in marine habitats including ocean beaches, rocky coastlines, intertidal mudflats. They also occur in coastal wetland habitats and river estuaries, including saltmarsh and mangroves, and in freshwater wetland habitats such as marshes, the margins of lagoons and along creeks (Department of the Environment, 2015). Migratory shorebirds will also utilise other potential habitats within urbanised areas including parks with open grassland, golf courses, other types of open/undeveloped land, and may use artificial structures as roosting habitat.

A migratory shorebird survey was undertaken to identify the shorebird species that are known to or are likely to use the wetlands within the Project site for foraging and/or roosting. The survey was conducted in January to coincide with the visiting period of migratory shorebirds to eastern Australia. Target species were those listed as Migratory under the EPBC Act and included (but was not limited to) the species listed in Table 2.

Table 2 The 37 migratory shorebird species listed under the EPBC Act

Scientific Name	Common Name
Actitis hypoleucos	Common sandpiper
Arenaria interpres	Ruddy turnstone
Calidris acuminata	Sharp-tailed sandpiper
Calidris alba	Sanderling
Calidris canutus	Red knot*
Calidris ferruginea	Curlew sandpiper*
Calidris melanotos	Pectoral sandpiper
Calidris ruficollis	Red-necked stint
Calidris subminuta	Long-toed stint
Calidris tenuirostris	Great knot*
Charadrius bicinctus	Double-banded plover
Charadrius dubius	Little ringed plover
Charadrius leschenaultii	Greater sand plover*
Charadrius mongolus	Lesser sand plover*
Charadrius veredus	Oriental plover
Gallinago hardwickii	Latham's snipe
Gallinago megala	Swinhoe's snipe
Gallinago stenura	Pin-tailed snipe

Scientific Name	Common Name
Glareola maldivarum	Oriental pratincole
Tringa brevipes	Grey-tailed tattler
Tringa incana	Wandering tattler
Limicola falcinellus	Broad-billed sandpiper
Limnodromus semipalmatus	Asian dowitcher
Limosa lapponica	Bar-tailed godwit*
Limosa limosa	Black-tailed godwit
Numenius madagascariensis	Eastern curlew*
Numenius minutus	Little curlew
Numenius phaeopus	Whimbrel
Phalaropus lobatus	Red-necked phalarope
Philomachus pugnax	Ruff
Pluvialis fulva	Golden plover
Pluvialis squatarola	Grey plover
Tringa glareola	Wood sandpiper
Tringa nebularia	Common greenshank
Tringa stagnatilis	Marsh sandpiper
Tringa totanus	Common redshank
Xenus cinereus	Terek sandpiper

* Species also listed as ‘Vulnerable’, ‘Endangered’ or ‘Critically Endangered’ under the EPBC Act

Ground surveys were conducted by two observers on foot at four wetlands within and adjacent to the Project site. Each wetland was surveyed multiple times during the survey period, with all wetlands surveyed at least once in the morning and afternoon (Table 3; Figure 3).

Wetlands were selected based on the proximity to the Project site, potential for hydrological impact and vegetation similarities to palustrine wetlands which were dry along the SRFL alignment. Two wetlands, Gavial Swamp Lagoon and Jellicoe Street Wetland were dry during the survey and were not targeted for migratory bird assessment.

Species were observed using binoculars and a spotting scope.

Table 3 Wetlands surveyed during the January 2019 field assessment

Site Name	Coordinates	Survey Effort	
		AM	PM
Yeppen Lagoon	-23.407340, 150.493307	30/01/2019 31/01/2019	30/01/2019 31/01/2019
Murray Lagoon	-23.398187, 150.485041	30/01/2019	30/01/2019 31/01/2019
Fiddes Street Wetland	-23.401851, 150.509777	31/01/2019 01/02/2019	30/01/2019
Woolwash Lagoon	-23.430744, 150.527095	30/01/2019 31/01/2019 01/02/2019	30/01/2019 31/01/2019

3.2.2.2 Targeted Ornamental Snake Survey

The ornamental snake (*Denisonia maculata*) is regarded as nocturnal and a specialist predator of native frogs. Peak activity levels, and hence highest potential for ornamental snake detection, are typically restricted to periods following suitable summer rainfall events which create optimum conditions for its favoured prey to be most active and concentrated around its breeding sites.

A wet-season survey of the Project site was undertaken for ornamental snake. Spotlighting on foot using head torches and hand-held spotlights was undertaken in areas of representative habitat and mapped essential habitat.

Spotlighting locations are illustrated on Figure 3 (ornamental snake survey locations).

3.2.2.3 Limitations

Due to landholder access restrictions, the targeted fauna field survey was unable to be undertaken on the large property to the south of the Project site, including Gavial Swamp Lagoon (Figure 3). Survey effort within these lots has been limited to public roads adjacent to the property.

The field survey was undertaken in a single survey event in January 2019 in warm, humid conditions. Although this coincided with the peak activity period for seasonally-dependent conservation significant species with potential to occur (i.e. ornamental snake and migratory birds), the survey represents a 'snapshot' of the species using the Project site at a single point in time. It does not account for seasonal or long-term variations in fauna movements.

3.3 Likelihood of Occurrence of Assessment

The presence or absence of species over time cannot be definitively determined during a single survey effort. The occurrence of species varies temporally (time of day), as a result of seasonal changes and between years of high rainfall and drought.

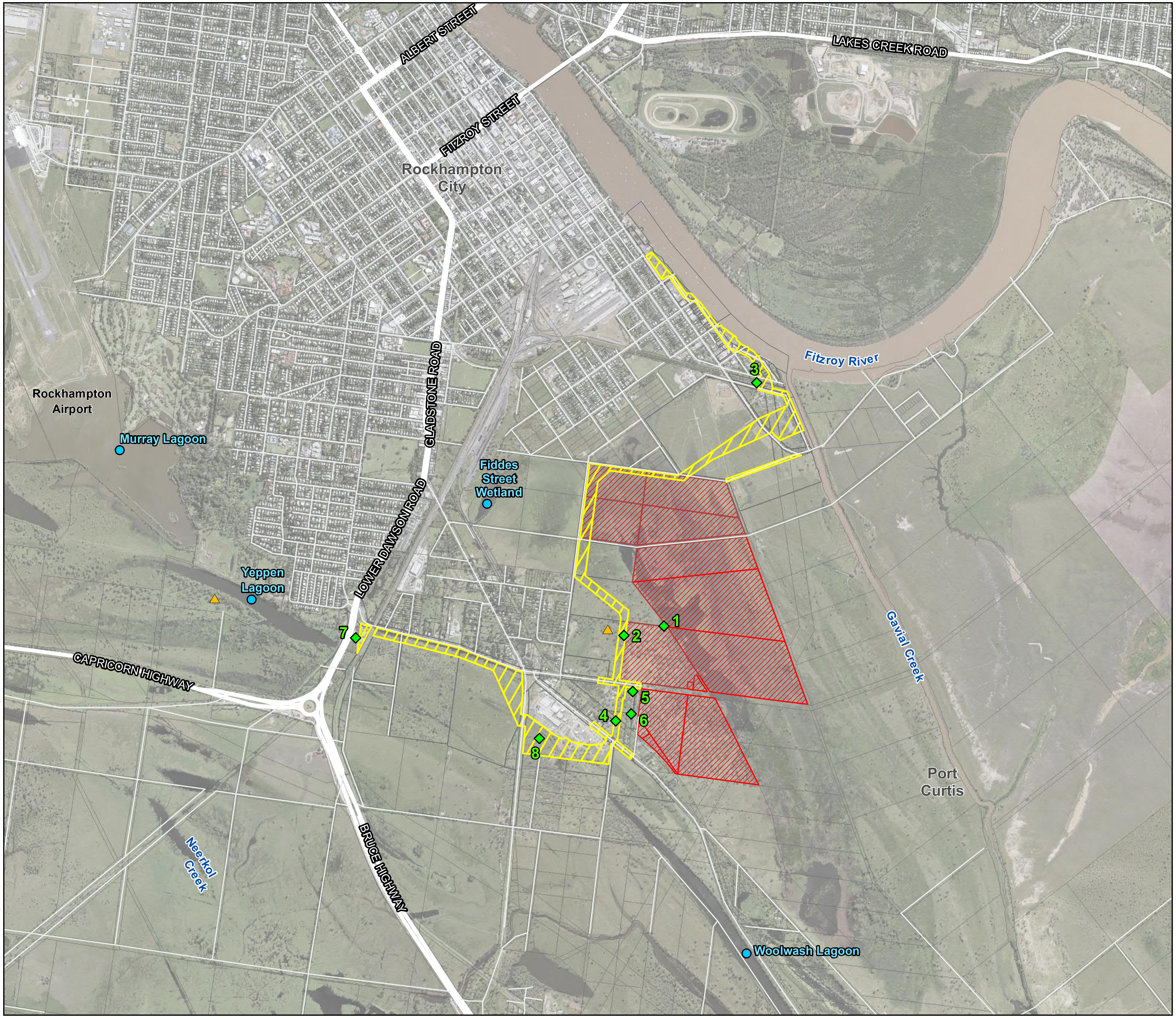
A likelihood of occurrence assessment for conservation significant species identified during the desktop review was undertaken. The assessment considered known habitat and ecological requirements of the species against the habitat types identified in the field surveys.

Each species was assessed against the categories defined below.

- Unlikely: The species has no recent historical records, has no preferred habitat in the Project site and is considered unlikely to be present.
- Low: Some of the preferred habitat is present in the Project site. Species may infrequently visit the site en-route for foraging but will not roost or otherwise be dependent on habitats on the site for their survival. Migratory and aerial foraging birds may overfly the site.
- Moderate: The Project site contains some of the preferred habitat to support a population of the species and/or the species has been recorded within the vicinity of Project site.
- High: Species has previously been recorded in the Project site. The site contains significant preferred habitat which is likely to support a population of the species, including roost sites.

- Present: Species directly observed in the Project site.

This process is to be used as a guide and is not to be used as indicating species presence or absence other than where observed presence is indicated.



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DATUM GDA 1994, PROJECTION MGA ZONE XX

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Metres

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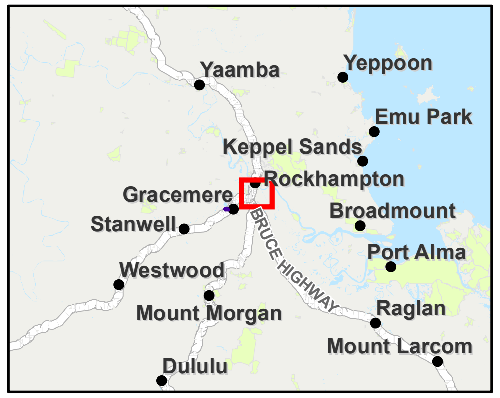
LEGEND

- Flora and Fauna Survey Sites
- Wetland Survey Sites
- Ornamental Snake Survey Locations
- Major Roads
- Minor Roads
- SRFL Alignment
- Access Denied
- Cadastre



Data sources:

Base Data: (c) 20XX (data source)
(additional data)

South Rockhampton Flood Levee Project

FIELD SURVEY LOCATIONS

PROJECT ID	60589157
CREATED BY	WeirW
LAST MODIFIED	11-Apr-2019
VERSION	<version number>

Figure 3

Filename: O:\Bus_Lines\WIS\Team - T&DS\1_Business_Development\60589157_SRFL\02_MXDs\60589157_F2_FieldSurveyLocations_20190212_v2_A3.mxd

A3 size

4.0 Results

4.1 Desktop Assessment

4.1.1 Previous Ecological Assessments

AECOM completed a preliminary environmental assessment of the Project site in 2014 to inform detailed design of the Project. The key findings from the report are summarised below:

- **South Rockhampton Flood Levee: Ecological Assessment Report (AECOM, 2014a)**
  - A fauna and flora survey was undertaken in February 2014, with a supplementary fauna survey undertaken in April 2014.
  - RE 11.3.2 was mapped within the SRFL alignment.
  - No conservation significant flora species were identified.
  - Three migratory species was identified during the field survey:
    - Latham's snipe (*Gallinago hardwickii*): Migratory under the EPBC Act.
    - Glossy ibis (*Plegadis falcinellus*): Migratory under the EPBC Act.
    - Eastern osprey (*Pandion cristatus*): Migratory under the EPBC Act.
  - A likelihood of occurrence assessment was undertaken and has informed the current assessment.
  - A number of key potential impacts, opportunities to reduce these impacts and a description of potential residual impacts were detailed.
  - Further hydrological modelling was recommended to better understand potential downstream impacts as a result of the Project.
- **South Rockhampton Flood Levee: Marine Plant Assessment (AECOM, 2018)**
  - A marine plant survey was undertaken along the Fitzroy River in April 2018.
  - Marine plants were identified within the Project site along the lower stream banks of the Fitzroy River. Marine plant species identified included:
    - Grey mangrove (*Avicennia marina*).
    - River she-oak (*Casuarina cunninghamiana*).
    - River lily (*Crinum pedunculatum*).
    - Sedge (*Cyperus* sp.).
    - Milky mangrove (*Excoecaria agallocha*).
    - Broad-leaved paperbark (*Melaleuca quinquenervia*).
    - Salt couch (*Sporobolus virginicus*).

4.1.2 Bioregional Context

The Project site is located entirely within the Marlborough Plains subregion of the Brigalow Belt Bioregion.

4.1.3 Flora

4.1.3.1 Mapped Regional Ecosystems

Based on the Queensland Herbarium RE mapping (Version 11), the Project site is predominantly located within non-remnant vegetation, intersecting two heterogeneous polygons of REs along the SRFL alignment, as listed in Table 4 below and illustrated on Figure 4.

Table 4 Mapped REs within the Project site

RE	Short Description[1]	VM Act Status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	Of Concern
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains.	Of Concern
11.3.3c	*Eucalyptus coolabah* woodland to open woodland (to scattered trees) on alluvial plains or levees.	Of Concern
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains.	Of Concern
11.3.27c	Mixed grassland or sedgeland with areas of open water +/- aquatic species on closed depressions on alluvial plains.	Least Concern
11.3.27x1b	Sedgelands to grasslands on Quaternary deposits.	Least Concern

[1] Description of REs as contained in the REDD Version 11 (Queensland Herbarium, 2018)

4.1.3.2 Threatened Ecological Communities

The desktop assessment identified four TECs as potentially occurring within the Project site. These TECs are described in Table 5 below with their status and corresponding REs (REs mapped by the Queensland Herbarium within the Project site are shown in bold).

Table 5 TECs potentially occurring within the Project site

TEC	EPBC Act Status	Analogous REs
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14, 11.12.21.
Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	**11.3.3**, 11.3.15, 11.3.16, 11.3.28, 11.3.37.
Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.11.18, 11.2.3, 11.8.3, 11.8.6, 11.9.8.
Weeping Myall Woodlands	Endangered	**11.3.2**, 11.3.28.

4.1.3.3 Conservation Significant Flora

The desktop assessment identified 13 conservation significant flora species with the potential to occur within the Project site. These species and their respective conservation status under the EPBC Act and NC Act are detailed in Table 6 below.

Table 6 Desktop results for conservation significant flora

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Bulbophyllum globuliforme	Miniature moss-orchid	Vulnerable	Near Threatened
Cadellia pentastylis	Ooline	Vulnerable	Vulnerable
Corymbia xanthope	Glen Geddes bloodwood	Vulnerable	Vulnerable
Cossinia australiana	Cossinia	Endangered	Endangered
Cycas megacarpa	-	Endangered	Endangered
Cycas ophiolitica	Marlborough blue	Endangered	Endangered

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Decaspermum struckoilicum	-	Endangered	Endangered
Dichanthium setosum	Bluegrass	Vulnerable	-
Eucalyptus raveretiana	Black ironbox	Vulnerable	Vulnerable
Macadamia integrifolia	Macadamia nut	Vulnerable	Vulnerable
Marsdenia brevifolia	-	Vulnerable	Vulnerable
Parsonsia larcomensis	Mt Larcom silk pod	Vulnerable	Vulnerable
Phaius australis	Lesser swamp-orchid	Endangered	Endangered

4.1.3.4 Essential Habitat

No essential habitat for conservation significant flora is mapped within the Project site.

4.1.3.5 Protected Plants Trigger Area

There are no high risk areas mapped within the Project site, as identified on the protected plants flora survey trigger map.

4.1.4 Fauna

4.1.4.1 Conservation Significant Fauna

The desktop assessment identified 34 conservation significant fauna species (excluding those species that are exclusively marine) with the potential to occur within the Project site. These species and their respective conservation status under the EPBC Act and NC Act are detailed in Table 7 below.

Table 7 Desktop results for conservation significant fauna

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Birds			
Botaurus poiciloptilus	Australasian bittern	Endangered	-
Calidris canutus	Red knot	Endangered	Endangered
Calidris ferruginea	Curlew sandpiper	Critically Endangered	Endangered
Epthianura crocea macgregori	Yellow chat	Critically Endangered	Endangered
Erythrotriorchis radiatus	Red goshawk	Vulnerable	Endangered
Fregetta grallaria grallaria	White-bellied storm petrel	Vulnerable	-
Geophaps scripta scripta	Squatter pigeon (southern)	Vulnerable	Vulnerable
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	Vulnerable	Vulnerable
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically Endangered	Endangered
Macronectes giganteus	Southern giant-petrel	Endangered	Endangered
Neochmia ruficauda ruficauda	Star finch	Endangered	Endangered
Numenius madagascariensis	Eastern curlew	Critically Endangered	Endangered
Pachyptila turtur subantarctica	Fairy prion	Vulnerable	-
Poephila cincta cincta	Black-throated finch (southern)	Endangered	Endangered

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Pterodroma neglecta neglecta	Kermadec petrel	Vulnerable	-
Rostratula australis	Australian painted snipe	Endangered	Vulnerable
Thalassarche impavida	Campbell albatross	Vulnerable	-
Turnix melanogaster	Black-breasted button quail	Vulnerable	Vulnerable
Mammals			
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable	Vulnerable
Dasyurus hallucatus	Northern quoll	Endangered	-
Macroderma gigas	Ghost bat	Vulnerable	Endangered
Nyctophilus corbeni	Corben's long-eared bat	Vulnerable	Vulnerable
Petauroides volans	Greater glider	Vulnerable	Vulnerable
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Pteropus poliocephalus	Grey-headed flying fox	Vulnerable	-
Xeromys myoides	Water mouse	Vulnerable	Vulnerable
Reptiles			
Crocodylus porosus	Salt-water crocodile	-	Vulnerable
Delma torquata	Collared delma	Vulnerable	Vulnerable
Denisonia maculata	Ornamental snake	Vulnerable	Vulnerable
Egernia rugosa	Yakka skink	Vulnerable	Vulnerable
Elseya albagula	White-throated snapping turtle	Critically Endangered	Endangered
Furina dunmalli	Dunmall's snake	Vulnerable	Vulnerable
Rheodytes leukops	Fitzroy River turtle	Vulnerable	Vulnerable
Fish			
Maccullochella peelii	Murray cod	Vulnerable	-

4.1.4.2 Migratory Fauna

The desktop assessment identified 25 migratory species with the potential to occur within the Project site (excluding those species that are also listed as Critically Endangered, Endangered, Vulnerable or Near Threatened). Marine species were also excluded from this assessment. These species and their respective conservation status under the EPBC Act and NC Act are detailed in Table 8 below.

Table 8 Desktop results for migratory species

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Migratory Marine Birds			
Anous stolidus	Common noddy	Migratory	Special Least Concern
Apus pacificus	Fork-tailed swift	Migratory	Special Least Concern
Calonectris leucomelas	Streaked shearwater	Migratory	Special Least Concern
Fregata ariel	Lesser frigatebird	Migratory	Special Least Concern
Fregata minor	Greater frigatebird	Migratory	Special Least Concern
Hydroprogne caspia	Caspian tern	Migratory	Special Least Concern

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Plegadis falcinellus	Glossy ibis	Migratory	Special Least Concern
Sterna albifrons	Little tern	Migratory	Special Least Concern
Migratory Terrestrial Species			
Cuculus optatus	Oriental cuckoo	Migratory	Special Least Concern
Hirundapus caudacutus	White-throated needletail	Migratory	Special Least Concern
Monarcha melanopsis	Black-faced monarch	Migratory	Special Least Concern
Monarcha trivirgatus	Spectacled monarch	Migratory	Special Least Concern
Myiagra cyanoleuca	Satin flycatcher	Migratory	Special Least Concern
Rhipidura rufifrons	Rufous fantail	Migratory	Special Least Concern
Migratory Wetland Species			
Actitis hypoleucos	Common sandpiper	Migratory	Special Least Concern
Calidris acuminata	Sharp-tailed sandpiper	Migratory	Special Least Concern
Calidris melanotos	Pectoral sandpiper	Migratory	Special Least Concern
Calidris ruficollis	Red-necked stint	Migratory	Special Least Concern
Gallinago hardwickii	Latham's snipe	Migratory	Special Least Concern
Limosa limosa	Black-tailed godwit	Migratory	Special Least Concern
Numenius minutus	Little curlew	Migratory	Special Least Concern
Pandion cristatus	Eastern osprey	Migratory	Special Least Concern
Tringa glareola	Wood sandpiper	Migratory	Special Least Concern
Tringa nebularia	Common greenshank	Migratory	Special Least Concern
Tringa stagnatilis	Marsh sandpiper	Migratory	Special Least Concern

4.1.4.3 Essential Habitat

Essential habitat for the ornamental snake (*Denisonia maculata*) occurs within the Project site and is depicted in Figure 4. Essential habitat for the Australian painted snipe (*Rostratula australis*), squatter pigeon (southern) (*Geophaps scripta scripta*), and curlew sandpiper (*Calidris ferruginea*) also occur within the region (Figure 4).

4.1.5 Wetlands

The western side of the city of Rockhampton is surrounded by the Important Bird Area (IBA) and Directory of Important Wetlands (DIW) wetland of the Fitzroy Floodplain and Delta which extends from Yamba to the coast at Port Alma, and is approximately 98, 743 ha in size (BirdLife International, 2019). The Fitzroy floodplain, which extends north-west from Rockhampton, largely consists of cleared and grazed floodplain that generally extends to the banks of dissecting streams, but in some places is bordered by remnant woodland along drainage channels or punctuated by heavily disturbed sedgeland and aquatic macrophytes associated with lagoons (BirdLife International, 2019). The Fitzroy delta is a 15 km wide strip of wetland that extends approximately 60 km south-east from Rockhampton. The area is heavily modified, with Brennan, (1994) reporting no pristine sites found in a survey of riparian zones and only 17.2% of lower Fitzroy catchment with > 90% of its original vegetation intact.

Significant permanent wetlands south of Rockhampton near the SRFL alignment are mostly associated with the Fitzroy River and Gavial Creek. The wetlands include Yeppen, Woolwash and Murray (which can be described as floodwater lagoons/wetlands) as well as the semi-permanent pools within the defined natural change of Gavial Creek.

The wetlands provide important bird habitat (Queensland Wetlands Program, 2013) consisting of:

- Diverse mosaics of wetlands ranging from permanent deepwater habitats through to ephemeral swamps that support migratory shorebirds.
- Regionally significant breeding populations of waterfowl, including cotton pygmy geese, swans, black-necked storks, magpie geese and brolgas.
- A seasonally dry environment but with a number of permanent freshwater lagoons and at least one perennial stream fed by groundwater.

4.1.5.1 Wetland Protection Area Mapping

On 25 November 2011, the State Planning Policy (SPP) 4/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments took effect. The SPP seeks to ensure that development in or adjacent to wetlands of high ecological significance in Great Barrier Reef catchments is planned, designed, constructed and operated to prevent the loss or degradation of wetlands and their values, or enhances these values - in particular, the hydrological regime and ecological values of those wetlands.

The trigger area mapping of wetland protection areas identify where policies apply under the SPP 4/11. Wetlands of ecological significance within the trigger areas have been identified using the Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM). The method identifies relative wetland conservation values within a specified study area (usually a catchment). Wetlands have been classified as being of high ecological significance (HES) or general ecological significance (GES).

The wetland protection area mapping shows that the Project site contains trigger areas for wetland protection areas and HES wetlands (Figure 5). Wetlands mapped within the area and considered in the potential impact assessment include:

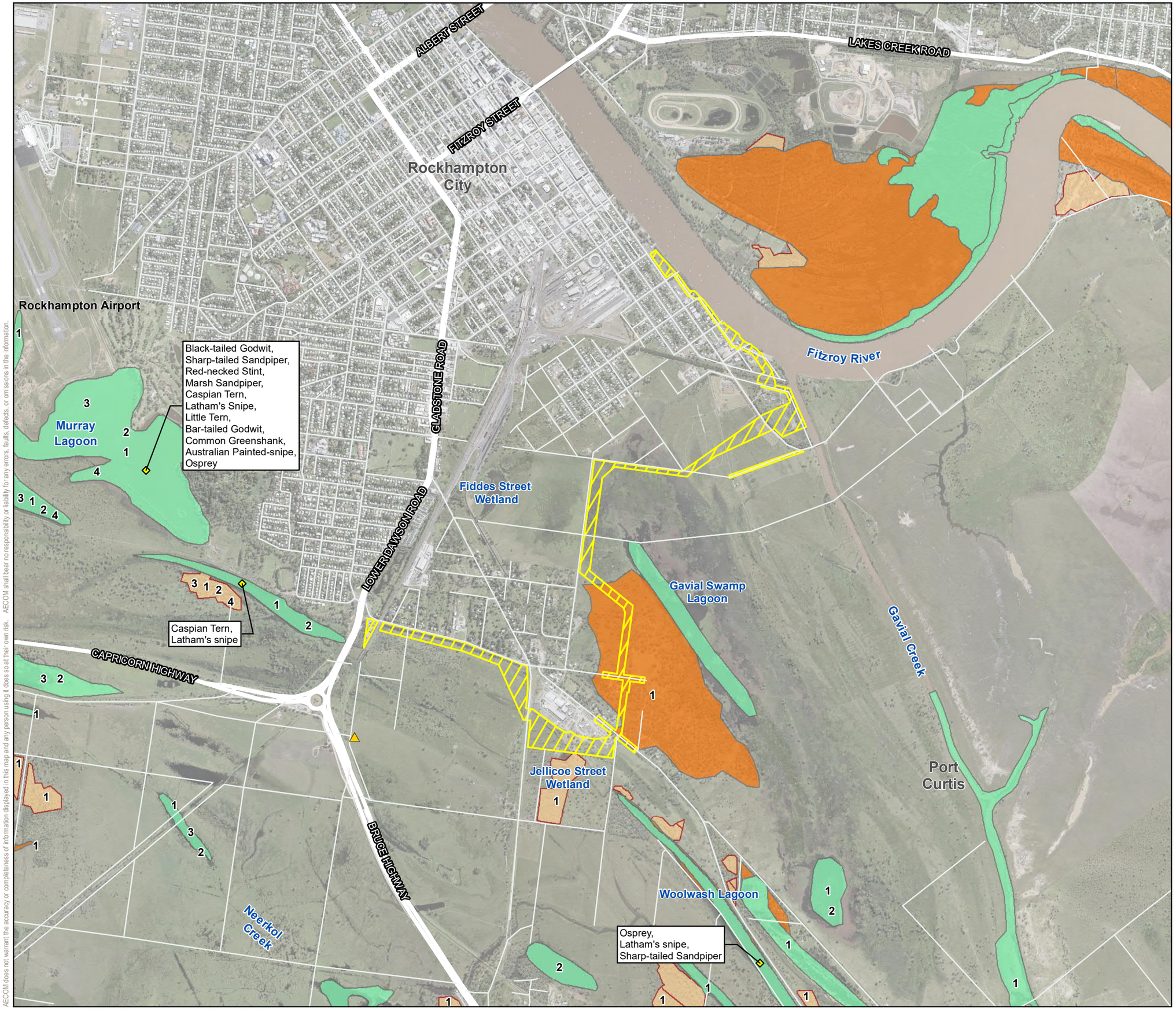
- Fiddes Street Wetland
- Gavial Swamp Lagoon
- Woolwash Lagoon
- Yeppen Lagoon
- Murray Lagoon
- Jellicoe Street Wetland.

4.1.5.2 Migratory Shorebirds in Rockhampton

Publicly available records of migratory shorebirds in and around the Project site were reviewed. Previously identified species include:

- Australian painted snipe (Rostratula australis) (2013)
- Black-tailed godwit (Limosa limosa) (2018)
- Caspian tern (Hydroprogne caspia) (2018)
- Common greenshank (Tringa nebularia) (2016)
- Eastern osprey (Pandion cristatus) (2017)
- Latham’s snipe (Gallinago hardwickii) (2018)
- Little tern (Sterna albifrons) (2017)
- Marsh sandpiper (Tringa stagnatilis) (2018)
- Red-necked stint (Calidris ruficollis) (2018)
- Sharp-tailed sandpiper (Calidris acuminata) (2018)
- Western Alaskan bar-tailed godwit (Limosa lapponica bauera) (2016).

The locations of the above records are depicted on Figure 4.



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LEGEND

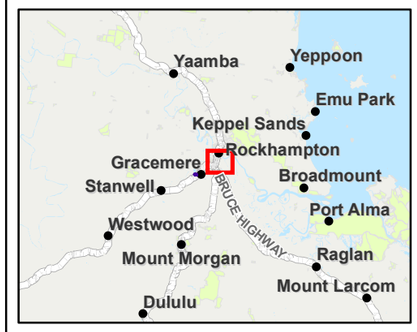
- Shorebird records
- Ornamental Snake Records
- Major Roads
- Minor Roads
- SRFL Alignment

Vegetation: Regional Ecosystems

- Category A or B area containing of concern
- Category A or B area that is least concern
- Category C area containing of concern
- Category C area that is of least concern
- Area not categorised

Essential Habitat:

1 Ornamental Snake (*Denisonia maculata*)
2 Australian Painted Snipe (*Rostratula australis*)
3 Squatter Pigeon (Southern) (*Geophaps scripta scripta*)
4 Curlew Sandpiper (*Calidris ferruginea*)



Data sources:
Imagery: QLDBase Imagery WMS
Ornamental Snake & Shorebired Records: Atlas of Living Australia, eBird.

South Rockhampton Flood Levee Project

DESKTOP ASSESSMENT RESULTS

PROJECT ID	60589157
CREATED BY	WeirW
LAST MODIFIED	11-Apr-2019
VERSION	<version number>

Figure 4

A3 size

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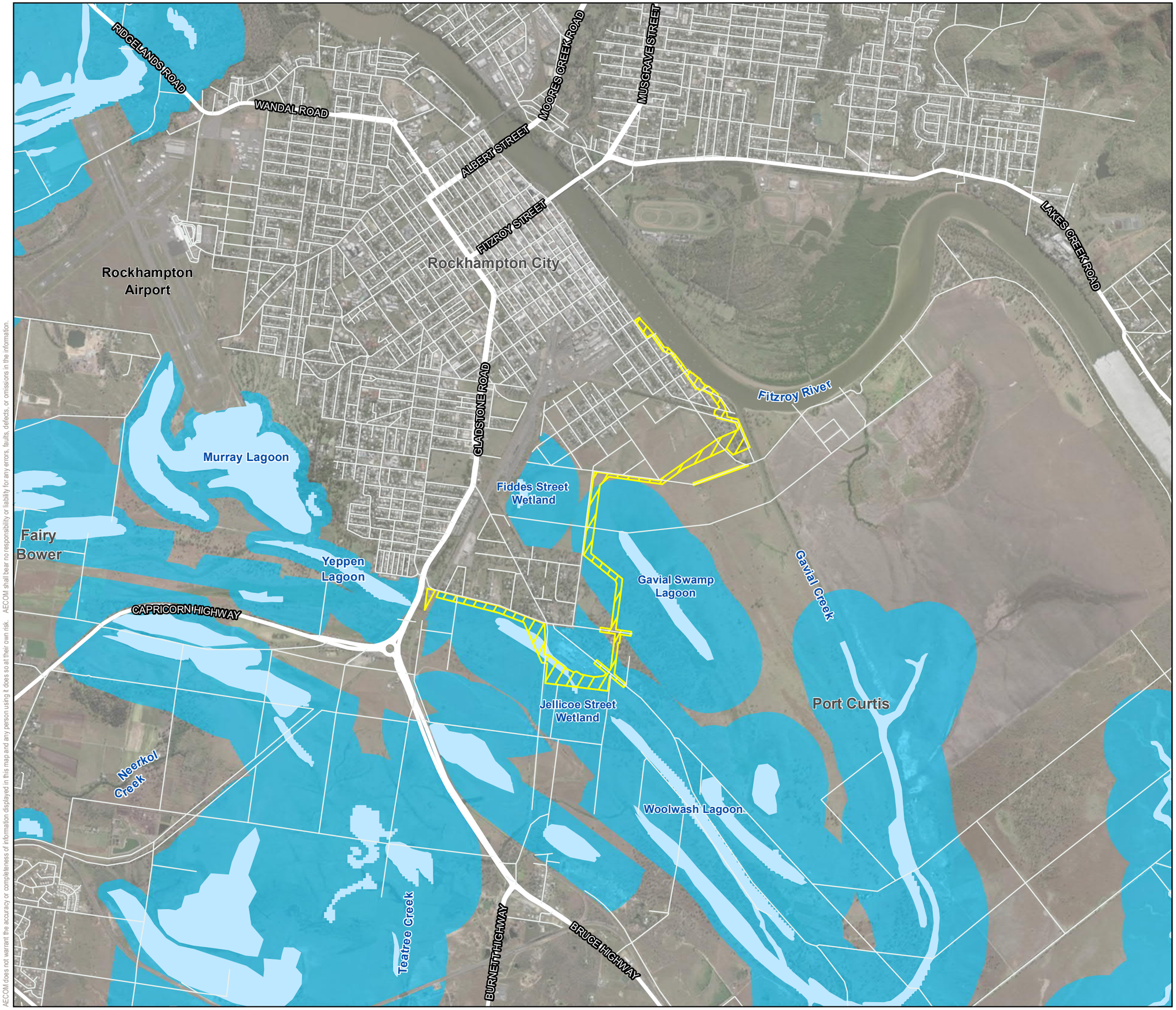

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DATUM GDA 1994, PROJECTION MGA ZONE XX

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Metres

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LEGEND

- Major Roads
- Minor Roads
- SRFL Alignment
- High Ecological Significance Wetlands
- Wetland Protection Trigger Area

Data sources:
Imagery: QLDBase Imagery WMS
Ornamental Snake & Shorebired Records: Atlas of Living Australia, eBird.

South Rockhampton Flood Levee Project

WETLAND PROTECTION AREA MAPPING

PROJECT ID	60589157
CREATED BY	WeirW
LAST MODIFIED	11-Apr-2019
VERSION	<version number>

Figure 5

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4.2 Field Surveys

4.2.1 Survey Timing and Climatic Conditions

4.2.1.1 November 2018

The first field survey was undertaken over three days from 21 November to 23 November 2018. Weather conditions experienced consisted of hot days and warm nights. A review of the daily weather observations sourced from the BoM Rockhampton Aero Research Station (Station 39083) recorded the minimum and maximum temperature during the survey as 19.1ºC and 36.1ºC respectively (BOM, 2019). 8.2 mm of rainfall was recorded on 19 November; however prior to this the most recent rainfall event was 24.0 mm from 1-4 November 2018.

4.2.1.2 January 2019

The targeted fauna field survey was undertaken over four days from 29 January to 1 February 2019. Weather conditions experienced consisted of hot days and warm nights, with minimum and maximum temperatures recorded at the BoM Rockhampton Aero Research Station as 22.4ºC and 32.5ºC respectively (BOM, 2019).

December to March is generally considered the wet season in Rockhampton. However, at the time of the field survey, the preceding environmental conditions were dry. Rainfall recorded for the months prior to the January survey was well below the collated average data for the local area, with the exception of December which received the annual rainfall (Figure 6). January 2019 received less than half the average annual amount of rainfall.

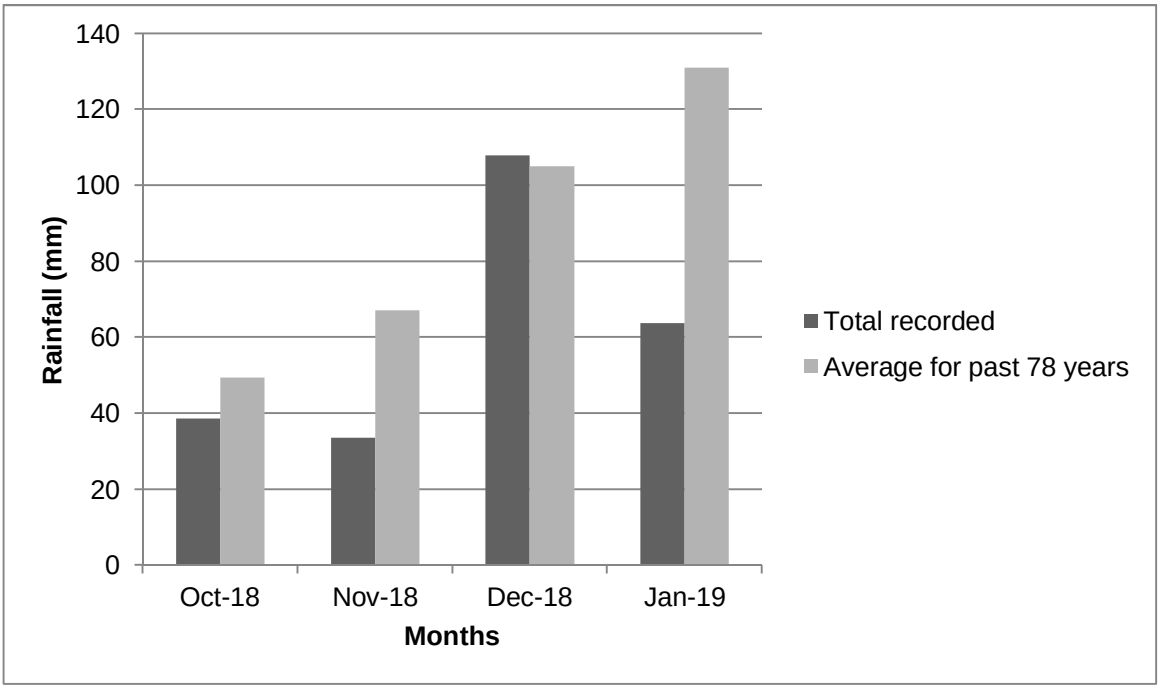


Figure 6 Rainfall Data Recorded at Rockhampton Aero (BOM, 2019)

4.2.2 Flora

4.2.2.1 Species Diversity

The field survey identified 41 flora species from 21 families, with the full species list provided in Appendix A. The dominant families present were Myrtaceae and Poaceae.

4.2.2.2 Regional Ecosystems

REs were ground-truthed during the field survey, with one RE mapped as occurring within the Project site. The short description of the RE is presented in Table 9 below and the extent of the RE is illustrated on Figure 7.

Table 9 RE mapped within the Project site

RE	Short description[1]	VM Act Status
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains.	Of Concern

[1] Description of REs as contained in the REDD Version 11 (Queensland Herbarium, 2018)

4.2.2.3 Threatened Ecological Communities

No TECs were identified within the Project site during the field survey and none are considered likely to occur.

4.2.2.4 Marine Plants

Marine plants were identified during the field survey at one location within the SRFL alignment in a tributary to Gavial Creek. The extent of the marine plants was mapped and is shown in Figure 7. The marine plants identified along the Fitzroy River are discussed and mapped within the Marine Plant Assessment report (AECOM, 2018).

Dominant marine plant species found within the Project site during the field survey are outlined in Table 10 below.

Table 10 Dominant marine plants identified within the Project site

Scientific Name	Common Name
Aegiceras corniculatum	River mangrove
Excoecaria agallocha	Milky mangrove
Phragmites australis	Common reed

4.2.2.5 Conservation Significant Species

No conservation significance species or protected plants were recorded within the Project site during the field survey.

4.2.2.6 Introduced Species

Eighteen introduced species were identified during the flora survey and are presented in Table 11 below. Five species identified are listed as Category 3 Restricted Matter under the *Biosecurity Act 2014* and three species are listed as WoNS.

Table 11 Weed species and their status under the relevant legislation

Scientific Name	Common Name	Status
Bidens pilosa	Cobbler's peg	-
Bothriochloa pertusa	Indian bluegrass	-
Cardiospermum grandiflorum	Balloon vine	-
Cryptostegia grandiflora	Rubber vine	C3, WoNS
Dactyloctenium aegyptium	Crowsfoot grass	-

Scientific Name	Common Name	Status
Digitaria didactyla	Couch	-
Gomphrena celosioides	Gomphrena weed	-
Harrisia martinii	Harrisia cactus	C3
Mangifera indica	Mango	-
Parthenium hysterophorus	Parthenium	C3, WoNS
Passiflora suberosa	Corky passion vine	-
Portulaca oleracea	Pigface	-
Sida rhombifolia	Sida	-
Stachytarpheta jamaicensis	Snake weed	-
Urochloa decumbens	Signal grass	-
Urochloa mutica	Paragrass	-
Vachellia farnesiana	Mimosa	C3
Vachellia nilotica	Prickly acacia	C3, WoNS

4.2.3 Fauna

4.2.3.1 Species Diversity

The November 2018 and January 2019 field surveys recorded 97 fauna species, comprising 88 bird, 3 mammal, 4 reptile and 2 amphibian species. All observed fauna were typical for the region and habitat types recorded on site.

The field survey undertaken in 2014 recorded 86 fauna species, including 71 bird, 3 mammal, 5 reptile and 7 amphibian species (AECOM, 2014a).

The combined species list is provided in Appendix B, Table 19.

4.2.3.1.1 Conservation Significant Species

No conservation significant fauna species were identified during the field surveys.

4.2.3.1.2 Migratory Birds

A total of 31 waterbirds were recorded during the January 2019 field survey. Three species are listed as migratory:

- Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act. This species was recorded at Murray Lagoon and Fiddes Street Wetland.
- Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act. This species was recorded at Fiddes Street Wetland.
- Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act. This species was recorded at Yeppen Lagoon, Fiddes Street Wetland and Woolwash Lagoon.

Additionally, the field survey undertaken in 2014 recorded an eastern osprey (*Pandion cristatus*).

The locations that the above species were recorded are depicted on Figure 7.

Species encountered most frequently included Australian white ibis (*Threskiornis molucca*), Australian pelican (*Pelecanus conspicillatus*), Australian wood duck (*Chenonetta jubata*), eastern great egret (*Ardea modesta*), and pacific black duck (*Anas superciliosa*).

Key outcomes of the survey include the following.

- None of the migratory bird species present occur as ecologically significant proportions of the overall population of the species.

- There do not appear to be any especially significant population characteristics or processes occurring within the Project site that indicate ecological significance of the site.
- No distributional limits for any of the migratory bird species occur within the Project site.
- The habitat within the Project site is mostly ephemeral and is heavily impacts by cattle and weeds, and is therefore not considered especially important to any of the migratory species.

The list of all waterbird species recorded at each surveyed wetland is presented in Appendix B, Table 20.

4.2.3.1.3 Ornamental Snake

Weather conditions during the field survey were considered to be poor to adequately survey for the ornamental snake and none were identified during the January 2019 survey. During dry times, this species can remain inactive in suitable shelter sites for months (Department of the Environment, 2019).

The ornament snake principally has a diet of native frogs. Low frog activity was recorded within the Project site, with one green tree frog (*Litoria caerulea*) observed. Cane toads (*Rhinella marina*) were recorded in abundance; a known threat to the ornamental snake by lethal toxic ingestion and by competition with native amphibians for food, shelter and breeding sites.

The habitat that was accessed during the field survey was not considered to be suitable habitat for the ornament snake. The vegetation adjacent to the surveyed wetlands was heavily impacted by cattle and weeds, and were considered unlikely to support a population of ornamental snake.

One property, that was unable to be accessed during the field survey (including Gavial Swamp Lagoon), contains a large area of mapped essential habitat for the ornamental snake and aerial photography of the property indicates that it contains gilgai. Gavial Swamp Lagoon was dry at the time of the field survey; however during times of rainfall, this wetland may contain suitable habitat for the ornamental snake.

4.2.3.2 Introduced Species

The November 2018 and January 2019 field surveys recorded six introduced species:

- Feral pigeon (*Columba livia*)
- Common myna (*Sturnus tristis*)
- Cane toad (*Rhinella marina*)
- Asian house gecko (*Hemidactylus frenatus*)
- Dingo/dog (*Canis lupus*); listed as Categories 3, 4, 5, 6 Restricted Matter under the *Biodiversity Act 2014*
- Cat (*Felis catus*); listed as Categories 3, 4, 6 Restricted Matter under the *Biodiversity Act 2014.*

Additionally, the field survey undertaken in 2014 recorded the red fox (*Vulpes vulpes*); listed as Categories 3, 4, 5, 6 Restricted Matter under the *Biodiversity Act 2014,* and the nutmeg manikin (*Lonchura punctulata*) (AECOM, 2014a).

A number of other introduced species, restricted under the *Biodiversity Act 2014*, are likely to occur within the Project site including black rat (*Rattus rattus*) and European rabbit (*Oryctolagus cuniculus*).

4.2.3.3 Fauna Habitat Values

Three vegetation communities were recorded within the Project site, including

- Open woodland on alluvial floodplains dominated by *Eucalyptus tereticornis*
- Palustrine wetlands
- Non-remnant woodlands and tidal creeks.

A summary of these communities is provided below in Table 12.

Table 12 Fauna habitat within the Project site

Habitat Type	Analogous RE	Key Habitat Features
Open woodland on alluvial floodplains dominated by *Eucalyptus tereticornis*	11.3.4	Open alluvial woodland of *Eucalyptus tereticornis* to 16m. This habitat type supported the following features: • Occasional hollows in trees and stags. • Sparse shrub layer. • Wood ground debris. Disturbances were typically associated with grazing activities and include the presence of weeds including non-native grasses and historical thinning.
Palustrine wetlands	Non-remnant	At the time of the survey, wetlands were typically dry or had significantly receded. Fringing vegetation was typically absent. Cracking clay soils may provide habitat for amphibians and reptiles. The wetlands provide habitat for migratory shorebirds.
Non-remnant woodlands and tidal creeks	Non-remnant	Non-remnant vegetation as a result of historical clearing dominates the Project site. Vegetation within this habitat type varied and included isolated paddock trees, planted street trees and mangrove lined creeks. Habitat values were limited and included: • Cracking clay soils. • Gilgai. • Sparse to dense grass layer. • Dense mid-story along tidal creeks (mangroves).

4.2.3.4 Wetland Values

The wetlands within the Project site provide a range of habitat values for fauna, specifically birds. Wetlands comprised both permanent and ephemeral systems, with most exhibiting signs of disturbance. The hydrological and fauna values of wetlands observed during the field survey are noted in Table 13 below. Whilst not targeted for bird surveys due to the absence of water, descriptions of Jellicoe Street Wetland and Gavial Swamp Lagoon and their potential habitat values have also been provided.

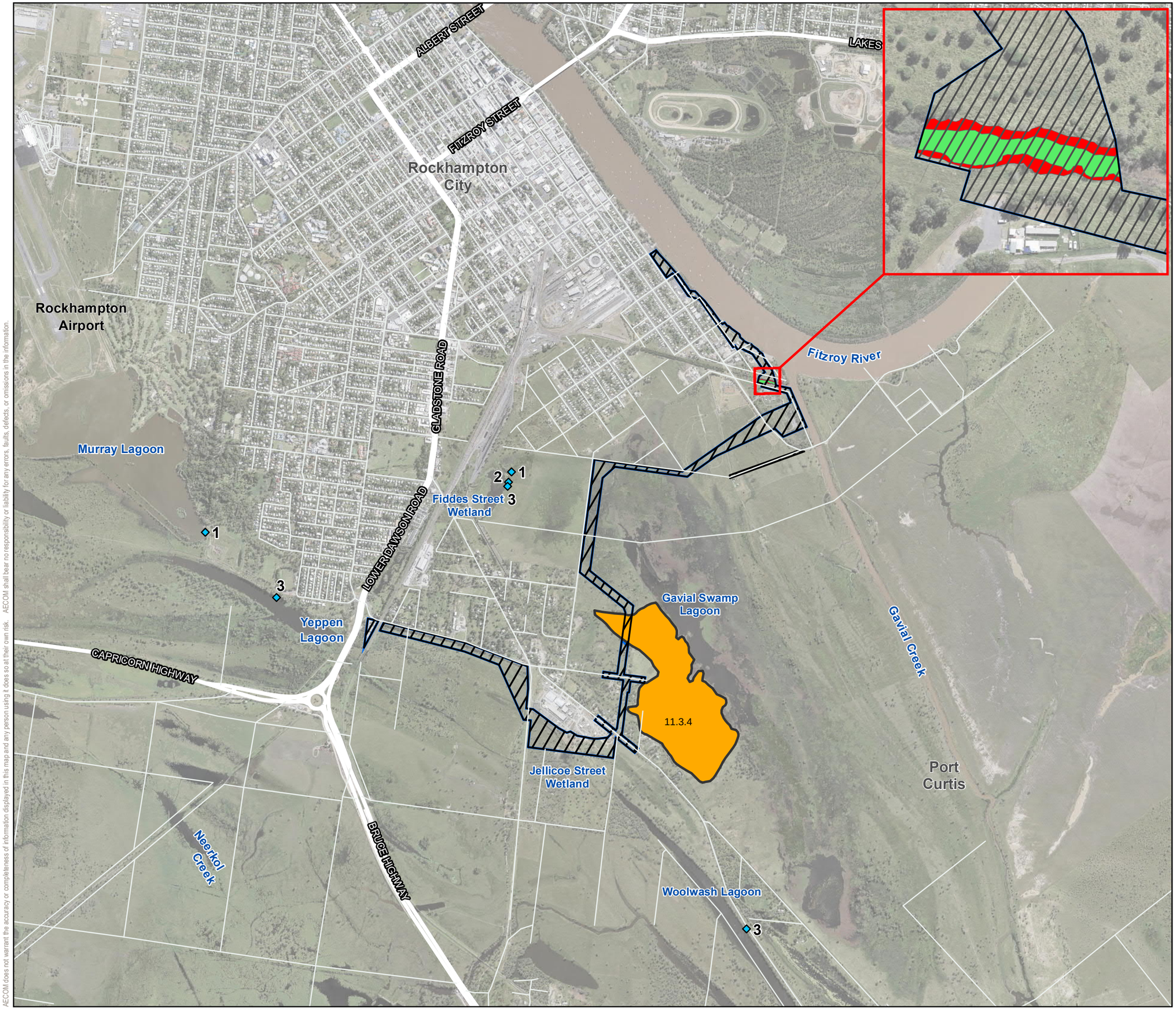
Table 13 Wetland values within the Project site

Wetland	Hydrological Summary	Fauna Values
Fiddes Street Wetland	Small wetland complex containing both a permanent waterbody and fringing sedgeland. The wetland is recharged locally from urban rainwater runoff to the west. Ultimately drains from Fiddes Street Wetland into Gavial Creek.	Wetland is surrounded by urban development to the north and within disturbed grazing paddocks. Nonetheless it supports foraging and nesting values for non-colonial waterbirds such as waterfowl, grebes and moorhens. Roosting and foraging values within sedgeland habitat for migratory waterbirds requiring vegetated cover, such as Latham's snipe.
Gavial Swamp Lagoon	Large ephemeral wetland comprising gilgai paddocks and a large waterbody. This wetland is locally recharged from adjacent paddocks and overflows from Fiddes Street Wetland. During periods of flood, the wetland also has recharge points from the Woolwash Lagoon and Fitzroy River.	This wetland is heavily disturbed, with portions grazed during dry periods. Gilgai and the large ephemeral waterbody are dominated by exotic grasses and the declared weed, *Parthenium hysterophorus*. When full, the wetland may support a range of birds including waterbirds (ducks, grebes etc.), terrestrial birds, ornament snake and potentially low abundances of migratory wetland birds,

Wetland	Hydrological Summary	Fauna Values
Jellicoe Street Wetland	Small ephemeral wetland recharged locally and from outwash from Yeppen Lagoon. This wetland was dry at the time of survey and is situated within a disturbed paddock.	When full, the wetland may support a range of birds including waterbirds (ducks, grebes etc.), terrestrial birds and potentially low abundances of migratory wetland birds.
Woolwash Lagoon	Woolwash Lagoon is located south of the SRFL alignment and is recharged locally from Yeppen Lagoon and Gavial Creek. Woolwash Lagoon discharges into the Fitzroy River and is largely a permanent system comprising elongated water basins.	Elongated basin with steep banks, situated within a disturbed landscape. Waters are likely permanent providing nesting and foraging opportunities to a range of birds including waterbirds (ducks, grebes etc.), terrestrial birds and infrequent, low abundances of migratory wetland birds.
Yeppen Lagoon	An elongated, perennial basin connected to the Fitzroy River, Neerkol Creek and other associated estuarine waters during major flood events. Yeppen Lagoon ultimately drains into Gavial Creek and Woolwash Lagoon.	Yeppen Lagoon supports a range of foraging and nesting values for non-colonial waterbirds such as waterfowl, grebes and moorhens. Habitat is open and disturbed such that large numbers of migratory wetland birds are unlikely to occur, although individuals may occur infrequently. The perennial water may support a host of native amphibians and reptiles.
Murray Lagoon	A large, permanent waterbody located west of the Botanic Gardens and south of the Rockhampton airport. Murray Lagoon is recharged from local runoff and during flood events in the Yeppen Floodplain.	This large waterbody may provide a host of nesting and foraging opportunities for waterbirds including pelicans, egrets, ducks and cormorants. The lagoon likely supports numerous reptiles including freshwater turtles. Mudflats within the lagoon may also support migratory species, such as the common greenshank and sharp-tailed sandpiper.

4.2.3.5 Connectivity

Remnant habitat through the Project site occurs in isolated patches, unconnected from significant regional fauna corridors. Palustrine wetlands and gilgai complexes will provide small scale movement opportunities for amphibians and reptiles during the wet season.



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LEGEND

- Conservation Significant Species
- Major Roads
- Minor Roads
- SRFL Alignment

Marine Plants Mapping

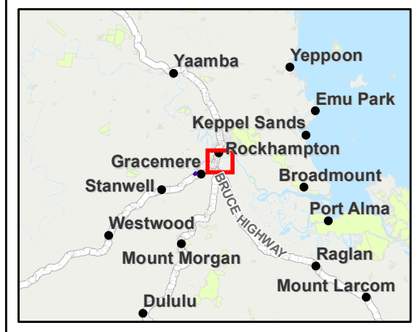
- Mangroves
- *Phragmites australis*

Ground-truthed RE mapping

- 11.3.4 (Of Concern)
- Non-rem

Conservation Significant Species

1 Latham's Snipe (*Gallinago hardwickii*)
2 Caspian Tern (*Hydroprogne caspia*)
3 Glossy Ibis (*Plegadis falcinellus*)



Data sources:
Imagery: QLDBase Imagery WMS
Ornamental Snake & Shorebired Records: Atlas of Living Australia, eBird.

South Rockhampton Flood Levee Project

FIELD SURVEY RESULTS

PROJECT ID	60589157
CREATED BY	WeirW
LAST MODIFIED	11-Apr-2019
VERSION	<version number>

Figure 7

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4.3 Likelihood of Occurrence Assessment

The likelihood assessment performed during the desktop assessment was refined following confirmation of habitat values during the field surveys. The resulting occurrence assessment identified 21 fauna species as present or having a moderate or high likelihood of occurring. No conservation significant flora species are considered likely to occur based on the absence of suitable habitat. The full assessment is presented in Appendix C.

Table 14 Likelihood of occurrence assessment summary

Value	Likelihood of Occurrence		
	Moderate	**High**	**Present**
Conservation Significant Fauna	• Australasian bittern (*Botaurus poiciloptilus*) • Curlew sandpiper (*Calidris ferruginea*) • Western Alaskan bar-tailed godwit (*Limosa lapponica bauera*) • Koala (*Phascolarctos cinereus*) • Ornamental snake (*Denisonia maculata*)	• Australian painted snipe (*Rostratula australis*) • Squatter pigeon (southern) (*Geophaps scripta scripta*)	-
Migratory Fauna	• Common sandpiper (*Actitis hypoleucos*) • Pectoral sandpiper (*Calidris melanotos*) • Black-tailed godwit (*Limosa limosa*) • Little curlew (*Numenius minutus*) • Wood sandpiper (*Tringa glareola*)	• Sharp-tailed sandpiper (*Calidris acuminate*) • Red-necked stint (*Calidris ruficollis*) • Little tern (*Sterna albifrons*) • Common greenshank (*Tringa nebularia*) • Marsh sandpiper (*Tringa stagnatilis*)	• Latham's snipe (*Gallinago hardwickii*) • Caspian tern (*Hydroprogne caspia*) • Eastern osprey (*Pandion cristatus*) • Glossy ibis (*Plegadis f alcinellus*)

5.0 Potential Impacts and Mitigation Measures

Potential impacts to ecological values may occur in the following phases of the Project.

1. Construction Phase.
2. Operation and Maintenance Phase.

Further information on the potential impacts associated with the Project is outlined below, as well as mitigation measures to minimise the potential impacts on flora and fauna values. Potential impacts to conservation significant and migratory species are detailed in Section 5.3.

5.1 Construction Phase

5.1.1 Vegetation Clearing

The Project will potentially clear the entire Project site. Clearing extents are outlined in Table 15 below.

Table 15 Area of vegetation clearing within the SRFL alignment

RE	VM Act Status	Clearing (ha)
11.3.4	Of Concern	0.95
Non-remnant	-	53.44
	Total	**54.39**

Marine plants were identified during the field survey at one location within the SRFL alignment in a tributary to Gavial Creek. Clearing extents of the marine plants assessed in this report (excluding the areas assessed in AECOM, (2018)) are outlined in Table 16 below.

Table 16 Area of marine plant clearing within the SRFL alignment

Species	Clearing Area (ha)
Mangroves (*Aegiceras corniculatum* and *Excoecaria agallocha*)	0.20
Phragmites australis	0.13
Total	**0.33**

There are a range of measures that will be implemented to minimise the level of impact from clearing vegetation. These include the following.

- Vegetation clearing will be minimised in sensitive environments, specifically riparian areas around creek lines and wetlands.
- The Project Environmental Management Plans will include vegetation management to provide clear guidance on areas to be cleared and retained, methods for clearing and other relevant environmental protection measures.

5.1.1.1 Loss of Wetland Vegetation

Vegetation clearing through mapped wetland and wetland trigger areas is required for the Project. Approximately 30.13 ha of the SRFL alignment crosses into the wetland protection trigger area of both Gavial Swamp Lagoon and Jellicoe Street Wetland, both of which were dry at the time of the field survey. The SRFL alignment also dissects 3.63 ha of the mapped HES wetland area of the Jellicoe Street Wetland. This wetland may provide habitat for native fauna; however it is not considered an important area for conservation significant or migratory species.

5.1.2 Loss of Fauna Habitat and Fragmentation

The clearance of native vegetation can adversely affect native fauna species. Potential impacts resulting from clearing native vegetation can include the following.

- Loss of habitat causing a reduction of biological diversity or loss of local populations and genotypes.
- Fragmentation of populations, which can reduce gene flow between small isolated populations, reduce the potential for species to adapt to environmental change and loss or severe modification of the interactions between species.
- Disturbance which can permit the establishment and spread of exotic species that may displace native species.
- Loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.
- Loss of food resources such as foliage, flowers, nectar, fruit and seeds.

The low lying nature of Fiddes Street, the topography of the area and its position within a floodplain/wetland environment means that this road is frequently over-topped by significant local rainfall events. The SRFL alignment will be raised several meters higher than the current road; therefore connectivity between Fiddes Street Wetland and Gavial Creek for reptiles, amphibians and fish is expected to be disrupted during Fitzroy River flood events when the culverts are closed.

The SRFL alignment intersects 53.44 ha of non-remnant vegetation and cleared paddocks, accounting for approximately 98% of the estimated potential impact. While non-remnant vegetation is considered to contain less ecologically significant values, these areas may still provide habitat for fauna, including trees, grasses and wetlands.

While the extent of vegetation clearing for the Project will mean that potential impacts on fauna habitat are unavoidable, there are a range of measures that may be taken to minimise the level of impact. These include the following.

- Suitably qualified fauna spotter catchers must be engaged to undertake pre-clearance habitat searches and be present during vegetation clearing activities to minimise fauna harm.
- A Construction Environmental Management Plan will be prepared to provide clear guidance on areas to be cleared and retained, methods for clearing, role of the spotter-catcher and other relevant environmental protection matters.
- Identify and map clear no-go zones to avoid unauthorised disturbance of areas of sensitive vegetation and habitat; such as identified nests and trees that are to be retained.
- Habitat features such as felled trees and logs will be considered for relocation to other areas where practical to provide microhabitat for fauna.

5.1.3 Fauna Mortality or Injury

Clearing of vegetation can result in injury or mortality of fauna, particularly ground dwelling fauna (e.g. reptiles), that may be crushed by machinery or struck by vehicles. Arboreal mammals may be trapped in trees as they are felled. Whilst a local impact on fauna may occur, the impact on fauna populations within the broader landscape is considered minimal.

Mitigation measures to reduce the likelihood of injury or mortality to fauna include the following.

- Pre-clearance surveys to identify shelters and breeding places potentially utilised by Least Concern species, colonial breeders and conservation significant fauna will be undertaken.
- Fauna spotter-catchers will be used to capture and relocate fauna prior to clearing.
- No unauthorised off-track driving.
- Any injured, sick and dead vertebrate fauna will be recorded before (by fauna spotter-catchers), during and after construction and operation.

5.1.4 Introduced Species

Eighteen introduced flora species were identified, including five species listed as Category 3 Restricted Matter and three species as WoNS. Activities that may increase the risk of establishment of new infestations and exacerbation of existing infestations include the following.

- Soil disturbance through vegetation clearance and construction activities.
- Areas of ground remaining bare for extended periods will establish weed species where there is little competition from other species.
- Increased pedestrian and vehicular traffic through the area.
- Importation of construction materials to the site which may harbour introduced species.
- Construction of the levee may also impede the flushing capability of the wetland system and cause establishment of aquatic weed infestations around built infrastructure and new in areas not previously subject to infestations, as a result of altered hydrology.

Mitigation measures for the control of weed spread include:

- Staff and contractors must be equipped with information on the location of biosecurity threats, which enables them to move within 'clean areas' without the need to wash-down.
- When moving from a 'dirty area' to a clean area, a vehicle hygiene inspection will be required to determine whether a wash-down is necessary. Vehicle hygiene practices (including records) will be undertaken applying risk management principles in consultation with landholders.
- The origin of high risk construction materials, machinery and equipment will be identified to mitigate introduction of weed species.
- Management methods to control spread of weeds considered to be Restricted Matters must be in keeping with regional management practice or Queensland Department of Agriculture and Fisheries pest control prescriptions.
- Appropriate weed monitoring to identify any new incidence of weeds.

It is unlikely that further introductions of feral vertebrate species would occur as a result of the Project. It is also unlikely that the proposed development would exacerbate current pest populations given they are well established in the region.

5.1.5 Activity and Noise

During the construction phase, there will be an increase in noise and activity in the Project site as machinery undertakes clearing and construction activities. It is important to note that these potential impacts will not affect the entire Project site simultaneously nor will they persist in any one area for a considerable period of time (months). However, when activity and noise is occurring in areas adjoining retained habitat, potential impacts may include the following.

- Reduced foraging ability by auditory predators due to increased background noise.
- Increased risk of predation by visual predators due to increased background noise.
- Increased potential for collisions with vehicles.
- Human visitation causing disturbance to foraging or breeding behaviours.

Current research indicates that there are no government policies or other widely-accepted guidelines in respect to the noise levels which may be acceptable to wildlife. The levels or character of noise that may "startle" or otherwise affect the feeding or breeding pattern of birds or other wild animals are also not firmly established in the technical literature.

Sudden loud, impulsive or impact noises are capable of causing birds and other fauna to become startled, which if occurring over the longer term, may affect feeding and breeding behaviour in some species. It is expected that excavation, construction and earthmoving associated with the Project will potentially cause disturbance to all groups of fauna, especially birds. This will most likely result in avoidance of the area for the duration of these activities.

5.2 Operation and Maintenance Phases

5.2.1 Hydrological Change and Potential Ecological Impact

Once constructed, the levee is designed to prevent Fitzroy flood waters from impacting populated areas of South Rockhampton, up to and including the design flood event. Mapped wetlands occur immediately adjacent and within the SRFL alignment and may have the following potential impacts.

- Altered surface hydrological regimes.
- Loss of biodiversity due to reduction in habitat connectivity.
- Altered sedimentation regimes.

The hydraulic assessment determined that the Project will not result in changes to the hydrological processes of the Project site during times of typical rainfall. The wetlands within the Project site are recharged from the local catchment, as well as the Fitzroy River and its tributaries.

Potential impacts to the wetlands addressed as part of this report are detailed below in Table 17.

Table 17 Potential impacts to wetlands

Wetland	Potential Hydrological Change	Potential Ecology Impact
Fiddes Street Wetland	Located on the interior of the SRFL alignment, Fiddes Street Wetland will be cut-off from Fitzroy River flood waters. Natural recharge from local sources will be maintained. Pump stations will be required to maintain baseline water levels and facilitate local recharge of Gavial Creek. The use of pump stations may see a slight increase in the volume of water in Fiddes Street Wetland, as well as slight increases in velocity downstream of the discharge location.	Given the natural regime is being maintained, no loss to the size and extent of the waterhole and sedgeland is expected. Connectivity between Fiddes Street Wetland and Gavial Creek for reptiles such as turtles is expected to be disrupted during Fitzroy River flood events when the culverts are closed.
Gavial Swamp Lagoon	Recharge from Yeppen Lagoon, Woolwash Lagoon and the Fitzroy River will not be impacted, although water velocities may increase during flood events. The natural regime (ephemeral wetland) will be maintained.	Given the natural regime of the wetland will be maintained, the capacity of this wetland to support wetland birds and other associated fauna is unlikely to be severely impacted. Minor impacts associated with the loss of gilgai will occur as a result of construction.
Jellicoe Street Wetland	This ephemeral wetland occurs within the SRFL alignment. As a result, this wetland is likely to be lost, with waters diverted downstream to Gavial Swamp Lagoon and Woolwash Lagoon.	Low ecological value wetland with limited values. The loss of this wetland may result in the seasonal displacement of common fauna such as wetland birds. Given the low value of this wetland, and the availability of similar wetlands in the immediate area, it is unlikely that these impacts will be significant.
Woolwash Lagoon	The SRFL alignment is unlikely to have an impact on the regime or recharging of this wetland.	The regime and recharging of this wetland is unlikely to be impacted. The potential ecology impacts are thus unlikely to impacted, with opportunities for flora and fauna species unchanged from the existing baseline conditions.

Wetland	Potential Hydrological Change	Potential Ecology Impact
Yeppen Lagoon	The SRFL alignment is unlikely to impact Yeppen Lagoon under normal conditions. Water depth may increase following flood events, however not significantly.	The natural regime of this lagoon will be maintained, with no impact expected under normal conditions. Flood events may result in adjacent woodlands being temporally inundated.
Murray Lagoon	Murray Lagoon is not likely to experience hydrological impact as a result of the Project.	No ecological impacts as a result of hydrological changes are expected.

5.3 Conservation Significant and Migratory Species

The potential impacts outlined above may potentially impact on conservation significant and migratory species, namely through habitat loss and degradation.

An assessment to determine whether the Project is likely to have a significant impact on any conservation significant or migratory species protected under the EPBC Act was undertaken in accordance with the EPBC Act Policy Statement 1.1 *'Significant Impact Guidelines: Matters of National Environmental Significance'* (Department of the Environment Water Heritage and the Arts, 2013) and the EPBC Act Policy Statement 3.21 '*Significant Impact Guidelines for 36 Migratory Shorebird Species'* (Department of the Environment and Energy, 2017). The full assessment is provided in Appendix D.

No significant impacts to conservation significant or migratory species were identified.

6.0 Conclusion

Based on the field surveys, the following ecological values have been identified within the Project site:

- The Project site largely consists of non-remnant vegetation; however one area of remnant vegetation was identified. The clearing extent of remnant vegetation includes:
  - 0.95 ha of RE 11.3.4 within the SRFL alignment.
- A total of 41 flora species from 21 families were identified. No conservation significant flora species were identified during the field assessment and none are considered to have a moderate or high likelihood of occurring within the Project site.
- Marine plants were identified during the field survey at one locations within the SRFL alignment in a tributary to Gavial Creek. The total clearing extent of marine plants includes:
  - 0.20 ha of mangroves (*Aegiceras corniculatum* and *Excoecaria agallocha*)
  - 0.13 ha of *Phragmites australis*.
- Five introduced flora species listed under the *Biosecurity Act 2014* were identified:
  - *Cryptostegia grandiflora* (rubber vine) (Category 3, WoNS)
  - *Harrisia martini* (Harrisia cactus) (Category 3)
  - *Vachellia farnesiana* (Mimosa) (Category 3)
  - *Parthenium hysterophorus* (Parthenium) (Category 3, WoNS)
  - *Vachellia nilotica* (Prickly acacia) (Category 3, WoNS).
- A total of 97 fauna species were recorded during the field surveys, comprising 88 bird, 3 mammal, 4 reptile and 2 amphibian species.
- Four migratory species were identified within the Project site during the field surveys:
  - Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act
  - Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act
  - Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act
  - Eastern osprey (*Pandion cristatus*); Migratory under the EPBC Act (recorded in 2014).
- The fauna surveys identified a range of habitat values suitable to support both conservation significant and Least Concern species. Three habitat types were recorded within the Project site.
- The habitat that was accessed during the field survey was not considered to be suitable habitat for the ornamental snake. However, the property that was unable to be accessed during the field survey contains a large area of mapped essential habitat for the ornamental snake and may contain suitable habitat.
- Seven conservation significant and 10 migratory species are considered to have a moderate or high likelihood of occurring in the Project site based on the habitat assessed during the field surveys.
- A number of potential impacts to flora and fauna may occur as a result of the Project. Mitigation and management measures are recommended to ensure the potential impact on ecological values are minimised or avoided.
- The significant impact assessment determined that the Project is unlikely to result in a significant impact on conservation significant and migratory species.

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Appendix A

Flora Species List

Appendix A Flora Species List

Table 18 Flora species list (November 2018)

Family	Scientific Name	Common Name	Status
Amaranthaceae	*Achyranthes aspera*	Devil's horsewhip	
Amaranthaceae	*Gomphrena celosioides*	Gomphrena weed	*
Anacardiaceae	*Mangifera indica*	Mango	*
Apocynaceae	*Cryptostegia grandiflora*	Rubber vine	*
Asteraceae	*Bidens pilosa*	Cobbler's peg	*
Asteraceae	*Calotis* sp.		
Asteraceae	*Parthenium hysterophorus*	Parthenium	*
Cactaceae	*Harrisia martinii*	Harrisia cactus	*
Chenopodiaceae	*Atriplex muelleri*	Lagoon saltbush	
Chenopodiaceae	*Salsola australis*	Saltbush	
Chenopodiaceae	*Sclerolaena* sp.	Saltbush	
Cyperaceae	*Cyperus* sp.		
Euphorbiaceae	*Excoecaria agallocha*	Milky mangrove	
Laxmanniaceae	*Eustrephus latifolius*	Wombat berry	
Loranthaceae	*Dendrophthoe glabrescens*	Orange mistletoe	
Malvaceae	*Sida rhombifolia*	Sida	*
Mimosaceae	*Acacia salicina*	Sally wattle	
Mimosaceae	*Albizia lebbeck*	Siris	
Mimosaceae	*Vachellia farnesiana*	Mimosa	*
Mimosaceae	*Vachellia nilotica*	Prickly acacia	*
Moraceae	*Ficus* sp.	Fig	
Myrsinaceae	*Aegiceras corniculatum*	River mangrove	
Myrtaceae	*Corymbia clarksoniana*	Brown bloodwood	
Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash	
Myrtaceae	*Eucalyptus coolabah*	Coolabah	
Myrtaceae	*Eucalyptus tereticornis*	Blue gum	
Myrtaceae	*Melaleuca leucadendra*	Weeping paperbark	
Myrtaceae	*Melaleuca* sp.		
Passifloraceae	*Passiflora suberosa*	Corky passion vine	*
Poaceae	*Bothriochloa pertusa*	Indian bluegrass	*
Poaceae	*Chloris* sp.		
Poaceae	*Dactyloctenium aegyptium*	Crowsfoot grass	*
Poaceae	*Digitaria didactyla*	Couch	*
Poaceae	*Eragrostis* sp.	Lovegrass	
Poaceae	*Phragmites australis*	Common reed	
Poaceae	*Urochloa decumbens*	Signal grass	*
Poaceae	*Urochloa mutica*	Paragrass	*

Family	Scientific Name	Common Name	Status
Portulacaceae	*Portulaca oleracea*	Pigface	*
Rutaceae	*Geijera parviflora*	Wilga	
Sapindaceae	*Cardiospermum grandiflorum*	Balloon vine	*
Verbenaceae	*Stachytarpheta jamaicensis*	Snake weed	*

* Invasive species

Appendix B

Fauna Species List

Appendix B Fauna Species List

Table 19 Fauna species list

Scientific Name	Common Name	2014	2018/2019
Birds			
Anas castanea	Chestnut teal		X
Anas gracilis	Grey teal	X	X
Anas superciliosa	Pacific black duck	X	X
Anhinga novaehollandiae	Australasian darter	X	X
Anseranas semipalmata	Magpie goose	X	X
Anthus novaeseelandiae	Australasian pipit		X
Aprosmictus erythropterus	Red-winged parrot		X
Ardea ibis	Cattle egret	X	X
Ardea intermedia	Intermediate egret	X	X
Ardea modesta	Eastern great egret		X
Ardea pacifica	White-necked heron	X	X
Aviceda subcristata	Pacific baza	X	
Aythya australis	Hardhead	X	X
Cacatua galerita	Sulphur-crested cockatoo	X	X
Cacatua sanguinea	Little corella	X	
Calyptorhynchus banksii	Red-tailed black-cockatoo		X
Centropus phasianinus	Pheasant coucal	X	X
Chenonetta jubata	Australian wood duck	X	X
Cisticola exilis	Golden-headed cisticola	X	
Cisticola juncidus	Zitting cisticola	X	
Columba livia	Feral pigeon*		X
Coracina novaehollandiae	Black-faced cuckoo-shrike	X	X
Corvus orru	Torresian crow	X	X
Cracticus nigrogularis	Pied butcherbird	X	X
Cracticus torquatus	Grey butcherbird		X
Cracticus tibicen	Australian magpie	X	X
Cygnus atratus	Black swan	X	X
Dacelo leachii	Blue-winged kookaburra	X	X
Dacelo novaeguineae	Laughing kookaburra	X	X
Dendrocygna arcuata	Wandering whistling-duck	X	
Dendrocygna eytoni	Plumed whistling-duck	X	X
Dicaeum hirundinaceum	Mistletoebird		X
Dicrurus bracteatus	Spangled drongo		X
Dromaius novaehollandiae	Emu		X
Egretta garzetta	Little egret	X	X
Egretta novaehollandiae	White-faced heron	X	X

Scientific Name	Common Name	2014	2018/2019
Entomyzon cyanotis	Blue-faced honeyeater		X
Eolophus roseicapilla	Galah	X	
Ephippiorhynchus asiaticus	Black-necked stork		X
Eudynamys orientalis	Eastern koel		X
Eurystomus orientalis	Dollarbird		X
Falco cenchroides	Nankeen kestrel		X
Fulica atra	Eurasian coot	X	X
Gallinago hardwickii	Latham's snipe	X	X
Gallinula tenebrosa	Dusky moorhen		X
Geopelia striata	Peaceful dove	X	X
Gerygone levigaster	Mangrove gerygone		X
Grallina cyanoleuca	Magpie-lark	X	X
Grus rubicunda	Brolga	X	X
Haliaeetus leucogaster	White-bellied sea-eagle	X	X
Haliastur indus	Brahminy kite	X	X
Haliastur sphenurus	Whistling kite	X	X
Hieraaetus morphnoides	Little eagle	X	
Himantopus himantopus	Black-winged stilt	X	X
Hirundo neoxena	Welcome swallow		X
Hydroprogne caspia	Caspian tern		X
Irediparra gallinacea	Comb-crested jacana	X	X
Lichmera indistincta	Brown honeyeater		X
Lonchura castaneothorax	Chestnut-breasted mannikin	X	X
Lonchura punctulata	Nutmeg manikin*	X	
Malacorhynchus membranaceus	Pink-eared duck		X
Malurus melanocephalus	Red-backed fairy-wren	X	X
Manorina melanocephala	Noisy miner	X	X
Megalurus timoriensis	Tawny grassbird		X
Meliphaga lewinii	Lewin’s honeyeater	X	
Melithreptus albogularis	White-throated honeyeater		X
Merops ornatus	Rainbow bee-eater	X	X
Microcarbo melanoleucos	Little pied cormorant		X
Milvus migrans	Black kite	X	X
Myiagra rubecula	Leaden flycatcher		X
Nettapus coromandelianus	Cotton pygmy-goose	X	
Ninox novaeseelandiae	Southern boobook		X
Nymphicus hollandicus	Cockatiel	X	X
Ocyphaps lophotes	Crested pigeon	X	X
Pachycephala rufiventris	Rufous whistler	X	

Scientific Name	Common Name	2014	2018/2019
Pandion cristatus	Eastern osprey	X	
Pardalotus striatus	Striated pardalote	X	
Pelecanus conspicillatus	Australian pelican	X	X
Petrochelidon ariel	Fairy martin		X
Phalacrocorax carbo	Great cormorant	X	X
Phalacrocorax sulcirostris	Little black cormorant	X	X
Phalacrocorax varius	Pied cormorant	X	X
Philemon citreogularis	Little friarbird		X
Platalea regia	Royal spoonbill	X	X
Platycercus adscitus	Pale-headed rosella	X	X
Plegadis falcinellus	Glossy ibis	X	X
Pomatostomus temporalis	Grey-crowned babbler		X
Porphyrio porphyrio	Purple swamphen	X	X
Ramsayornis fasciatus	Bar-breasted honeyeater		X
Rhipidura leucophrys	Willie wagtail	X	X
Scythrops novaehollandiae	Channel-billed cuckoo	X	X
Sphecotheres vieilloti	Australasian figbird	X	
Stictonetta naevosa	Freckled duck		X
Struthidea cinerea	Apostlebird	X	
Sturnus tristis	Common myna*		X
Tachybaptus novaehollandiae	Australasian grebe	X	X
Taeniopygia bichenovii	Double-barred finch	X	X
Threskiornis molucca	Australian white ibis	X	X
Threskiornis spinicollis	Straw-necked ibis	X	X
Todiramphus macleayii	Forest kingfisher	X	
Todiramphus sanctus	Sacred kingfisher		X
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet	X	X
Trichoglossus haematodus	Rainbow lorikeet	X	X
Vanellus miles	Masked lapwing	X	X
Mammals			
Canis lupus	Dingo/dog*		X
Felis catus	Cat*		X
Macropus giganteus	Eastern grey kangaroo	X	X
Trichosurus vulpecula	Common brushtail possum	X	
Vulpes vulpes	Red fox*	X	
Amphibians			
Litoria caerulea	Green tree frog	X	X
Litoria fallax	Eastern sedge frog	X	

Scientific Name	Common Name	2014	2018/2019
Litoria inermis	Peters' frog	X	
Litoria nasuta	Striped rocket frog	X	
Litoria rubella	Desert tree frog	X	
Limnodynastes peronii	Striped marsh frog	X	
Rhinella marina	Cane toad*	X	X
Reptiles			
Chelodina longicollis	Snake-necked turtle	X	
Cryptoblepharus virgatus	Face skink	X	
Dendrelaphis punctulata	Green tree snake	X	
Emydura macquarii krefftii	Krefft's river turtle	X	X
Gehyra dubia	Dubious dtella	X	
Gehyra sp.	Gehyra sp.		X
Hemidactylus frenatus	Asian house gecko*		X
Tropidonophis mairii	Keelback		X

* Invasive Species

Table 20 Waterbirds recorded at each wetland (January 2019)

Site Name	Scientific Name	Common Name
Yeppen Lagoon	*Anas superciliosa*	Pacific black duck
	Ardea intermedia	Intermediate egret
	Aythya australis	Hardhead
	Chenonetta jubata	Australian wood duck
	Egretta novaehollandiae	White-faced heron
	Irediparra gallinacea	Comb-crested jacana
	Microcarbo melanoleucos	Little pied cormorant
	Phalacrocorax carbo	Great cormorant
	Phalacrocorax sulcirostris	Little black cormorant
	Phalacrocorax varius	Pied cormorant
	Threskiornis molucca	Australian white ibis
	Vanellus miles	Masked lapwing
Murray Lagoon	*Anas castanea*	Chestnut teal
	Anas gracilis	Grey teal
	Anas superciliosa	Pacific black duck
	Anhinga novaehollandiae	Australasian darter
	Ardea modesta	Eastern great egret
	Chenonetta jubata	Australian wood duck
	Dendrocygna eytoni	Plumed whistling-duck
	Gallinago hardwickii	Latham's snipe
	Gallinula tenebrosa	Dusky moorhen
	Microcarbo melanoleucos	Little pied cormorant
	Pelecanus conspicillatus	Australian pelican
	Phalacrocorax sulcirostris	Little black cormorant
	Platalea regia	Royal spoonbill
	Porphyrio porphyrio	Purple swamphen
	Stictonetta naevosa	Freckled duck
	Threskiornis molucca	Australian white ibis
Fiddes Street Wetland	*Anas castanea*	Chestnut teal
	Anas superciliosa	Pacific black duck
	Ardea ibis	Cattle egret
	Ardea intermedia	Intermediate egret
	Aythya australis	Hardhead
	Cygnus atratus	Black swan
	Dendrocygna eytoni	Plumed whistling-duck
	Egretta novaehollandiae	White-faced heron

Site Name	Scientific Name	Common Name
	Fulica atra	Eurasian coot
	Gallinago hardwickii	Latham's snipe
	Gallinula tenebrosa	Dusky moorhen
	Hydroprogne caspia	Caspian tern
	Irediparra gallinacea	Comb-crested jacana
	Microcarbo melanoleucos	Little pied cormorant
	Pelecanus conspicillatus	Australian pelican
	Plegadis falcinellus	Glossy ibis
	Porphyrio porphyrio	Purple swamphen
	Tachybaptus novaehollandiae	Australasian grebe
	Threskiornis molucca	Australian white ibis
	Threskiornis spinicollis	Straw-necked ibis
	Vanellus miles	Masked lapwing
Woolwash Lagoon	*Anas castanea*	Chestnut teal
	Anas gracilis	Grey teal
	Anas superciliosa	Pacific black duck
	Ardea ibis	Cattle egret
	Ardea intermedia	Intermediate egret
	Ardea modesta	Eastern great egret
	Aythya australis	Hardhead
	Chenonetta jubata	Australian wood duck
	Cygnus atratus	Black swan
	Dendrocygna eytoni	Plumed whistling-duck
	Egretta garzetta	Little egret
	Egretta novaehollandiae	White-faced heron
	Gallinula tenebrosa	Dusky moorhen
	Irediparra gallinacea	Comb-crested jacana
	Microcarbo melanoleucos	Little pied cormorant
	Pelecanus conspicillatus	Australian pelican
	Phalacrocorax varius	Pied cormorant
	Plegadis falcinellus	Glossy ibis
	Porphyrio porphyrio	Purple swamphen
	Tachybaptus novaehollandiae	Australasian grebe
	Threskiornis molucca	Australian white ibis
	Threskiornis spinicollis	Straw-necked ibis
	Vanellus miles	Masked lapwing

Appendix C

Likelihood of Occurrence Assessments

Table 21 Likelihood of occurrence assessment – flora

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Flora				
Bulbophyllum globuliforme	Miniature moss-orchid	Vulnerable; Near Threatened	The miniature moss-orchid is endemic to eastern Australia. The species is recorded from near Paluma, north-east Queensland and south to the McPherson Range on the Queensland/New South Wales border. The orchid grows only on hoop pines (*Araucaria cunninghamii*), colonising the upper branches of mature trees in upland rainforest. The hoop pine occurs in upland (usually 100-900 m above sea level) subtropical rainforest communities that have a discontinuous distribution along the Australian east coast (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Cadellia pentastylis	Ooline	Vulnerable; Vulnerable	Ooline occurs on the north-west slopes of New South Wales and in central and southern Queensland. The species occurs between 23° S to 30° S within the 500 mm and 750 mm rainfall isohyets. This species grows in semi-evergreen vine thickets and sclerophyll vegetation on undulating terrain of various geology, including sandstone, conglomerate and claystone. Soils generally have low to medium nutrient content and are normally associated with upper and mid-slopes in the landscape (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Corymbia xanthope	Glen Geddes bloodwood	Vulnerable; Vulnerable	The Glen Geddes bloodwood occurs in the Rockhampton area of central Queensland, and within the Fitzroy (Queensland) Natural Resource Management Region. This species occurs in woodlands with *Eucalyptus fibrosa* on ridges or hill slopes on serpentinite geology with sandy soils. This community is recognised as a distinct regional ecosystem (RE 11.11.7) (Department of the Environment, 2019).	**Low.** While records of this species occur in the area, no suitable habitat is present to support this species.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Cossinia australiana	Cossinia	Endangered; Endangered	Cossinia is known from fragmented relict patches of Araucarian vineforests or vine thickets on fertile soils in central and southern Queensland. The species' distribution is from Rockhampton to Kingaroy, east of the Great Dividing Range, a distance of approximately 300 km. At most sites it is recorded as uncommon, usually as scattered individuals. Cossinia occurs from 20 to 520 m altitude. The species appears to prefer ecotonal situations around dry rainforest edges, although it also occurs as scattered individual plants within closed forest communities. It grows in araucarian microphyll vine forest and relict semi-evergreen vine thicket on a variety of soils, including red volcanic soil and black loam (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Cycas megacarpa	-	Endangered; Endangered	*Cycas megacarpa* is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north. *Cycas megacarpa* is found in woodland, open woodland and open forests, often in conjunction with a grassy understory. This species is found in habitat dominated by *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur (outside of the Botanic Gardens).
Cycas ophiolitica	Marlborough blue	Endangered; Endangered	Marlborough blue is endemic to Queensland, occurring from Marlborough to Rockhampton in central-eastern Queensland. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, Corymbia erythrophloia, Corymbia xanthope* and *Eucalyptus fibrosa* (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur (outside of the Botanic Gardens).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Decaspermum struckoilicum	-	Endangered; Endangered	*Decaspermum struckoilicum* is known from two populations, both about 8 km east of Mount Morgan in Queensland, in the area known as Struck Oil. This species occurs in semi-evergreen vine thicket on chocolate-coloured or reddish soil (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Dichanthium setosum	Bluegrass	Vulnerable; -	In Queensland, this species has been reported from the Leichhardt, Morton, North Kennedy and Port Curtis regions. Bluegrass occurs in heavy cracking clay or alluvial soils, often gilgaied, in brigalow or eucalypt communities in tropical or subtropical climates with marked seasonal drying (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Eucalyptus raveretiana	Black ironbox	Vulnerable; Vulnerable	Black ironbox has a wide distribution in coastal and sub-coastal areas of Queensland, from south of Townsville to Nebo, around Rockhampton and areas 100 km west of the city. This species usually grows along watercourses, and sometimes on river flats or open woodland. Soil varies from sand through to heavy clay. Altitudinal range is 0–300 m and the climate of the area is sub-tropical with an annual rainfall of 650–1100 m (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is present to support this species; however no individuals were identified during the field surveys. Nearby records occur (latest record is dated 1981).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Macadamia integrifolia	Macadamia nut	Vulnerable; Vulnerable	In Queensland, the macadamia nut is known from Mount Bauple, north of Gympie, to Currumbin Valley in the Gold Coast hinterland. This species grows in remnant rainforest, preferring partially open areas such as rainforest edges. However, this habitat is not continuously fit for the species. Vegetation communities in which the macadamia nut is found range from complex notophyll mixed forest, extremely tall closed forest, simple notophyll mixed very tall closed forest to simple microphyll-notophyll mixed mid-high closed forest with *Araucaria* and *Argyrodendron* emergent (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Marsdenia brevifolia	-	Vulnerable; Vulnerable	*Marsdenia brevifolia* occurs in north and central Queensland where it is known from near Townsville, Springsure and north of Rockhampton. *Marsdenia brevifolia* occurs on serpentine outcrops of crumbly black soils in eucalypt woodlands, often in association with *Eucalyptus fibrosa* or *Corymbia xanthope* (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. A record of this species occurs at Lotus Lagoon, north of the Rockhampton Airport.
Parsonsia larcomensis	Mt Larcom silk pod	Vulnerable; Vulnerable	The Mt Larcom silk pod grows in the region between Rockhampton to Bundaberg in Queensland and has a range of approximately 280 km. This species is found in open heathland and shrubland at or near the summits of mountain peaks, in shallow loamy soils on cliffs or among outcrops of acid volcanic rocks and serpentites at 350 to 750 m above sea level. It has also been recorded from riverine rainforest habitat at one location (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Phaius australis	Lesser swamp-orchid	Endangered; Endangered	The lesser swamp-orchid is often associated with rainforest communities and tends to be restricted to the coastal areas of Queensland. In North and Central Queensland, *Phaius australis* tends to be restricted to areas that are permanently wet. This species is restricted to the margins of swamps surrounded by dry sclerophyll, swampy rainforest or fringing open forest (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Pimelea leptospermoides	-	Vulnerable; Near Threatened	*Pimelea leptospermoides* occurs from near Marlborough to Rockhampton in Queensland. This species is restricted to stony ridges, slopes and flats in sandy clay soils derived from serpentine. *Pimelea leptospermoides* typically occurs in open *Eucalyptus fibrosa* subsp. *fibrosa–Corymbia xanthope* woodland, often with a shrubby understorey including *Xanthorrhoea johnsonii, Macrozamia serpentina* and *Acacia* species (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.
Pultenaea setulosa	-	Vulnerable; Vulnerable	*Pultenaea setulosa* is confined to Queensland where it occurs in the Marlborough district and south to Rockhampton and Mt Fairview. There are eight known locations: north of Yaamba, Edan Baan, Mt Fairview, near Marlbrough Station, Gap Creek Road, Mt Redcliffe and Mt Slopeway. *Pultenaea setulosa* is restricted to hillsides and ridges with serpentinite soils. It occurs in open eucalypt forest of *Eucalyptus fibrosa*, *Corymbia xanthope* and *Corymbia clarksoniana* (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Samadera bidwillii	Quassia	Vulnerable; Vulnerable	Quassia is endemic to Queensland and is currently known to occur in several localities between Scawfell Island, near Mackay, and Goomboorian, north of Gympie. Included within this range are a number of populations along the Mary River; Tinana Creek, Tallegalla Weir, Teddington Weir pondage, and from Teddington Weir to Tiana Barrage. This species prefers lowland rainforest, open forest and woodlands and often adjacent to watercourses. It commonly occurs in association with *Corymbia citriodora*, *Eucalyptus propinqua*, *Eucalyptus acmeniodes*, *Eucalyptus tereticornis*, *Eucalyptus intermedia*, *Eucalyptus siderophloia*, *Eucalyptus moluccana*, *Eucalyptus cloziana* and *Eucalyptus fibrosa* (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur (outside of the Botanic Gardens).
Tectaria devexa	-	Endangered; Endangered	On mainland Australia, *Tectaria devexa* has been recorded from limestone caves 23 km north of Rockhampton, Queensland. The species has been recorded from Olsens Capricorn Caverns and caves in Mt Etna National Park. In Queensland, this species is found only in limestone caves, often on the walls at the cave entrance and sometimes within the cave where shafts of light occasionally penetrate. It grows in isolation from other vascular plants in shallow acid, brown, sandy-clay loams (pH 5.5) (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is present to support this species. No nearby records occur.

Table 22 Likelihood of occurrence assessment - fauna

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Birds				
Botaurus poiciloptilus	Australasian bittern	Endangered; -	In Australia, the Australasian bittern's core range is the south and east (including Tasmania) and the south-west of western Australia, with apparently isolated records and perhaps populations elsewhere around coastal regions. This species favours freshwater wetlands and rarely, estuarine or tidal wetlands. Its preferred microhabitats are shallow water with tall vegetation such as rushes, reeds and sedges or trampled vegetation adjacent to deep-water pools (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found at the Fiddes Street Wetland. The closest record is at Thompsons Point along the Fitzroy River (2003).
Calidris canutus	Red knot	Endangered & Migratory; Endangered	This species has a large, global range and is found in the Arctic, Americas, Africa, Europe and Australasia. In Queensland, the red knot is widespread along the coast south of Townsville. This species mainly inhabits intertidal mudflats, sandflats and sandy beaches and flooded pastures. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (Department of the Environment, 2019).	**Low.** The wetlands within the Project site are freshwater which are not preferred by this species. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Calidris ferruginea	Curlew sandpiper	Critically Endangered & Migratory; Endangered	In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. This species 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 occur in both fresh and brackish waters (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site. A record of this species occurs along the Fitzroy River (1979) and at Murray Lagoon (2012).
Epthianura crocea macgregori	Dawson yellow chat	Critically Endangered; Endangered	Distribution of this species includes northern Australia from Kimberley in Western Australia to western Queensland. This subspecies is restricted to coastal areas of central Queensland and is known to breed at three locations: Torilla Plain, Fitzroy River Delta and Curtis Island. This subspecies inhabits wetlands in marine plain areas that have variable tidal inputs and are seasonally inundated. Yellow chats are typically associated with more coastal systems; however are known to also utilise freshwater systems when food sources and habitat availability are low (Department of the Environment, 2019).	**Low.** Suitable habitat for this species occurs within the Project site; however this species is typically known from south of Rockhampton. The holotype of the species was recorded adjacent to the South Rockhampton Cemetery (undated record) and no other records exist in the surrounding area.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Erythrotriorchis radiatus	Red goshawk	Vulnerable; Endangered	This species is sparsely distributed across coastal and sub-coastal Australia, from the western Kimberly to northern New South Wales. There appears to have been a contraction in range in recent years. Occasionally recorded from gorge country in central Australia and western Queensland. In northern and central Queensland, red goshawks are mainly associated with extensive, uncleared, mosaics of native vegetation, especially riparian vegetation, open forest and woodland that contain a mix of eucalypt, ironbark and bloodwood species. Permanent water (watercourses and wetlands) is usually present in close proximity, with tall emergent trees used for nesting. The red goshawk is thought to have a very large home range covering between 50 and 220 square kilometres (Department of the Environment, 2019).	**Low.** Permanent water occurs within and adjacent to the Project site; however the Project site lacks the mosaics of native vegetation required by this species. No nearby records exist.
Fregetta grallaria grallaria	White-bellied storm petrel	Vulnerable; -	The white-bellied storm-petrel breeds on small offshore islets and rocks in the Lord Howe Island group, including Roach Island and Balls Pyramid. In Australia, white- bellied storm petrels are only occasionally found in inshore waters and more commonly along the edge of the continental shelf and further out to sea (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.
Geophaps scripta scripta	Squatter pigeon (southern)	Vulnerable; Vulnerable	This species is now largely (if not wholly) restricted to Queensland, from the New South Wales border, north to the Burdekin River, west to Charleville and Longreach, and east to the coast to Townsville and Proserpine. The squatter pigeon (southern) occurs in dry grassy woodland and open forest, mostly in sandy areas close to water (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project site. Numerous recent records occur within the area, including at Woolwash Lagoon.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	Vulnerable; Vulnerable	During the non-breeding period, the distribution of the western Alaskan bar-tailed godwit is predominately New Zealand and northern and eastern Australia. Habitat for this species includes tidal mudflats, estuaries, shallow river margins and inland on large shallow fresh or brackish waters along the Queensland coast (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site. No nearby records exist.
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically Endangered & Migratory; Endangered	During the non-breeding period, the distribution of the northern Siberian bar-tailed godwit is predominantly in the north and north-west of Western Australia and in south-eastern Asia. Habitat for this species includes tidal mudflats, estuaries, shallow river margins and inland on large shallow fresh or brackish waters along the Queensland coast (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site; and this species is typically found in Western Australia. No nearby records exist.
Macronectes giganteus	Southern giant-petrel	Endangered & Migratory; Endangered	The southern giant-petrel breeds on six subantarctic and Antarctic islands in Australian territory: Macquarie Island, Heard Island and McDonald Island in the Southern Ocean, and Giganteus Island, Hawker Island, and Frazier Island in the Australian Antarctic Territories. Habitat includes inshore and open sea areas, favouring the edges of the continental shelf (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Neochmia ruficauda ruficauda	Star finch (eastern)	Endangered; Endangered	The star finch (eastern) occurs in central Queensland and its population is extremely limited. The distribution of this subspecies is poorly known, and it has disappeared from much of its former range. The most recent records occur in an area from near Wowan, north to Bowen, west to beyond Winton. This species occurs mainly in grasslands and grassy woodlands that are located close to bodies of fresh water. It also occurs in cleared or suburban areas such as along roadsides and in towns (Department of the Environment, 2019).	**Low.** Suitable habitat for this species is found within the Project site; however this species is not known from the Rockhampton region and records only occur in a few scattered locations.
Numenius madagascariensis	Eastern curlew	Critically Endangered & Migratory; Endangered	Within Australia, the eastern curlew has a primarily coastal distribution, they are rarely recorded inland. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (*Zosteraceae*). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets (Department of the Environment, 2019).	**Low.** The wetlands within the Project site are freshwater which are not preferred by this species. Records occur along the Fitzroy River (1955) and at Woolwash Lagoon (1997).
Pachyptila turtur subantarctica	Fairy prion (southern)	Vulnerable; -	This species as a whole has a circumpolar distribution, and probably frequents subtropical waters during the non-breeding period. Breeding is currently known from only from two rock stacks off Macquarie Island, and on Bishop and Clerk Islands nearby (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Poephila cincta cincta	Black-throated finch (southern)	Endangered; Endangered	The black-throated finch's (southern) primary stronghold is the region surrounding Townsville; however it is also known to occur in scattered locations across central-eastern Queensland. Mapping indicates this subspecies has not been found around Rockhampton since 1995. The black-throated finch's (southern) preferred habitat is grassy open woodland/forest dominated by *Eucalyptus*, *Melaleuca* or *Acacia*, but they are also known from pandanus flats and scrubby plains. The black-throated finch (southern) feeds on the seed of native grasses from the ground. Three resources are required for the species to persist: water, grass seeds and trees providing suitable habitat (Department of the Environment, 2019).	**Low.** No suitable habitat for this species is found within the Project site and this species is no longer known from the Rockhampton region.
Pterodroma neglecta neglecta	Kermadec Petrel (western)	Vulnerable; -	The kermadec petrel (western) is a pelagic seabird that occurs in tropical, subtropical and temperate waters of the Pacific Ocean. It breeds on islands, atolls and islets in the southern Pacific Ocean (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.
Rostratula australis	Australian painted snipe	Endangered; Vulnerable	The Australian painted snipe has been recorded from wetlands in all Australian states, however is most common in eastern Australia, especially the Murray-Darling Basin. Individuals are nomadic, and there is some evidence of partial migration from south-eastern wetlands to coastal central and northern Queensland in autumn and winter. Preferred habitat includes shallow inland wetlands, brackish or freshwater, that are permanently or temporarily inundated. Breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby (Department of the Environment, 2019).	**High.** Habitat across the Project site is well suited to this species and it is known from the Rockhampton region in recent years, including a record at Murray Lagoon from 2013.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Thalassarche impavida	Campbell albatross	Vulnerable & Migratory; -	The Campbell albatross is a non-breeding visitor to Australian waters. Breeding birds are most commonly seen foraging over the oceanic continental slopes off Tasmania, Victoria and New South Wales. After breeding, birds move north and may enter Australia's temperate shelf waters (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.
Turnix melanogaster	Black-breasted button quail	Vulnerable; Vulnerable	The black-breasted button-quail is endemic to eastern Australia. It is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland. This species is restricted to rainforests and forests including semi-evergreen vine thicket, low microphyll vine forest and araucarian microphyll vine forest, and occasionally dense thickets of *Acacia* and in vegetation behind sand dunes. Dense layer of leaf litter is crucial in order for the quail to forage (Department of the Environment, 2019).	**Low.** Marginal suitable habitat occurs within the Project site. An undated record occurs in Rockhampton City.
Mammals				
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable; Vulnerable	This species' current distribution is also poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, New South Wales in the south. Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously understood. Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is habitat of importance to the large-eared pied bat. Records from south-east Queensland suggest that rainforest and moist eucalypt forest habitats on other geological substrates at high elevation are of similar importance to the species (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Dasyurus hallucatus	Northern quoll	Endangered; -	In Queensland, the northern quoll is known to occur as far south as Gracemere and Mount Morgan, south of Rockhampton, as far north as Weipa in Queensland and extends as far west into central Queensland to the vicinity of Carnarvon Range National Park. The northern quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Northern quoll are also known to occupy non rocky lowland habitats such as beachscrub communities in central Queensland. Northern quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. Historical records are found around Rockhampton City (1964).
Macroderma gigas	Ghost bat	Vulnerable; Endangered	This species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley, Northern Territory, the Gulf of Carpentaria, coastal and near coastal eastern Queensland from Cape York to near Rockhampton, and western Queensland. The ghost bat currently occupies habitats ranging from the arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines. Roost areas used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°−28°C and a moderate to high relative humidity of 50−100% (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site; however the Project site lacks the caves or old mines required by this species. An undated record occurs at Berserker.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Nyctophilus corbeni	Corben's long-eared bat	Vulnerable; Vulnerable	The Corben's long-eared bat is found in southern central Queensland, central western New South Wales, north-western Victoria and eastern South Australia, where it is patchily distributed, with most of its range in the Murray Darling Basin. Most records are from inland of the Great Dividing Range. This species is found in a wide range of inland woodland vegetation types. These include box/ironbark/cypress pine woodlands, *Allocasuarina luehmannii* woodlands, *Acacia harpophylla* woodland, *Casuarina cristata* woodland, *Angophora costata* woodland, *Eucalyptus camaldulensis* forest, *Eucalyptus largiflorens* woodland, and various types of tree mallee (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.
Petauroides volans	Greater glider	Vulnerable; Vulnerable	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria, with an elevational range from sea level to 1200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands. The greater glider is largely restricted to eucalypt forests. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is found within the Project site. No recent nearby records exists.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Phascolarctos cinereus	Koala	Vulnerable; Vulnerable	In Queensland, the koala's distribution extends inland from the east coast: from the Wet Tropics interim biogeographic regionalisation of Australia bioregion, into the Einasleigh Uplands bioregion in the north of the state; from the Central Mackay Coast bioregion, through the Brigalow Belt North bioregion to the Desert Uplands and Mitchell Grass Downs bioregions, and from the Southeast Queensland bioregion, through the Brigalow Belt to the Mulga Lands and Channel Country bioregions in the southwest of the state. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities. Koalas eat a variety of eucalypt leaves and a few other related tree species, including *Lophostemon*, *Melaleuca* and *Corymbia* species. Koalas are found in higher densities where food trees are growing on more fertile soils and along watercourses. They do, however, remain in areas where their habitat has been partially cleared and in urban areas (Department of the Environment, 2019).	**Moderate.** Habitat across the Project site is well suited to this species, although fragmented. The Of Concern vegetation community located in the Project site is dominated by *Eucalyptus tereticornis*, a primary food tree for the koala in the region.
Pteropus poliocephalus	Grey-headed flying-fox	Vulnerable; -	Grey-headed flying-foxes occupy the coastal lowlands and slopes of south-eastern Australia from Bundaberg to Geelong and are usually found at altitudes < 200 m. Areas of repeated occupation extend inland to the tablelands and western slopes in northern New South Wales and the tablelands in southern Queensland. The grey-headed flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. The primary food source is blossom from *Eucalyptus* and related genera but in some areas it also utilises a wide range of rainforest fruits (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Xeromys myoides	Water mouse	Vulnerable; Vulnerable	The water mouse occurs in three regions of coastal Australia: The Northern Territory, central south Queensland and south-east Queensland. Within its range, it is patchily distributed and nowhere is it particularly abundant. Although the water mouse had been documented in three distinct locations, they require similar habitat including mangroves and the associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands. The main habitat difference at each location is the littoral, supra-littoral and terrestrial vegetation which differs in structure and composition (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.
Reptiles				
Crocodylus porosus	Salt-water crocodile	Migratory; Vulnerable	In Queensland the saltwater crocodile inhabits reef, coastal and inland waterways from Gladstone on the east coast, throughout the Cape York Peninsula and west to the Queensland-Northern Territory border. A seven-year survey recorded 6,444 sightings of the species in the waterways of the Southern Gulf Plains, Northern Gulf Plains, north-west and north-east Cape York Peninsula, Lakefield National Park, East Coast Plains, the Burdekin River catchment and the Fitzroy River catchment. The saltwater crocodile mostly occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland from the coast. Preferred nesting habitat includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (Department of the Environment, 2019).	**Low.** This species may occur in the Fitzroy River but is unlikely to be found in the freshwater wetlands in the Project site.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Delma torquata	Collared delma	Vulnerable; Vulnerable	This species has been recorded at the following sites: the Bunya Mountains, Blackdown Tablelands National Park, Expedition National Park, Western Creek, and the Toowoomba Range. The collared delma normally inhabits eucalypt-dominated woodlands and open-forests in Queensland RE Land Zones 3, 9, and 10. The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter (typically 30–100 mm thick) appears to be an essential characteristic of the adorned delma microhabitat and is always present where the species occurs (Department of the Environment, 2019).	**Low.** Marginal habitat for this species is located in the Of Concern vegetation patch adjacent to the SRFL alignment. This area is heavily impacted by intensive grazing and is seasonally impacted by flood waters. No nearby records exist.
Denisonia maculata	Ornamental snake	Vulnerable; Vulnerable	This species is known only from the Brigalow Belt North and parts of the Brigalow Belt South biogeographical regions. The core of the species' distribution occurs within the drainage system of the Fitzroy and Dawson Rivers. This species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in Queensland RE Land Zone 4, but also lake margins and wetlands. This species' habitat is likely to be found in *Acacia harpophylla*, *Acacia cambagei*, *Acacia argyrodendron* or *Eucalyptus coolabah*-dominated vegetation communities, or pure grassland associated with gilgais (Department of the Environment, 2019).	**Moderate.** Suitable habitat, including gilgai, occurs across the Project site. Records occur surrounding the Project site, including at Berserker and one adjacent to the Bruce Highway at Port Curtis (1974).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Egernia rugosa	Yakka skink	Vulnerable; Vulnerable	The known distribution of the yakka skink extends from the coast to the hinterland of sub-humid to semi-arid eastern Queensland. This vast area covers portions of the Brigalow Belt, Mulga Lands, South-east Queensland, Einasleigh Uplands, Wet Tropics and Cape York Peninsula Biogeographical Regions. Habitat requirements are poorly known, however this species is known from rocky outcrops, sand plain areas and dense ground vegetation, in association with open dry sclerophyll forest (ironbark) or woodland, brigalow forest and open shrubland (Department of the Environment, 2019).	**Low.** Marginal habitat for this species is located in the Of Concern vegetation patch adjacent to the SRFL alignment. This area is heavily impacted by intensive grazing and is seasonally impacted by flood waters. No nearby records exist.
Elseya albagula	White-throated snapping turtle	Critically Endangered; Endangered	This species occurs only in three catchments (Burnett, Mary and Fitzroy) and is considered a habitat specialist. The white-throated snapping turtle prefers clear, flowing, well-oxygenated water associated with their ability to extract oxygen from the water via cloacal respiration. Populations occur at much lower densities where flow is reduced (upstream of dams, weirs etc.) (Department of the Environment, 2019).	**Low.** This species may occur in the Fitzroy River adjacent to the Project site but is unlikely to be impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Furina dunmalli	Dunmall's snake	Vulnerable; Vulnerable	The Dunmall's snake occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland. Records indicate sites at elevations between 200–500 m above sea level. This species has been found in a broad range of habitats, including: forests and woodlands on black alluvial cracking clay and clay loams dominated by *Acacia harpophylla*, *Acacia burrowii, Acacia deanei, Acacia leiocalyx*, *Callitris* spp. or *Allocasuarina luehmannii*; and various *Corymbia citriodora*, *Eucalyptus crebra* and *Eucalyptus melanophloia*, *Callitris glaucophylla* and *Allocasuarina luehmannii* open forest and woodland associations on sandstone derived soils (Department of the Environment, 2019).	**Low.** Marginal habitat for this species is located in the Of Concern vegetation patch adjacent to the SRFL alignment. This area is heavily impacted by intensive grazing and is seasonally impacted by flood waters. No nearby records exist.
Rheodytes leukops	Fitzroy River turtle	Vulnerable; Vulnerable	The bulk of records for this species are associated with the large primary streams of the Fitzroy River system: the Nogoa, Comet, MacKenzie, Connors, Isaac, Dawson and Fitzroy Rivers. Fitzroy River turtles are generally attributed to fast-flowing clear freshwater rivers and rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles, commonly in association with *Eucalyptus tereticornis, Casuarina cunninghamiana, Callistemon viminalis, Melaleuca linariifolia* and *Vallisneria* sp (Department of the Environment, 2019).	**Low.** This species may occur in the Fitzroy River adjacent to the Project site but is unlikely to be impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Fish				
Maccullochella peelii	Murray cod	Vulnerable; -	The Murray cod was historically distributed throughout the Murray-Darling Basin, which extends from southern Queensland, through New South Wales, the Australian Capital Territory and Victoria to South Australia, with the exception of the upper reaches of some tributaries. The species still occurs in most parts of this natural distribution up to approximately 1000 m above sea level. Murray cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Murray cod tend to occur in floodplain channels and anabranches when they are inundated, but the species' use of these floodplain habitats appears limited (Department of the Environment, 2019).	**Low.** This species may occur in the Fitzroy River adjacent to the Project site but is unlikely to be impacted by the Project.

Table 23 Likelihood of occurrence assessment - migratory species

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Migratory Marine Birds				
Anous stolidus	Common noddy	Migratory, Special Least Concern	Mainly occurs in the ocean off the Queensland coasts in the pelagic zone. During the breeding season, this species is found on islands, rocky islets, shoals or cays, nesting in shrubs and other low vegetation and on saltbushes on the ground (Department of the Environment, 2019).	**Unlikely.** This species is largely marine and therefore unlikely to be present or impacted by the Project.
Apus pacificus	Fork-tailed swift	Migratory, Special Least Concern	The fork-tailed swift is recorded generally east of the Great Dividing Range from Cooktown to the New South Wales border, but extends further west in southern Queensland. 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. This species mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Department of the Environment, 2019).	**Low.** This species may exist in airspace above the Project site but is unlikely to roost or otherwise depend on the habitat within the Project site.
Calonectris leucomelas	Streaked shearwater	Migratory, Special Least Concern	The streaked shearwater is a pelagic seabird that feeds mainly on fish and squid (Department of the Environment, 2019).	**Unlikely.** This species is largely marine and therefore unlikely to be present or impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Fregata ariel	Lesser frigatebird	Migratory, Special Least Concern	The species is found in tropical and subtropical seas, coasts and islands, nesting in low trees, shrubs and grasses (Department of the Environment, 2019).	**Unlikely.** This species is largely marine and therefore unlikely to be present or impacted by the Project.
Fregata minor	Greater frigatebird	Migratory, Special Least Concern	The species is found in tropical and subtropical seas, coasts and islands, nesting in low trees, shrubs and grasses (Department of the Environment, 2019).	**Unlikely.** This species is largely marine and therefore unlikely to be present or impacted by the Project.
Hydroprogne caspia	Caspian tern	Migratory, Special Least Concern	In Queensland, this species is widespread in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. It has been recorded in the western districts, especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mount Isa and Cloncurry, and there are also scattered records from central Queensland. The caspian tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks (Department of the Environment, 2019).	**Present.** This species was identified flying over the Project site during the field survey.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Plegadis falcinellus	Glossy ibis	Migratory, Special Least Concern	Within Australia, this species moves in response to good rainfalls, expanding its range, however the core breeding areas used are within the Murray-Darling Basin region of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland. The Glossy Ibis often moves north in autumn, then return south to the main breeding areas in spring and summer. The glossy ibis' preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (Department of the Environment, 2019).	**Present.** This species was identified within the Project site during the field survey.
Sterna albifrons	Little tern	Migratory, Special Least Concern	The Australian breeding population can be divided into two major subpopulations: (1) a northern subpopulation that breeds across northern Australia, from about Broome in north-western Western Australia, through coastal Northern Territory to the Gulf of Carpentaria and eastern Cape York Peninsula; and (2) an eastern subpopulation that breeds on the eastern and south-eastern coast of the mainland and northern and eastern Tasmania. In Australia, little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project site. A record occurs at Murray Lagoon (2017).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Migratory Terrestrial Species				
Cuculus optatus	Oriental cuckoo	Migratory, Special Least Concern	The oriental cuckoo is a regular migrant to Australia, where it spends the non-breeding season (Sept- May) in coastal regions across northern and eastern Australia as well as offshore islands. This species uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.
Hirundapus caudacutus	White-throated needletail	Migratory, Special Least Concern	This species is widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and New South Wales, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. The white-throated needletail is found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial, though does occasionally roost in tree hollows and the foliage canopy. It forages for insects on the wing; flying anywhere between “cloud level” and “ground level” and readily forms mixed feeding flocks with other aerial insectivores (Department of the Environment, 2019).	**Low.** This species may exist in airspace above the Project site but is unlikely to roost or otherwise depend on the habitat within the Project site.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Monarcha melanopsis	Black-faced monarch	Migratory, Special Least Concern	In Queensland, the black-faced monarch is widespread from the islands of the Torres Strait and on Cape York Peninsula, south along the coasts (occasionally including offshore islands) and the eastern slopes of the Great Divide, to the New South Wales border. The black-faced monarch is a wet forest specialist, occurring mainly in rainforests and riparian vegetation. This species mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrub land, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest (Department of the Environment, 2019).	**Low.** Scattered records occur surrounding the Project site; however the Project site does not contain the preferred habitat to support this species.
Monarcha trivirgatus	Spectacled monarch	Migratory, Special Least Concern	The spectacled monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. This species occupies dense vegetation, mainly in rainforest but also in moist or wet sclerophyll forest and occasionally in other densely vegetated habitats such as mangroves, drier forest, woodlands, parks and gardens (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is found within the Project site. No recent nearby records exists.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Myiagra cyanoleuca	Satin flycatcher	Migratory, Special Least Concern	In Queensland, this species is widespread but scattered in the east, being recorded on passage on a few islands in the western Torres Strait. Satin flycatchers are also found extensively along the Great Dividing Range. Satin flycatchers are eucalypt forest and woodland inhabitants. During the non-breeding period, some individuals winter in northern Queensland around Innisfail and farther north around Atherton; however their movements are described as erratic. Wintering birds in northern Queensland will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. No nearby records exist.
Rhipidura rufifrons	Rufous fantail	Migratory, Special Least Concern	The rufous fantail is found in northern and eastern coastal Australia, being more common in the north. This species migrates to south-east Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range. In east and south-east Australia, the rufous fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts, usually with a dense shrubby understorey often including ferns (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project site. Scattered records occur around Rockhampton City and the Botanic Gardens.
Migratory Wetland Species				
Actitis hypoleucos	Common sandpiper	Migratory, Special Least Concern	Found along all coastlines of Australia and in many areas inland, the common sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. The common sandpiper is known to occur in a range of wetland environments, both coastal and inland. Their primary habitat is rocky shorelines and narrow muddy margins of billabongs, lakes, estuaries and mangroves (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Calidris acuminata	Sharp-tailed sandpiper	Migratory, Special Least Concern	In Queensland, the sharp-tailed sandpiper is recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions. In Australasia, the sharp-tailed sandpiper 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 salt lakes inland (Department of the Environment, 2019).	**High.** Suitable habitat exists in the Project site and numerous records occur in the surrounding area, including from Woolwash Lagoon (2014) and Murray Lagoon (2018).
Calidris melanotos	Pectoral sandpiper	Migratory, Special Least Concern	In Queensland, most records for the pectoral sandpiper occur around Cairns. There are scattered records elsewhere, mainly from east of the Great Divide between Townsville and Yeppoon. Records also exist in the south-east of the state as well as a few inland records at Mount Isa, Longreach and Oakley. This species is usually found in coastal or near coastal habitat but very occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site. No nearby records exist.
Calidris ruficollis	Red-necked stint	Migratory, Special Least Concern	This species is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The red-necked stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable. In Australasia, the red-necked stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project site. A record occurs at Murray Lagoon (2018).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Gallinago hardwickii	Latham's snipe	Migratory, Special Least Concern	Latham's snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia. This species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. In Queensland, the range extends inland over the eastern tablelands in south-eastern Queensland. In Australia, the Latham's snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Department of the Environment, 2019).	**Present.** This species was identified at two locations during the field survey.
Limosa limosa	Black-tailed godwit	Migratory, Special Least Concern	The black-tailed godwit is found in all states and territories of Australia, however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. In Australia the black-tailed godwit has a primarily coastal habitat environment. This species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species occurs within the Project site. A record of this species occurs at Murray Lagoon (2018).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Numenius minutus	Little curlew	Migratory, Special Least Concern	Little curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast. There are records of the species from inland Australia, and widespread but scattered records on the east 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. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site.
Pandion cristatus	Eastern osprey	Migratory, Special Least Concern	The breeding range of the eastern osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in New South Wales; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island. Eastern ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (Department of the Environment, 2019).	**Present.** Suitable habitat is found within the Project site and this species was identified during the 2014 survey. Records of this species also occur at Woolwash Lagoon (2017) and Murray Lagoon (2012).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Tringa glareola	Wood sandpiper	Migratory, Special Least Concern	In Queensland, there are sparsely scattered records, generally south of 17° S, but also around Cairns. The wood sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project site. No nearby records exist.
Tringa nebularia	Common greenshank	Migratory, Special Least Concern	In Queensland, this species is widespread in the Gulf country and eastern Gulf of Carpentaria. It has been recorded in most coastal regions, possibly with a gap between north Cape York Peninsula and Cooktown. Inland, there have been a few records south of a line from near Dalby to Mount Guide, and sparsely scattered records elsewhere. The common greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms (Department of the Environment, 2019).	**High.** Habitat across the Project site is well suited to this species and it is known from the Rockhampton region in recent years, including at Murray Lagoon in 2016.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Tringa stagnatilis	Marsh sandpiper	Migratory, Special Least Concern	The marsh sandpiper is found on coastal and inland wetlands throughout Australia. The species is widespread in coastal Queensland, but few records exist north of Cooktown. This species lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project site. Numerous recent records occur surrounding the Project site, including at Murray Lagoon (2018).

Appendix D

Significant Impact Assessment

Appendix D Significant Impact Assessment

Introduction

Under the EPBC Act, a referral to DoEE will be required if the Project has the potential to cause a 'significant impact' on MNES. In relation to listed conservation significant and migratory species, an action will require approval if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct
- extinct in the wild
- critically endangered
- endangered
- vulnerable
- migratory (species which are native to Australia and are included in the appendices to the Bonn Convention, and/or included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA), and/or native, migratory species identified in a list established under an international agreement such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

Significant Impact Criteria

The EPBC Act Policy Statement 1.1 states that the following measures should be considered to determine whether an action is likely to have a significant impact on a MNES.

1. Whether there are any MNES located in the area of the proposed action (noting that 'the area of the proposed action' is broader that the immediate location where the action is undertaken; consider also whether there are any MNES adjacent to or downstream from the immediate location that may potentially be impacted)?
2. Consider the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), whether there is potential for impacts, including indirect impacts, on MNES?
3. Whether there are any proposed measures to avoid or reduce impacts on MNES (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the 'significant impact' threshold)?
4. Whether any impacts of the proposed action on MNES are likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)?

Vulnerable Species

An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of an important population of a species;
- Reduce the area of occupancy of an important population;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of an important population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat;
- Introduce disease that may cause the species to decline; **or**
- Interfere substantially with the recovery of the species.

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 (Department of the Environment Water Heritage and the Arts, 2013):

- 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.

'Habitat critical to the survival of a species' refers to areas that are necessary (Department of the Environment Water Heritage and the Arts, 2013):

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators);
- To maintain genetic diversity and long term evolutionary development, **or**
- For the reintroduction of populations or recovery of the species.

1. Squatter pigeon (southern) (*Geophaps scripta scripta*)

Squatter pigeons (southern) are ground-dwelling birds that inhabit the grassy understorey of open eucalypt woodland, as well as sown grasslands with scattered remnant trees, disturbed areas (such as roads, railways, settlements and stockyards), scrubland, and *Acacia* regrowth. It is nearly always found near permanent water such as rivers, creeks and waterholes.

The squatter pigeon (southern) nests on the ground, and usually lays two eggs among or under vegetation. This species will breed throughout the year; however breeding is influenced by heavy rainfall and most commonly occurs during the dry season between May to June. It forages for seeds among sparse and low grass, in improved pastures, and beside railway lines and with domestic fowl around settlements.

In Queensland, squatter pigeon (southern) foraging and breeding habitat is known to occur on well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills (i.e. Queensland Regional Ecosystem Land Zone 5), and lateritic (duplex) soils on low 'jump-ups' and escarpments (i.e. Queensland Regional Ecosystem Land Zone 7) (Department of the Environment, 2019). The Project site is on Land Zone 3. Therefore, the Project site is considered to contain dispersal habitat only.

The potential impacts on the squatter pigeon (southern) include habitat loss and/or fragmentation and direct mortality from vehicle strike or destruction of nests. Mitigation measures include the following.

- Wherever practicable, signage should be erected to increase awareness of squatter pigeons (southern) in the area.
- Prior to site entry, all site personnel will be appropriately trained and made aware of the responses of this species to vehicle movement.
- Due to the location of nests (on ground) and the ground dwelling nature of the birds, all vehicles and pedestrians will remain within the designated access tracks.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from potential habitat (i.e. permanent water bodies).

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 24.

Important Population

'Important populations' for this species is listed as all of the relatively small, isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland (Department of the Environment, 2019). This species remains common north of the Carnarvon Ranges in Central Queensland and is considered to be distributed as a single, continuous (i.e. inter-breeding) sub-population (Department of the Environment, 2019). A potential population of squatter pigeons (southern) in the Project site is not considered an important population.

Table 24 Significant impact assessment for squatter pigeon (southern) (*Geophaps scripta scripta*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	A potential population of squatter pigeons (southern) in the Project site is not considered an important population. Therefore, it is unlikely that the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	The area of occupancy of the squatter pigeon (southern) was estimated to be 10,000 km² in the year 2000. A potential population of squatter pigeons (southern) in the Project site is not considered an important population. Therefore, it is unlikely that the Project will reduce the area of occupancy of an important population.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Fragment an existing important population into two or more populations?	As this species is found within disturbed areas such as access tracks and easements, clearing of the vegetation within the Project site is unlikely to affect this species. A potential population of squatter pigeons (southern) in the Project site is not considered an important population. Therefore, it is unlikely that the Project will fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	Critical habitat for the survival of this species is not defined; however the squatter pigeon (southern) is known to access suitable waterbodies to drink on a daily basis. As the Project will not change the hydrological conditions of the wetlands within and surrounding the Project site, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	This species breeds at any time of the year if conditions are favourable with most activity in May to June. The nest is a scrape in the ground sheltered by a bush or tussock of grass and thinly lined with dry grass. No breeding habitat is found within the Project site, and a potential population of squatter pigeons (southern) in the Project site is not considered an important population. Therefore, the Project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	Ongoing disturbance to the pastoral landscape (including remnant vegetation) is occurring throughout the Project site. As this species is known to occur in areas of active grazing and substantial habitat degradation, the Project 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.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	Invasive flora and fauna species have been identified on the SPRAT database as a key threat to the species; however it is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.
Interfere substantially with the recovery of the species?	The federal environment minister has declared that that a national recovery plan for the squatter pigeon (southern) is not required; however current threats to this species include loss and fragmentation of habitat due to clearing for agricultural purposes, the degradation of habitat by overgrazing by domesticated herbivores, the degradation of habitat by invasive weeds, and predation by numerous avian and terrestrial predators. While a small amount of clearing of suitable habitat may occur, the extent of habitat loss as a proportion of the habitat available within the region is small. In addition, the species is known to utilise a wide range of different habitats, minimising the impact of habitat clearing on the species. Given this, the Project is unlikely to interfere with the recovery of the squatter pigeon (southern).

2. Ornamental snake (*Denisonia maculata*)

The ornamental snake occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and in adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands, such as brigalow, and in riverine habitats, and lives in soil cracks and under fallen timber. It is also known to persist in cleared, disturbed habitats, particularly where brigalow communities have been cleared.

The ornamental snake's preferred habitat is within, or close to, habitat that is favoured by its prey - frogs. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in Queensland Regional Ecosystem Land Zone 4, but also lake margins and wetlands.

Although the ornamental snake has not been recorded within the Project site, an undated record occurs immediately south of the Project site adjacent to the Bruce Highway at Port Curtis. Essential habitat for the species is also mapped throughout much of the Project site and is associated with open *Eucalyptus* alluvial woodlands.

Suitable habitat for this species may be available in the vegetation and wetland adjacent to the SRFL alignment (unable to be accessed during the field survey). The potential impacts on the ornamental snake include habitat loss and/or fragmentation and direct mortality from construction activities. Mitigation measures include the following.

- All vehicles and pedestrians will remain within the designated access tracks.
- Where possible, excavating and dozing should be avoided in ornamental snake habitat to reduce direct mortality, compaction of the soil and impacts to gilgai.
- Develop appropriate spill prevention and response plans to cover Project activities and the types and quantities of fuel, oil and chemicals held at each site.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from waterbodies.

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 25.

Important Population

DoEE considers that an occurrence of important habitat for the ornamental snake is a surrogate for an ‘important population’ of the species. Suitable habitat for the ornamental snake is considered important if it is (Department of Sustainability, Environment, Water, 2011):

- Habitat where the species has been identified during a survey;
- Near the limit of the species’ known range;
- Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); **or**
- A habitat type where the species is identified during a survey, but which was previously thought not to support the species.

The habitat available within the Project site does not meet the criteria to be considered ‘important’.

Table 25 Significant impact assessment for ornamental snake (*Denisonia maculata*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	The Project site does not contain large contiguous suitable habitat and the area for development is largely in cleared areas. The scale of habitat impact would not reduce the carrying capacity of habitat in the Project site to the extent that it would reduce the size of a population. Therefore, the Project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	The area of occupancy of this species is unknown. However, fallen timber and other microhabitat features will be retained and relocated into the adjacent potential habitat, where practical. Therefore, the Project is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	The potential habitat within the Project site is severely fragmented. The Project is has been designed to avoid dissecting remnant vegetation where possible, with large patches of habitat unaffected by the Project. Roads, floodplains and other barriers to ornamental snake movement currently exist in the Project site; therefore the Project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	The majority of habitat for the ornamental snake across the Project site is highly degraded and of poor quality due to existing fragmentation and grazing impacts, and is therefore not considered to be habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	There is no information on the breeding season of the species. However, fallen timber and other microhabitat features will be retained and relocated into the adjacent potential habitat, where practical. Therefore, the Project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The majority of habitat for this species within the Project site is highly degraded and of poor quality due to existing fragmentation and grazing impacts. Therefore, the Project is unlikely to result in the modification, destruction, removal, isolation or decrease to the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	Key threats to this species include destruction of wetland habitat by feral pigs (*Sus scrofa*) and poisoning resulting from the ingestion of cane toads (*Rhinella marina*). It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Interfere substantially with the recovery of the species?	The federal environment minister has declared that that a national recovery plan for the ornamental snake is not required; however current threats to this species include loss and fragmentation of habitat, alteration of landscape hydrology in and around gilgai environments, and alteration of water quality through chemical and sediment pollution of wet areas. The Project will not change the hydrological conditions of the wetlands within and surrounding the Project site, and considering the mitigation measures suggested, the Project is unlikely to interfere with the recovery of the species.

3. Western Alaskan bar-tailed godwit (*Limosa lapponica bauera*)

The western Alaskan bar-tailed godwit forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches. Roosting habitat consists of sandy beaches, sandbars, spits and near-coastal saltmarsh.

This species does not breed in Australia. Breeding occurs in the northern hemisphere (Scandinavia, northern Asia and Alaska) and they migrate southwards for the boreal winter. The western Alaskan bar-tailed godwit is found in Australia during the non-breeding period, typically from August to March.

Suitable habitat for this species includes the wetlands within and surrounding the Project site. Given the migratory habits of the species, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. The potential impacts on the western Alaskan bar-tailed godwit include habitat degradation and disturbance from construction activities. Mitigation measures include the following.

- Develop measures to minimise disturbance around important shorebird habitat during construction.
- Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from waterbodies.
- Direct lighting for access tracks and construction activities away from adjacent wetlands.

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 26.

Important Population

The SPRAT database does not identify 'important populations' of this species (Department of the Environment, 2019) and any individuals of western Alaskan bar-tailed godwit in the Project site do not meet the definition of an important population.

Table 26 Significant impact assessment for western Alaskan bar-tailed godwit (*Limosa lapponica bauera*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	A potential population of western Alaskan bar-tailed godwits in the Project site is not considered an important population. Therefore, it is unlikely that the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	The area of occupancy of the western Alaskan bar-tailed godwit while in Australia is estimated at 8,100 km^2. A potential population of western Alaskan bar-tailed godwits in the Project site is not considered an important population. Therefore, it is unlikely that the Project will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	The Project is considered unlikely to result in the creation of barriers to movement to, between or within habitat. A potential population of western Alaskan bar-tailed godwits in the Project site is not considered an important population. Therefore, it is unlikely that the project will fragment an existing important population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	Critical habitat for the survival of this species has not been defined; however intertidal habitats used by godwits in Australasia are considered of critical importance as this species relies on the food obtained during the non-breeding season to fuel the return journey back to the northern hemisphere. Additionally, as this species shows high site fidelity, habitat supporting a nationally significant proportion of the population is also considered critical. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Considering the mitigation measures proposed, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	This species does not breed in Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Considering the mitigation measures proposed, the Project 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.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	Invasion of intertidal mudflats by weeds have been identified on the SPRAT database as a key threat to the species; however it is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	The western Alaskan bar-tailed godwit is susceptible to avian influenza and so may be threatened by future outbreaks of the virus. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease. Therefore the project is unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species?	The federal environment minister has declared that that a national recovery plan for the western Alaskan bar-tailed godwit is not required; however current threats to this species include loss and fragmentation of habitat, climate change, pollution/contamination, human disturbance, disease and direct mortality as a result of collisions with large structures. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Considering the mitigation measures proposed, the Project is unlikely to interfere with the recovery of the species.

4. Koala (*Phascolarctos cinereus*)

The koala is a leaf-eating specialist that feeds primarily during dawn, dusk or night. Its diet is restricted mainly to foliage of *Eucalyptus* spp; however, it may also consume foliage of related genera, including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp, and may, at times, supplement its diet with other species, including *Leptospermum* spp. and *Melaleuca* spp.

During the field survey, no koalas were observed in the Project site; however potential habitat exists within the open woodlands. In the Brigalow Belt bioregion, the approximate density is 0.005 koalas/ha (Department of the Environment, 2019).

Habitat Critical to the Survival of Koala

Before assessing the significance of potential impacts on koala habitat, an assessment against the EPBC Act Referral Guidelines for the Vulnerable Koala (Department of the Environment, 2014) must be undertaken. These guidelines inform significant impact assessment through the assessment of habitat as being 'critical to the survival of the species'.

The Project site is situated near Rockhampton, Queensland, with an average annual rainfall of approximately 815 mm (BOM, 2019). This indicates that koala habitat is to be assessed with respect to the coastal context described in the Koala EPBC referral guidelines (Department of the Environment, 2014). Thus, koala habitat is defined as including large, connected areas of native vegetation including in forests and woodlands where logging has altered tree species composition. These areas may be remnant, regrowth or plantation vegetation. Habitat also includes: small, isolated patches of native vegetation in rural, urban or peri-urban areas, windbreaks and narrow areas of native vegetation along riparian areas or linear infrastructure and isolated food and/or shelter trees (i.e. on farm lands, in suburban streetscapes, parks and yards).

Koala food trees are species of tree whose leaves are consumed by koalas. Koala food trees can generally be considered to be those of the following genus: *Angophora, Corymbia, Eucalyptus, Lophostemon* and *Melaleuca*. It should be noted that 'primary' and 'secondary' food trees (as defined by some resources) are all considered to be 'food trees' for the purposes of assessment using these guidelines.

Koala utilisation within the Project site is considered within all remnant vegetation (RE 11.3.4) which contains the primary food tree *Eucalyptus tereticornis* and another known food tree, *Eucalyptus coolabah*.

The Koala EPBC referral guidelines define habitat as 'critical to the survival of the koala' if a score of five or more using the koala habitat assessment tool is obtained for the whole of the site. This assessment is presented in Table 27 below. The assessment determined that habitat within the Project site is not habitat critical to the survival of the koala (due to a total score of 3).

Table 27 Koala habitat assessment tool

Attribute	Score	Description
Koala occurrence	0	• The field survey did not find evidence of one or more koalas occurring within the Project site. • The Atlas of Living Australia has no koala records within 5 km of the Project site within the last 2 years (excluding the Rockhampton Zoo).
Vegetation composition	+2 (high)	• The Project site has remnant vegetation with two or more known koala food trees.
Habitat connectivity	0	• Remnant woodlands within the Project site do not form part of a larger woodland < 500 ha, but ≥ 300 ha.
Key existing threats	+1 (medium)	• There are no known data on koala mortality from vehicle strike or dog attack. • Wild dogs are likely to occur within the Project site. • The Project site is occurs in close proximity to the Capricorn Highway (a major arterial road).

Attribute	Score	Description
		• The Project is not expected to increase the threat of mortality from vehicle strike or dog attack.
Recovery value	0	• The Project site is not situated within a large, contiguous habitat corridor. • The vegetation within the Project site has limited potential to support a viable breeding population.
Total	**3**	**Decision: Habitat is Not Critical to the Survival of the Koala**

Interference to the Recovery of Koala

In addition to considering adverse effects on habitat critical to the survival of the koala, the Project must be assessed for its potential to interfere substantially with the recovery of the koala. This assessment is presented in Table 28 below.

Table 28 Assessment of the Project against the recovery of the koala

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Increase koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities?	The Project site does not contain habitat that is critical to the survival of the species. Additionally, the Project will not result in the introduction or increase in the number of dogs to the local area. Therefore, the Project is unlikely to cause multiple, ongoing mortalities.
Increase koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities?	The Project site does not contain habitat that is critical to the survival of the species. Periodic vehicle access to the Project site may be required during the operational phase of the Project; however vehicles will be restricted to existing tracks. The Project is unlikely to cause multiple, ongoing mortalities.
Facilitate the introduction or spread of disease or pathogens, for example Chlamydia or *Phytophthora cinnamomi*, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat?	The Project site does not contain habitat that is critical to the survival of the species. The Project is not expected to facilitate the introduction or spread of disease or pathogens such as Chlamydia or *Phytophthora cinnamomi*. Standard vehicle hygiene practices will be implemented to prevent the introduction or spread of diseases and pathogens to the Project site.
Create a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala?	The Project site does not contain habitat that is critical to the survival of the species. The potential habitat within the Project site is severely fragmented. The Project is has been designed to avoid dissecting remnant vegetation where possible, with large patches of habitat unaffected by the Project. Roads, floodplains and other barriers to koala movement currently exist in the Project site. Therefore, the Project is not expected to result in a long-term reduction in genetic fitness or access to critical habitat areas.
Change hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term?	The Project site does not contain habitat that is critical to the survival of the species. The Project is not expected to result in any significant changes to the hydrological regime of the site to the extent that degradation of habitat would occur or the result in long-term reduction of critical habitat for this species.

The impacts of the Project are not expected to result in substantial interference to the recovery of the koala.

Significant Impact Assessment

The potential impact of the Project on the koala includes indirect impacts associated with adjacent vegetation clearing. This vegetation was not deemed habitat critical to the survival of the koala. Recommended mitigation measures for this species include:

- If an individual is found prior to or during clearing activities, it must not be forcibly relocated. Any tree that has a koala present, as well as any tree with its crown overlapping that tree, must not be removed and remain in place until the koala vacates the tree of its own accord.

An assessment against the Significant Impact Guidelines 1.1 for this species is provided in Table 29.

Important Population

The SPRAT database does not identify 'important populations' of koala (Department of the Environment, 2019). Koalas are expected to occur in low-density in this region. The limited vegetation within the Project site and the existing barriers to movement (high fragmentation and the existing Capricorn Highway) mean that the Project site is unlikely to support an important population.

Table 29 Significant impact assessment for koala (*Phascolarctos cinereus*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	The habitat identified during the field survey is not considered extensive and, if present, koalas are expected to occur in low densities. If present within the Project site, the population does not meet the definition of an important population. The Project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	The area of occupancy of this species is unknown. If present within the Project site, the population does not meet the definition of an important population. The Project is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	Fragmentation is unlikely to be significantly exacerbated beyond current levels as a result of the Project. If present within the Project site, the population does not meet the definition of an important population. The Project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	The assessment of the Project site against the Habitat Assessment Tool determined that it does not contain habitat that is critical to the survival of the koala (Table 27 above).
Disrupt the breeding cycle of an important population?	Koalas give birth between October and May each year. This species does not use a habitual breeding place. The Project site does not support habitat critical to the survival of the koala. If present within the Project site, the population does not meet the definition of an important population. The Project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The potential habitat within the Project site is severely fragmented and not considered to be of a high quality. The Project has been designed to minimise impacts on potential koala habitat. The Project 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.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	Invasive flora and fauna species have not been identified as a key threat to the species and it is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Threats to the koala include the root fungus *Phytophthora*, Bell Miner Associated Dieback and myrtle rust, all of which are known to impact on the health of eucalypts. The koala is known to contract strains of Chlamydia and the koala retrovirus. Chlamydia infections are known to cause reduced fertility in females of the species, and are expected to reduce the reproductive potential of koala populations. The koala retrovirus can cause a range of conditions including leukaemia and immunodeficiency syndrome. The Project does not involve any processes that are likely to introduce a disease that may result in the decline of the koala.
Interfere substantially with the recovery of the species?	Assessment of the Project against the Referral Guidelines for the koala determined that the Project is not likely to substantially interfere with the recovery of this species (Table 28 above).

Critically Endangered or Endangered Species Criteria

An action is likely to have a significant impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat;
- Introduce disease that may cause the species to decline; **or**
- Interfere with the recovery of the species.

'Habitat critical to the survival of a species' refers to areas that are necessary (Department of the Environment Water Heritage and the Arts, 2013):

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators);
- To maintain genetic diversity and long term evolutionary development, **or**
- For the reintroduction of populations or recovery of the species.

1. Australasian bittern (*Botaurus poiciloptilus*)

The Australasian bittern is generally solitary, but sometimes occurs in pairs or dispersed aggregations of up to 12 birds. The Australasian bittern occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands. It favours wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate.

The Australasian bittern breeds from October to February in solitary pairs. This species nests adjacent to relatively deep, densely vegetated freshwater swamps and pools, building its nests under dense cover over shallow water.

Suitable habitat for this species is limited to Fiddes Street Wetland. Given the natural regime is being maintained, no loss to the size and extent of Fiddes Street Wetland and the surrounding sedgeland is expected. The potential impacts on the Australasian bittern include habitat degradation and disturbance from construction activities. Mitigation measures include the following.

- Develop measures to minimise disturbance around important shorebird habitat during construction.
- Develop appropriate spill prevention and response plans to cover Project activities and the types and quantities of fuel, oil and chemicals held at each site.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from waterbodies.
- Direct lighting for access tracks and construction activities away from adjacent wetlands.

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 30.

Table 30 Significant impact assessment for Australasian bittern (*Botaurus poiciloptilus*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	While the Australasian bittern has not been recorded in the Project site or close surrounds, this species may use the wetland habitats. No direct impacts are expected to occur at Fiddes Street Wetland, and considering the mitigation measures proposed, the Project is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species?	The area of occupancy of the Australasian bittern in Australia is thought to have declined by seventy percent between 1977 and 2008. The declines are primarily linked to the clearing or modification of wetlands for urban and agricultural development, as well as the extraction of water from wetlands for irrigation. No direct impacts are expected to occur at Fiddes Street Wetland, and considering the mitigation measures proposed, the Project is unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations?	The Project is considered unlikely to result in the creation of barriers to movement to, between or within habitat and is therefore unlikely to fragment an existing population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	Critical habitat for the survival of this species is defined as all natural habitat (including constructed wetlands with suitable habitat) in which the Australasian bittern is known or likely to occur. No direct impacts are expected to occur at Fiddes Street Wetland. Given the natural regime is being maintained, no loss to the size and extent of Fiddes Street Wetland and the surrounding sedgeland is expected. Considering the mitigation measures proposed, the Project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of a population?	Given that this species makes nests over densely-vegetated wetlands on a platform of reeds, no breeding habitat is considered to be present in the Project site. The Project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No direct impacts are expected to occur at Fiddes Street Wetland. Given the natural regime is being maintained, no loss to the size and extent of Fiddes Street Wetland and the surrounding sedgeland is expected. Additionally, appropriate erosion and sediment control measures will be installed and maintained. Considering the mitigation measures proposed, the Project 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.
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 replacement of endemic wetland vegetation by invasive, noxious weeds could render habitats less suitable or unsuitable. Additionally, the introduced red fox is considered a major predator species, particularly eggs, chicks and immature birds before they can fly. It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.
Interfere with the recovery of the species?	The SPRAT profile identifies that a Recovery Plan for the Australian bittern is required; however no such plan exists at the time of this report. Actions that are recommended to facilitate the conservation and recovery of the species include: retaining and managing suitable wetland habitats; controlling feral animals in and close to wetlands; and fencing of wetlands to exclude trampling by stock. Given these recommendations, the Project is unlikely to interfere with the recovery of the species.

2. Curlew sandpiper (*Calidris ferruginea*)

Curlew sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm, deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats.

Curlew sandpipers 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.

This species is migratory that reach the northern shores of Australia in late August and early September. Curlew sandpipers do not breed in Australia.

Suitable habitat for this species includes the wetlands within and surrounding the Project site. Given the migratory habits and the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. The potential impacts on the curlew sandpiper include habitat degradation and disturbance from construction activities. Mitigation measures include the following.

- Develop measures to minimise disturbance around important shorebird habitat during construction.
- Develop appropriate spill prevention and response plans to cover Project activities and the types and quantities of fuel, oil and chemicals held at each site.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from waterbodies.
- Direct lighting for access tracks and construction activities away from adjacent wetlands.

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 31.

Table 31 Significant impact assessment for curlew sandpiper (*Calidris ferruginea*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	The observed decline in curlew sandpiper numbers across Australia is attributed to the ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Therefore, it is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species?	The area of occupancy in Australia is estimated at 6,800 km^2. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Therefore, it is unlikely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations?	The Project is considered unlikely to result in the creation of barriers to movement to, between or within habitat and is therefore unlikely to fragment an existing population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	Critical habitat for the survival of this species is defined as wetlands suitable for foraging and breeding, and important migration staging sites in the Yellow Sea. The Project will not change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Given the migratory habits and the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of a population?	This species does not breed in Australia.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Additionally, appropriate erosion and sediment control measures will be installed and maintained. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	The replacement of endemic wetland vegetation by invasive, noxious weeds could render habitats less suitable or unsuitable. It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.
Interfere with the recovery of the species?	The federal environment minister has declared that that a national recovery plan for the curlew sandpiper is not required; however key threats are identified as loss of breeding sites outside of Australia, habitat alteration and a rise in sea level. The Project will not change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Given this, the Project is unlikely to interfere with the recovery of the species.

3. Australian painted snipe (*Rostratula australis*)

Australian painted snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are nearly all from or near small islands in freshwater wetlands, provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover. The nest is usually placed in a scrape in the ground.

The Australian painted snipe forage on vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates. This species is mainly crepuscular (active at dawn and dusk), preferring to sit quietly under cover of grass, reeds or other dense cover during day, becoming more active at dawn, dusk and during night. They generally remain in dense cover when feeding, although may forage over nearby mudflats and other open areas such as ploughed land or grassland.

The movements of the Australian painted snipe are poorly known and it may be a migratory species. Sightings of individuals are erratic, and it is thought the species is likely to be nomadic in response to suitable conditions, such as floods.

Suitable habitat for this species includes the wetlands within and surrounding the Project site. Given the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. Potential impacts of the Project on the Australian painted snipe include habitat loss and/or degradation and direct mortality from vehicle strike or destruction of nests. Mitigation measures include the following.

- Due to the location of nests (on ground) and the ground dwelling nature of the birds, all vehicles and pedestrians will remain within the designated access tracks.
- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from permanent water bodies.
- Develop measures to minimise disturbance around important shorebird habitat during construction.
- Develop appropriate spill prevention and response plans to cover Project activities and the types and quantities of fuel, oil and chemicals held at each site.
- Direct lighting for access tracks and construction activities away from adjacent wetlands.

An assessment against the EPBC Act Significant Impact Guidelines 1.1 for this species is provided in Table 32.

Table 32 Significant impact assessment for Australian painted snipe (*Rostratula australis*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	The Australian painted snipe is inferred to have undergone a severe decline in the number of mature individuals since the 1950s and specifically over the last three generations (~26 years) due to the loss and degradation of its wetland habitat. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Therefore, it is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species?	The area of occupancy of the Australian painted snipe is estimated, with low reliability, to be 1,000 km². The area of occupancy has undoubtedly declined as approximately 50% of wetlands in Australia have been removed since European settlement. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Therefore it is unlikely to reduce the area of occupancy of the species.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Fragment an existing population into two or more populations?	The Project is considered unlikely to result in the creation of barriers to movement to, between or within habitat and is therefore unlikely to fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species?	Critical habitat for the survival of this species is defined as freshwater wetlands suitable for foraging and breeding. The Project will not substantially change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Given the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of a population?	The Australian painted snipe may breed in response to wetland conditions rather than during a particular season. Breeding in northern Queensland has been recorded between May and October. Project related impacts such as removal of vegetation and access by vehicles may impact on local breeding cycles or individual pairs; however this is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Project will not change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. Additionally, appropriate erosion and sediment control measures will be installed and maintained. Therefore, it is unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	The replacement of endemic wetland vegetation by invasive, noxious weeds could render habitats less suitable or unsuitable. It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.
Interfere with the recovery of the species?	The SPRAT profile identifies that a Recovery Plan for the Australian painted snipe is required; however no such plan exists at the time of this report. In 2001, a Project was initiated by the Threatened Bird Network and Australasian Wader Studies Group to improve knowledge of the Australian painted snipe so that meaningful conservation actions could be proposed. Recovery actions implemented as part of this study include: the development of a database of records; the introduction of national targeted surveys conducted twice per year at important historic and contemporary sites and other sites of interest; and an assessment of habitat preferences. Based on these objectives, the Project is unlikely to interfere with the recovery of the species.

Migratory Species Criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; **or**
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

'Important habitat' in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important (Department of the Environment, 2015). Wetland habitat should be considered internationally important if it regularly supports:

- 1% of the individuals in a population of one species or subspecies of waterbird; **or**
- A total abundance of at least 20,000 waterbirds.

Nationally important habitat for migratory shorebirds can be defined using a similar approach to these international criteria, i.e. if it regularly supports:

- 0.1% of the flyway population of a single species of migratory shorebird; **or**
- 2,000 migratory shorebirds; **or**
- 15 migratory shorebird species.

Latham's snipe does not commonly aggregate in large flocks or use the same habitats as other migratory shorebird species. Consequently, habitat important to Latham's snipe cannot be identified using the process outlined above and different criteria are necessary. Important habitat for Latham's snipe is described as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species (Department of the Environment, 2015).

'Ecologically significant proportion of the population' refers to the proportions of each migratory species population likely to result in a significant impact if affected. For species that aggregate in flocks, 1% of the population is considered internationally important and 0.1% as nationally important.

1. Migratory shorebirds

The following migratory species are considered present or likely to occur within the Project site:

- Black-tailed godwit (*Limosa limosa*);
- Caspian tern (*Hydroprogne caspia*);
- Common greenshank (*Tringa nebularia*);
- Common sandpiper (*Actitis hypoleucos*);
- Eastern osprey (*Pandion cristatus*);
- Glossy ibis (*Plegadis falcinellus*);
- Latham's snipe (*Gallinago hardwickii*);
- Little curlew (*Numenius minutus*);
- Little tern (*Sterna albifrons*);
- Marsh sandpiper (*Tringa stagnatilis*);
- Pectoral sandpiper (*Calidris melanotos*);
- Red-necked stint (*Calidris ruficollis*);
- Sharp-tailed sandpiper (*Calidris acuminate*);
- Wood sandpiper (*Tringa glareola*).

Important habitat and ecologically significant proportion of a population

The field survey results establish that there are no internationally or nationally important sites or locations for migratory shorebirds location within or adjacent to the Project site. Additionally, the Project site does not support an ecologically significant proportion of any migratory shorebird population. Specifically, in response to the criteria provided by the Commonwealth for assessing important habitat for migratory shorebirds the following is provided.

- The Project site does not contain any sites identified as internationally important for migratory shorebirds.
- The Project site does not contain any sites that support 0.1% or more of the flyway population of any migratory shorebird species given the very low densities of birds recorded during the survey.
- The Project site does not contain any sites that were observed to support 2,000 or more individual migratory shorebirds, with the largest group of individuals observed comprising three individuals.
- The Project site does not contain any sites that were observed to support 15 or more migratory shorebird species, with the total number of migratory shorebird species recorded for the entire Project site comprising five species.
- The Project site does not support at least 18 individual Latham’s snipe, as only two individuals were recorded within the Project site during the field survey. The highest count of Latham’s snipe within the Project site is 8 individuals at Murray Lagoon (eBird, 2012).

Given the large number of migratory bird species to be assessed, one assessment was undertaken for all species due to their similar habitat requirements, habitat use and migration patterns. An assessment against the EPBC Act Significant Impact Guidelines 1.1 for migratory birds is provided in Table 33.

Table 33 Significant impact assessment for migratory birds

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	The Project site does not contain 'important habitat' for any of the migratory species listed above. Given their migratory habits and the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project site would be utilised infrequently and on a transitory basis only. The Project is not considered likely to result in the creation of barriers to movement to, between or within habitat, nor will it alter the fire regimes, nutrient cycles or hydrological cycles. Therefore, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat a migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	There is no evidence to suggest that the Project site supports an 'ecologically significant proportion of a population' of any of the migratory species known or considered likely to occur. The occurrence and abundance of these species within the Project site within successive years is likely to be highly variable. The Project will not change the hydrological conditions of the wetlands within and surrounding the Project site and only minimal wetland vegetation clearing is required at two seasonally inundated wetlands. For these reasons, the Project is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of a migratory species population.