



Environmental Approval & Compliance Solutions

Baseline Shorebird Monitoring Study for the Townsville Port Expansion Project

October 2018 to January 2019

Port of Townsville Limited



Document Control Summary

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Report Summary	
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Abstract	Port of Townsville Limited (PoTL) proposes to undertake the Port of Townsville Expansion Project (PEP). This report presents the results of a baseline shorebird monitoring study. The monitoring study is a requirement of the PEP Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) approval.

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1. Introduction

1.1 Project context

On 5 February 2018, Port of Townsville Limited (PoTL) received approval under the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act) for the Townsville Port Expansion Project (PEP). Condition 12 of the EPBC Act approval (EPBC 2011/5979) requires the implementation of “a program to monitor the potential impacts to shorebirds before and during construction activities in the marine environment”. In response to this requirement, PoTL will implement a Shorebird Monitoring Program to achieve the following objectives:

- **Objective One:** Develop a Shorebird Monitoring Program to monitor potential impacts to shorebirds before and during construction activities.
- **Objective Two:** Conduct a pre-construction survey of shorebirds in the PEP area and on the nearby Ross River sand spit to identify and record the abundance of each bird species.
- **Objective Three:** Monitor and report on changes to shorebird roosting and foraging, beyond natural spatial and temporal variation, during the project construction activities in the marine environment, to identify any impacts from the project on shorebirds.
- **Objective Four:** Provide recommendations on key areas of actual impact and potential mitigation measures should impacts be detected.
- **Objective Five:** Contribute to improving public awareness on local avifauna biodiversity and species richness in the vicinity of the project area.

Construction works for Stage 1 of the PEP, the Channel Capacity Upgrade (CCU) Project, are planned to begin in April 2019. Prior to construction works, PoTL require that baseline shorebird monitoring surveys and reporting on results occur.

1.2 Scope

NRA Environmental Consultants (NRA) was commissioned by PoTL to undertake works to address Objectives One and Two, as described above. The scope included the following.

- An initial site reconnaissance survey to determine the changes in site conditions since the NRA 2012 avifauna surveys.
- Four shorebird monitoring events, one per month between October 2018 and January 2019 (the period of peak shorebird abundance at the site). The surveys were designed to permit comparison with previous (NRA 2012) and future work.
- A report, including the following:
 - Study context, scope and methods.
 - A description of shorebird habitat within the study area.
 - A list of shorebird species in the study area.
 - A record of species listed as Critically Endangered, Endangered, Vulnerable, Near Threatened and/or Migratory under the EPBC Act and/or the Queensland *Nature Conservation Act* 1992 (NC Act) occurring in the study area, and their abundance.
 - An assessment of the significance of observed species, abundances and habitats with reference to EPBC Act Policy.
 - A comparison of the results of the 2018/2019 survey to those reported in NRA (2012), noting any changes in the significance of identified values to shorebirds.

- Recommendations if any adverse impacts to shorebirds are detected.
- A summary of salient findings of public interest.

The study area will replicate that assessed by NRA (2012), comprising:

- Eastern Reclamation Area
- Marine Precinct
- rock walls along the Eastern Reclamation Area and Marine Precinct
- intertidal area between the Marine Precinct and Benwell Road (an undeveloped section of Lot 773 on SP223346)
- sand spit area at the mouth of Ross River (**Figure 1**).

1.3 Terminology

In this report Threatened and Near Threatened species are as defined under the EPBC Act and/or NC Act. Threatened species may include the categories Critically Endangered, Endangered or Vulnerable. Migratory species are as defined under the EPBC Act.

Shorebirds, also known as waders, refer to a subset of bird families, notably Charadriidae (*eg* plovers and dotterels) and Scolopacidae (*eg* curlews, godwits and sandpipers), belonging to the order Charadriiformes. These birds commonly feed by wading in shallow water or saturated substrate along the shores of lakes, rivers and the sea (Geering *et al.* 2007). They include a large group of species that migrates annually between Australia and areas as far north as the Arctic Circle, and a smaller group of species that permanently resides in Australia. Many of these migratory and resident species are listed as Migratory under the EPBC Act. Shorebirds often share their coastal habitats with a range of other waterbirds, notably seabirds of the family Laridae (terns and gulls) and various wetland species in the families Ardeidae (herons and egrets), Threskiornithidae (spoonbills and ibis) and Anatidae (ducks, geese and swans). Some species within the Laridae family are listed as Migratory under the EPBC Act. Some species belonging to the above groups of birds are also listed as Threatened and/or Near Threatened under the EPBC Act and/or NC Act.

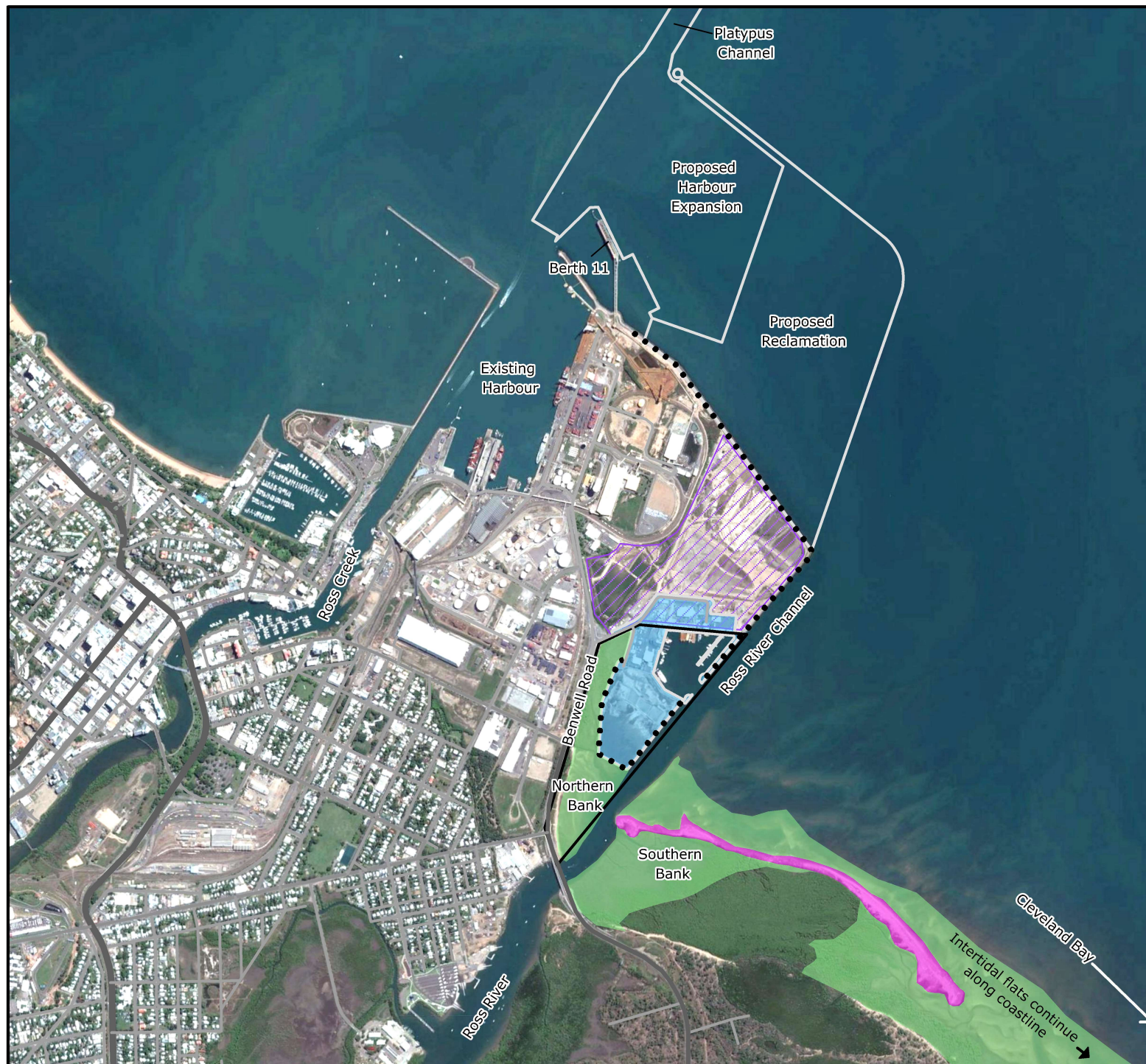
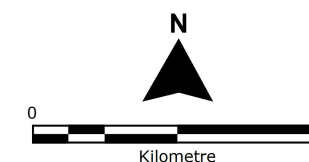


Figure 1: Proposed Townsville Port Expansion Project area

Project: Baseline Shorebird Monitoring Study for the Townsville Port Expansion Project (October 2018 to January 2019)

- Proposed port expansion project area
- Lot 773 on plan SP223346
- Rock wall
- Eastern reclamation area
- Marine precinct
- Ross River mouth sand spit
- Intertidal flats



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Date: May 2019

Source:
AECOM, Google Earth



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2. Background

2.1 Study area

The PEP area occurs near the mouth of the Ross River in Townsville (**Figure 1**). The Ross River mouth area contains terrestrial, intertidal and inshore marine habitats. Due to this variety of habitats, a diverse assemblage of bird species occurs in the Ross River mouth area. Of particular significance in this area is the sand spit near the river mouth and intertidal banks (or flats) that extend from the river mouth south-east along Cleveland Bay. The intertidal areas and sand spit provide ideal foraging and roosting habitat for a variety of shorebirds and other waterbirds, including species listed as Threatened, Near Threatened and Migratory under the EPBC Act and/or NC Act. Previous studies have found that the area supports transient Migratory shorebird populations that are of national and international significance with respect to species richness and abundance (NRA 2005, 2008, 2012; Driscoll 2009).

The Port of Townsville (PoT) is on the northern bank of the Ross River mouth. The developed areas are predominantly built on reclaimed land and contain administration buildings, ship loading facilities, and storage facilities. PoT also contains recently reclaimed areas (currently undeveloped) where future development is planned. The fill material used in the reclamation areas includes marine sediments obtained from dredging activities within and around PoT. NRA (2012) recorded Migratory shorebirds foraging in and roosting on sections of reclaimed land, and on some occasions certain shorebird species were present in nationally significant numbers. Land reclamation is a gradual process and the PoT land contains areas at various stages of reclamation. The lower lying habitats within the reclamation area are therefore transitional habitats and the use of these areas by shorebirds will evolve throughout the reclamation process.

The northern and eastern boundaries of the PoT are protected by constructed rock walls. The seaward edge of the rock walls is subject to tidal inundation and spray from wave action. The wet and dry cycles experienced along the seaward edge vary with tides, sea state and rainfall. These conditions are favourable for many species of mollusc, which are a food source for a variety of coastal bird species. Rock walls may also be used by a variety of waterbirds as perches for hunting, feeding and resting. These man-made structures provide very similar habitats to naturally occurring rocky headlands and foreshores, such as those found nearby at Kissing Point and Magnetic Island (approximately 4 km and 8 km from the study area respectively). NRA (2012) recorded small numbers of Migratory shorebirds and other waterbirds around the Marine Precinct, but very little bird activity around the Eastern Reclamation Area.

2.2 General bird use patterns of the Ross River mouth and surrounds

Based on work by NRA (2005, 2008, 2012) and Driscoll (2009), during high tide, most Migratory shorebirds from the local population and various other waterbirds move to the sand spit in the Ross River mouth to roost. This site is an ideal roost because it is near suitable foraging habitat, provides unobstructed visibility of potential predators and is relatively isolated from the mainland at high tide. Isolation at high tide is important because it affords roosting birds a degree of protection from land-based predators and human disturbance. Such areas are uncommon along the Queensland coastline and very uncommon in the Townsville region. Driscoll (2009) assessed this site as ranking within the top 40 sites

for shorebirds along the east coast of Queensland. While the sand spit is outside the PEP area, it plays an important role in the dynamics of the local shorebird population and was therefore included in the study area.

As the tide recedes, shorebirds move off the sand spit to mostly forage on the surrounding intertidal banks. The majority of birds uses the banks to the south-east of the river mouth (*ie* Cleveland Bay), especially the area near Sandfly Creek (approx. 2.3 km south-east of sand spit), with smaller numbers venturing farther south into Cleveland Bay or along the banks of the Ross River (NRA 2005, 2008, 2012; Driscoll 2009). The historical preference of shorebirds for the Sandfly Creek area could be related to the nutrient rich outfall from the Cleveland Bay Sewage Treatment Plant (Pell & Lawler 1996). The Sewage Treatment Plant was recently upgraded and the impacts of the upgrade on this foraging area have not been reported.

While the majority of local Migratory shorebirds and seabirds roost on the sand spit and forage on nearby intertidal banks, NRA (2012) found that some birds from this population used habitats on PoT land. This included 18 Migratory shorebird species, two NC Act Threatened species and two Near Threatened (NC Act) species¹. Of the species using PoT land, the Red-necked Stint (*Calidris ruficollis*; EPBC Act Migratory) and Lesser Sand Plover (*Charadrius mongolus*; EPBC Act Migratory) were the most abundant Migratory shorebird species and were observed in nationally significant numbers during the 2012 summer spring high tides. NRA (2012) found that up to 25% of the local Migratory shorebird population would occasionally roost in the Eastern Reclamation Area during spring high tides. Further, a small (<10%) proportion of the local population foraged and would roost in the recently constructed reclamation ponds of the Marine Precinct. While Migratory shorebird abundances were relatively low in the Marine Precinct in the NRA (2012) study, species richness was higher than at other PoT survey areas and at times similar to that found on the Ross River sand spit.

Compared with the Ross River mouth and surrounding intertidal lands, the constructed rock walls (*eg* breakwaters) around and near PoT land have been subject to less formal study. Natural Solutions (2008) surveyed the rock walls near to the existing harbour (outside the PEP; **Figure 1**) for avifauna. Their three day survey identified 21 bird species, and their consultation with local bird observers identified a further 14 species previously recorded in this area. These 35 bird species included nine Migratory species (mostly seabirds). Natural Solutions (2008) noted that most of the 35 species would be transient species that do not solely rely on the rock walls. Along rock walls of the PEP, NRA (2012) recorded small numbers of Grey-tailed Tattler (*Tringa brevipes*), Common Sandpiper (*Actitis hypoleucos*), Striated Heron (*Butorides striata*) and Whimbrel (*Numenius phaeopus*) around the Marine Precinct, but very little bird activity around the Eastern Reclamation Area.

2.3 Assessing significance

Under the EPBC Act, ‘important habitat’ is a key concept for assessing the significance of an area to Migratory shorebirds (DEWHA 2009). EPBC Act Policy Statement 3.21 ‘*Significant impact guidelines for 36 migratory shorebird species*’ (DEWHA 2009) states that sites contain important habitat when they support 2,000 or more Migratory shorebirds, 15 or more Migratory shorebird species or individual Migratory shorebird species abundance above thresholds for national significance. The threshold for national significance is 0.1% of the East Asian-Australasian flyway (EAA flyway) population for a given species. The most

¹ The legislative status for some species has changed since NRA (2012).

recent EAA flyway population estimates are available in Hansen *et al.* (2016). Sites supporting 20,000 or more waterbirds or $\geq 1\%$ of the EAA flyway population are considered to be of international significance.

2.4 Changes in species' legislative status

The status of some species under the EPBC Act and NC Act that are relevant to PoT has changed since the NRA (2012) study. The relevant changes are detailed in **Table 1**.

Table 1: Changes in legislative status between previous (*ie* NRA 2012) and current study of species relevant to PoT shorebird monitoring project

Species Name	Legislative Status (EPBC Act / NC Act) ^A	
	Reported in NRA (2102)	Current ^B
Eastern Great Egret (<i>Ardea modesta</i>)	M / LC	- / SLC
Cattle Egret (<i>Ardea ibis</i>)	M / LC	- / SLC
Eastern Reef Egret (<i>Egretta sacra</i>)	M / LC	- / SLC
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	M / LC	- / SLC
Rainbow Bee-eater (<i>Merops ornatus</i>)	M / LC	- / SLC
Gull-billed Tern (<i>Gelochelidon nilotica</i>)	- / LC	M / LC
Crested Tern (<i>Thalasseus bergii</i>)	- / LC	M / LC
Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)	- / NT	- / LC
Sooty Oystercatcher (<i>Haematopus fuliginosus</i>)	- / NT	- / LC
Little Tern (<i>Sternula albifrons</i>)	M / E	M / SLC
Eastern Curlew (<i>Numenius madagascariensis</i>)	M / NT	M, CE / E
Great Knot (<i>Calidris tenuirostris</i>)	M / LC	M, CE / E
Red Knot (<i>Calidris canutus</i>)	M / LC	M, E / E
Lesser Sand Plover (<i>Charadrius mongolus</i>)	M / LC	M, E / E
Greater Sand Plover (<i>Charadrius leschenaultii</i>)	M / LC	M, V / V
Western Alaskan Bar-tailed Godwit (<i>Limosa lapponica baueri</i>) ^C	M / LC	M, V / V

^A Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act) Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC) and Least Concern (LC). Under the EPBC Act a species can be listed as both Migratory and Threatened (*ie* Critically Endangered, Endangered, Vulnerable).

^B Status as of 3 April 2019.

^C Formerly known as Bar-tailed Godwit (*Limosa lapponica*).

The changes in Threatened species status since the NRA (2012) study are substantial and, in most cases, reflect the severe decline in abundance of shorebird species. Factors outside of Australia are primarily responsible for these declines (Hansen *et al.* 2016).

3. Methods

3.1 Overview

The survey methods follow those previously implemented by NRA (2012). The surveys were conducted between October 2018 and January 2019 on the dates shown in **Table 2**. The survey period (October 2018 and January 2019) was primarily chosen because overall shorebird abundance in the Ross River mouth (*ie* sand spit and adjacent intertidal areas) is highest during the spring and summer months (Driscoll 2009). The survey area comprised developed (section of rock wall south-east of Berth 11, Eastern Reclamation Area and Marine Precinct) and undeveloped (intertidal area between the Marine Precinct and Benwell Road²) sections of PoT, and the Ross River mouth sand spit (**Figures 1 and 2**).

Table 2: Survey dates, locations and corresponding tides during the 2018/19 Townsville PEP baseline shorebird monitoring study

Date	Survey Area ¹	Tide Times ²	Tide Height (m)
23/10/2018	Sand Spit (reconnaissance survey)	0757 hrs (H)	2.96
25/10/2018	Sand Spit	0902 hrs (H)	3.11
	Port of Townsville	1454 hrs (L)	1.10
26/10/2018	Port of Townsville	0945 hrs (H)	3.10
		1536 hrs (L)	1.26
21/11/2018	Port of Townsville	0741 hrs (H)	3.11
		1348 hrs (L)	1.14
22/11/2018	Sand Spit	0815 hrs (H)	3.27
20/12/2018	Port of Townsville	0730 hrs (H)	3.24
		1349 hrs (L)	1.28
21/12/2018	Sand Spit	0806 hrs (H)	3.47
21/1/2019	Sand Spit	0915 hrs (H)	4.04
21/1/2019	Port of Townsville	1550 hrs (L)	1.01
22/1/2019	Port of Townsville	1000 hrs (H)	4.05

¹ Port of Townsville survey areas comprised the section of rock wall south-east of Berth 11, Eastern Reclamation Area, Marine Precinct, intertidal area between the Marine Precinct and Benwell Road (section of Lot 773 on SP223346) (**Figure 2**). The sand spit extends east of the Ross River mouth.

² H = High tide; L = Low tide.

To best capture the range of habitat conditions available to birds, especially shorebirds, within the study area, the surveys were timed to occur around the spring tide.

The surveys were undertaken by a two-person team using binoculars (10 x 42) and, when necessary, a spotting scope (Swarovski ATS 65 mm).

A reconnaissance site visit preceded the October 2018 monthly survey. The purpose of the reconnaissance site visit was to assess survey conditions and logistics, and to confirm the survey plan. Shorebird counts were conducted on the sand spit during the reconnaissance survey though not on PoT land.

² This area is an undeveloped section of Lot 773 on SP223346.

3.2 Port of Townsville Land

Surveys within the PoT section of the study area (*ie* the section of rock wall south-east of Berth 11, Eastern Reclamation Area, Marine Precinct, intertidal area between the Marine Precinct and Benwell Road (section of Lot 773 on SP223346)) involved formal bird counts at fixed locations, informal searches for birds and habitat assessments. Formal counts involved visiting each of the count areas (**Figure 2**) and recording the abundance of each bird species and noting their behaviours. Counts were made around low and high tide³ on either the same day or consecutive days.

Count areas along the rock wall (sites RW1 to RW9, **Figure 2**) were 250 m apart. Included in the counts were birds perching or foraging along the rock wall and/or foraging within 250 m in the adjacent ocean waters. All birds within 250 m of the observation point (sites RW1 to RW9, **Figure 2**) were recorded. The overlap between the rock wall count areas was intentional and was done to counteract the obscured visibility caused by the rocks.

Counts at the Marine Precinct (reclaimed land and rock walls of MP1 and MP2, **Figure 2**) and of the adjoining intertidal area (STB1a to STB1c, **Figure 2**) were made from vantage points along the western rock wall of the Marine Precinct.

Count areas within the Eastern Reclamation Area comprised ER1 to ER6 (**Figure 2**). ER2 was only surveyed in October, November and December 2018. Temporary offices and support facilities were constructed over most of ER2 prior to the January 2019 survey, rendering the affected areas unsuitable for shorebirds. Counts were generally made from vantage points that offered good visibility without causing birds to flee or change their behaviour.

Residual areas in the Eastern Reclamation Area were informally surveyed while travelling between formal count areas.

3.3 Sand spit

A boat was used to access the sand spit and land-based counts were made around high tide⁴ from vantage points that offered optimal views without disturbing birds. The exception was the January 2019 survey when rough seas and high tide levels prohibited a beach landing. Instead, boat-based counts were used in January 2019.

³ Nominally two hours prior to and two hours following low and high tide.

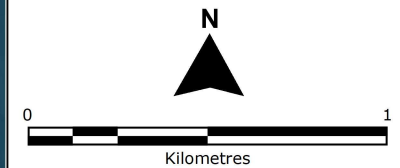
⁴ Nominally 1.5 hours prior to high tide.



Figure 2: Formal count areas used during the 2018/19 shorebird surveys

Project: Baseline Shorebird Monitoring Study for the Townsville Port Expansion Project (October 2018 to January 2019)

- Proposed port expansion project area
- Sand spit
- Formal count areas
 - South Townsville Beach (STB) count areas
 - Marine Precinct (MP) count areas
 - Eastern Reclamation Area (ER) count areas
 - Rock Wall (RW) count sites and count areas



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Source:
NRA, AECOM, Google Earth

NRA

4. Results

4.1 Survey conditions

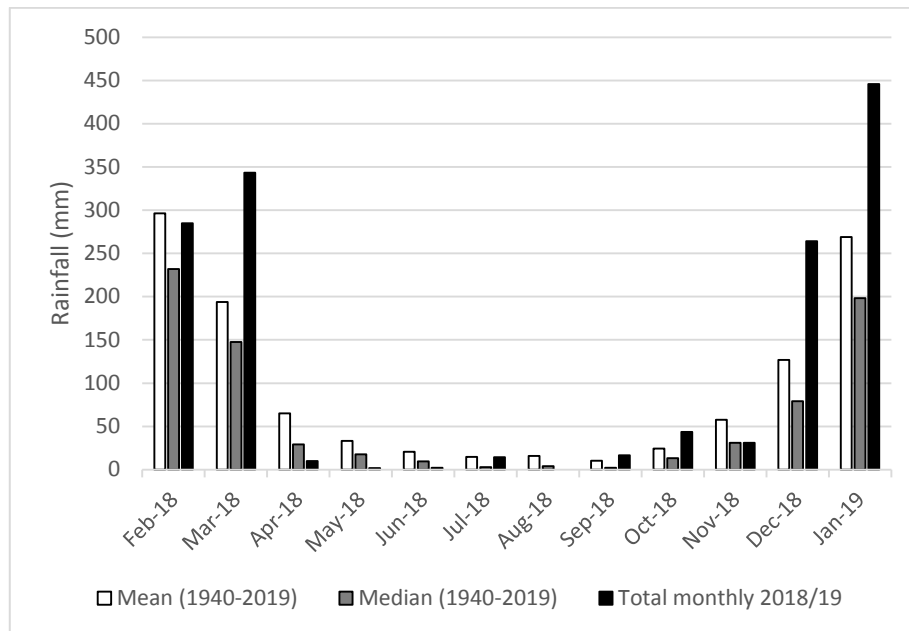
4.1.1 Changes to shorebird habitats

The habitats within the study area have changed since the work by NRA (2005, 2008, 2012) was completed. These changes are summarised as follows.

- **ER2 and MP2.** At the time of the NRA (2012) study, the ER2 and MP2 sites were mostly below ground surface levels and received tidal water during the highest tides. Since NRA (2012), further soil material has been deposited in these areas as part of the land reclamation process and they no longer hold tidal water. This change will have reduced, from that reported by NRA (2012), the quality of these sites as foraging habitat for shorebirds. Temporary offices and support facilities were constructed over most of ER2 prior to the January 2019 survey, making most of this area unsuitable habitat for shorebirds.
- **Sand spit.** The height and configuration of the sand spit near the mouth of Ross River has changed since NRA (2005, 2008, 2012). During the NRA (2012) study, the highest part of the sand spit was in the river mouth. This section of sand spit has since reduced in size and height. During the October, November and December 2018 surveys (high tide), the sand spit in the river mouth was mostly covered with tidal waters. It was completely submerged during the January 2019 survey. The largest and highest sections of sand spit now occur approximately 1.5 km south of the river mouth. This change means that most shorebirds now roost farther south, from that reported by NRA (2012), of the river mouth.
- **Intertidal flats.** In the time since the NRA (2005, 2008, 2012) studies, the sections of intertidal flats on the Southern Bank (**Figure 1**), and at STB1b and STB1c (**Figure 2**), have been colonised by mangroves. It is likely that changes to river flows and sediment movement associated with the construction of the Southern Port Road bridge in 2012 contributed to this change. The mangrove encroachment has reduced the quality of the affected intertidal areas to shorebirds as foraging habitat.

4.1.2 Weather

No extreme weather events (*eg* tropical cyclones, flooding) occurred during or immediately prior to any of the 2018/19 surveys. Monthly rainfall totals for the 2018/19 survey period and preceding months is shown on **Graph 1**. Weather data was obtained from the Bureau of Meteorology (BOM) website (www.bom.gov.au) and is based on records from the Townsville Airport, which is approximately 7 km from the study area. The data shows that Townsville received above average or near average rainfall during the survey period and month prior. Most of the rainfall in January 2019 occurred after the surveys were complete. These rainfall patterns are relevant given that the behaviours of some of the bird species are influenced by rainfall.



Graph 1: Monthly rainfall (2018/19) and long-term average and median rainfall recorded at the Townsville Aero BOM weather station

4.1.3 Tides

Tide times and heights during survey events are shown in **Table 2**. Habitats along the rock wall (sites RW1 to RW9), the intertidal areas (STB1a to STB1c) and the sand spit are influenced by tide heights. The influence of tide heights should be considered when reviewing the following results.

4.2 Field survey results

4.2.1 Overview

The results from each survey event are provided in **Appendix A**. Consistent with the project scope, the following sections focus on results relating to Migratory shorebirds recorded on PoT land *ie* less attention is devoted to non-Migratory species and results from the sand spit. Many of these species are also listed as Threatened under State and/or Commonwealth legislation. The Beach Stone Curlew (*Esacus magnirostris*) was the only recorded species that is listed as Threatened (Vulnerable, NC Act), though not listed as Migratory.

4.2.2 Species composition, species richness and abundance

Species composition and richness

Fifty-eight (58) bird species were recorded across all the 2018/19 surveys and all sites (including the sand spit). The species, their legislative status and general distribution are shown in **Table 3**.

Table 3: Bird species recorded on Port of Townsville (PoT) and the Ross River sand spit during 2018/19 baseline field surveys and their legislative status

Common Name	Scientific Name	Status ^A		Location	
		EPBC Act	NC Act	PoT ^B	Sand Spit
Threatened species					
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	✓	✓
Great Knot	<i>Calidris tenuirostris</i>	CE, M	E		✓
Red Knot	<i>Calidris canutus</i>	E, M	E		✓
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	✓	✓
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	✓	✓
Western Alaskan Bar-tailed Godwit	<i>Limosa lapponica baueri</i>	V, M	V		✓
Beach Stone-curlew	<i>Esacus magnirostris</i>	-	V	✓	
Non-threatened Migratory species					
Pacific Golden Plover	<i>Pluvialis fulva</i>	M	SLC		✓
Grey Plover	<i>Pluvialis squatarola</i>	M	SLC		✓
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	✓	✓
Terek Sandpiper	<i>Xenus cinereus</i>	M	SLC	✓	
Common Sandpiper	<i>Actitis hypoleucos</i>	M	SLC	✓	
Ruddy Turnstone	<i>Arenaria interpres</i>	M	SLC		✓
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SLC	✓	✓
Common Greenshank	<i>Tringa nebularia</i>	M	SLC	✓	
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	✓	✓
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	✓	✓
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	✓	✓
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	✓	✓
Little Tern	<i>Sternula albifrons</i>	M	SLC	✓	✓
Crested Tern	<i>Thalasseus bergii</i>	M	SLC	✓	✓
Other non-threatened and non-Migratory Species					
Plumed Whistling-duck	<i>Dendrocygna eytoni</i>	-	LC	✓	
Chestnut Teal	<i>Anas castanea</i>	-	LC	✓	
Grey Teal	<i>Anas gracilis</i>	-	LC	✓	✓
Pacific Black Duck	<i>Anas superciliosa</i>	-	LC	✓	✓
Hardhead	<i>Aythya australis</i>	-	LC	✓	
Peaceful Dove	<i>Geopelia striata</i>	-	LC	✓	
Pied Cormorant	<i>Phalacrocorax varius</i>	-	LC	✓	
Australian Pelican	<i>Pelecanus conspicillatus</i>	-	LC	✓	✓
Striated Heron	<i>Butorides striata</i>	-	LC	✓	✓
White-faced Heron	<i>Egretta novaehollandiae</i>	-	LC	✓	✓
Intermediate Egret	<i>Ardea intermedia</i>	-	LC	✓	
Eastern Great Egret	<i>Ardea modesta</i>	-	LC	✓	✓
Little Egret	<i>Egretta garzetta</i>	-	LC	✓	✓
Australian White Ibis	<i>Threskiornis molucca</i>	-	LC	✓	✓
Royal Spoonbill	<i>Platalea regia</i>	-	LC	✓	
Brahminy Kite	<i>Haliastur indus</i>	-	LC	✓	
Nankeen Kestrel	<i>Falco cenchroides</i>	-	LC	✓	
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	-	LC	✓	
Australian Pied Oystercatcher	<i>Haematopus longirostris</i>	-	LC	✓	✓
Black-winged Stilt	<i>Himantopus himantopus</i>	-	LC	✓	
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	LC	✓	✓
Masked Lapwing	<i>Vanellus miles</i>	-	LC	✓	
Lesser Crested Tern	<i>Thalasseus bengalensis</i>	-	LC	✓	✓
Whiskered Tern	<i>Chlidonias hybrida</i>	-	LC		✓
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	✓	✓
Little Bronze-Cuckoo	<i>Chrysococcyx minutillus</i>	-	LC	✓	
Rainbow Bee-eater	<i>Merops ornatus</i>	-	LC	✓	

Common Name	Scientific Name	Status ^A		Location	
		EPBC Act	NC Act	PoT ^B	Sand Spit
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	-	LC	✓	
Mangrove Honeyeater	<i>Gavicalis fasciogularis</i>	-	LC	✓	
Brown Honeyeater	<i>Lichmera indistincta</i>	-	LC	✓	
Mangrove Gerygone	<i>Greygona mouki</i>	-	LC	✓	
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	-	LC	✓	
Golden-headed Cisticola	<i>Cisticola exilis</i>	-	LC	✓	
Welcome Swallow	<i>Hirundo neoxena</i>	-	LC	✓	
Australasian Pipit	<i>Anthus novaeseelandiae</i>	-	LC	✓	
Non-native Species					
Rock Dove	<i>Columba livia</i>	-	I	✓	
SPECIES RICHNESS (ALL SPECIES)				50	30

^A Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act) Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Non-native species (I).

^B Port of Townsville. Species records from incidental observations and from count areas (Rock Wall, Eastern Reclamation Area, Marine Precinct, and STB1a to 1c (**Figure 2**)).

While more bird species were recorded on PoT (50 species) than on the sand spit (30 species), PoT supported fewer Migratory species (14 species) than the sand spit (17 species) (**Table 3**). Across all PoT areas, species richness was highest during the high tide surveys (*cf* low tide surveys) (**Table 4**). The minimum and maximum monthly species richness for Migratory shorebirds across the survey period was as follows.

- Sand spit (high tide only):
 - High tide: five species (January 2019) to 17 species (October 2018) (**Table 5**).
- PoT (Rock Wall, Eastern Reclamation Area, Marine Precinct and STB1a to STB1c) (**Table 4**):
 - High tide: seven species (January 2019) to 13 species (December 2018).
 - Low tide: three species (January 2019) to six species (November 2018).

Species richness exceeded the threshold for national significance on the sand spit in October 2018 (**Table 5**). While this threshold was not exceeded on PoT land, 13 species were recorded in December 2018, which is approaching the threshold value of 15 species (**Table 5**).

Abundance of Threatened, Near Threatened and Migratory bird species

The abundance of Threatened, Near Threatened and Migratory bird species recorded on PoT is shown in **Table 4**. The highest abundances were present at high tide (*cf* low tide). Red-necked Stint and Greater Sand Plover were consistently the most abundant species and were present in nationally significant abundances in October 2018 and January 2019 respectively (**Table 4**). Lesser Sand Plover was also present in relatively large numbers during November 2018 and December 2018, though below the threshold for national significance.

The abundance of Threatened, Near Threatened and Migratory shorebird species recorded on the sand spit is shown in **Table 5**. Seven species were present in nationally significant abundances during at least one survey event. Total shorebird abundance exceeded the threshold for significance in November 2018 (**Table 5**). The Great Knot was the most abundant species and exceeded the national threshold for significance during each month of the survey period.

Table 4: Abundance of Threatened, Near Threatened and Migratory bird species recorded on Port of Townsville land^A during the 2018/19 survey period (counts that exceed thresholds for national significance are shaded)

Common Name	Scientific Name	Status ^B		October 2018		November 2018		December 2018		January 2019		Significance Thresholds ^C	
		EPBC Act	NC Act	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide	International	National
Beach Stone Curlew	<i>Esacus magnirostris</i>	-	V	2	1	3	2	3	0	0	0	NA	NA
Common Sandpiper	<i>Actitis hypoleucos</i>	M	SLC	2	0	1	2	2	0	0	0	1900	190
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	1	0	5	0	51	0	42	0	850	85
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	522	0	391	0	445	0	10	0	4750	475
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2	3	97	0	181	0	274	0	2000	200
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	5	1	64	0	115	0	0	0	1800	180
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	7	0	2	1	6	0	5	0	NA	NA
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	9	0	20	0	22	1	27	11	NA	NA
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	0	1	0	0	1	1	0	0	350	35
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	4	1	2	1	3	0	1	0	650	65
Little Tern	<i>Sternula albifrons</i>	M	SLC	2	2	3	3	3	1	0	0	NA	NA
Crested Tern	<i>Thalasseus bergii</i>	M	SLC	1	0	0	0	1	0	0	4	NA	NA
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SLC	0	0	1	1	0	0	0	0	700	70
Common Greenshank	<i>Tringa nebularia</i>	M	SLC	1	0	3	3	2	1	1	1	1100	110
Terek Sandpiper	<i>Xenus cinereus</i>	M	SLC	0	0	0	0	4	0	0	0	500	500
MIGRATORY SHOREBIRD SPECIES ABUNDANCE				556	8	589	11	836	4	360	16	NA	2000
MIGRATORY SHOREBIRD SPECIES RICHNESS				11	5	11	6	13	4	7	3	NA	15
THREATENED, NEAR THREATENED & MIGRATORY BIRD SPECIES RICHNESS				12	6	12	7	14	4	7	3	-	-

^A Port of Townsville land comprises the following count areas: Rock Wall, Eastern Reclamation Area, Marine Precinct and STB1a to STB1c (Figure 2).^B Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act) Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC) and Least Concern (LC).^C Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). NA = Not available; '-' = Not applicable.

Table 5: Abundance of Threatened, Near Threatened and Migratory bird species recorded at high tide on Port of Townsville land^A (PoT) and on the sand spit (SS) during the 2018/19 survey period (counts that exceed thresholds for national significance are shaded)

Common Name	Scientific Name	Status ^B		October 2018 (recon) ^C	October 2018		November 2018		December 2018		January 2019		Significance Thresholds ^D	
		EPBC Act	NC Act	SS	PoT	SS	PoT	SS	PoT	SS	PoT	SS	International	National
Beach Stone Curlew	<i>Esacus magnirostris</i>	-	V	0	2	0	3	0	3	0	0	0	NA	NA
Common Sandpiper	<i>Actitis hypoleucos</i>	M	SLC	0	2	0	1	0	2	0	0	0	1900	190
Ruddy Turnstone	<i>Arenaria interpres</i>	M	SLC	2	0	0	0	0	0	0	0	0	300	30
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	138	1	313	5	263	51	0	42	0	850	85
Red Knot	<i>Calidris canutus</i>	E/M	E	0	0	2	0	0	0	0	0	0	1100	110
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	497	522	173	391	51	445	0	10	0	4750	475
Great Knot	<i>Calidris tenuirostris</i>	CE/M	E	403	0	750	0	993	0	729	0	576	4250	425
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	48	2	3	97	0	181	0	274	0	2000	200
Lesser Sand Plover	<i>Charadrius mongolus</i>	E/M	E	187	5	2	64	0	115	0	0	0	1800	180
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	111	7	53	2	79	6	10	5	0	NA	NA
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	3	9	3	20	6	22	0	27	0	NA	NA
Western Alaskan Bar-tailed Godwit	<i>Limosa lapponica baueri</i>	V/M	V	0	0	216	0	203	0	263	0	218	3250	325
Eastern Curlew	<i>Numenius madagascariensis</i>	CE/M	E	96	0	163	0	128	1	174	0	7	350	35
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	211	4	77	2	232	3	159	1	15	650	65
Pacific Golden Plover	<i>Pluvialis fulva</i>	M	SLC	30	0	15	0	16	0	34	0	17	1200	120
Grey Plover	<i>Pluvialis squatarola</i>	M	SLC	2	0	3	0	0	0	0	0	0	800	80
Little Tern	<i>Sternula albifrons</i>	M	SLC	29	2	33	3	30	3	67	0	0	NA	NA
Crested Tern	<i>Thalasseus bergii</i>	M	SLC	21	1	58	0	3	1	17	0	0	NA	NA
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SLC	27	0	5	1	24	0	0	0	0	700	70
Common Greenshank	<i>Tringa nebularia</i>	M	SLC	0	1	0	3	0	2	0	1	0	1100	110
Terek Sandpiper	<i>Xenus cinereus</i>	M	SLC	0	0	0	0	0	4	0	0	0	500	500
MIGRATORY SHOREBIRD SPECIES ABUNDANCE				1805	556	1869	589	2028	836	1453	360	833	NA	2000
MIGRATORY SHOREBIRD SPECIES RICHNESS				15	11	16	11	12	13	8	7	5	NA	15
THREATENED, NEAR THREATENED & MIGRATORY BIRD SPECIES RICHNESS				15	12	16	12	12	14	8	7	5	-	-

^A Port of Townsville comprises the following count areas: Rock Wall, Eastern Reclamation Area, Marine Precinct and STB1a to STB1c (**Figure 2**).^B Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act) Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC) and Least Concern (LC).^C Results of reconnaissance survey 23 October 2018.^D Significance thresholds with reference to DEWHA (2009) and Hansen et al. (2016). NA = Not available. '-' = Not applicable.

Between 23% and 30% (average = 28%, n = 4) of the local Migratory bird population used PoT (primarily for roosting) at high tide, with the majority of the local population using the sand spit (average 72%, n = 4) (**Table 6**). Within PoT, Migratory bird abundances at high tide were generally greatest in the Eastern Reclamation Area, and on average 22% of the local population used this area (**Table 6**).

Table 6: Proportion of local Migratory bird population recorded at high tide on Port of Townsville land^A and on the sand spit during the 2018/19 survey period

	Port of Townsville				Sand Spit
	STB	MP	ER	RW	
October 2018	<1%	22%	<1%	<1%	77%
November 2018	<1%	2%	20%	<1%	77%
December 2018	<1%	1%	35%	<1%	63%
January 2019	<1%	0%	30%	0%	70%
Average	<1%	6%	22%	<1%	72%

^A Port of Townsville comprises the following count areas: Rock Wall (RW), Eastern Reclamation Area (ER), Marine Precinct (MP) and STB1a to STB1c (STB) (**Figure 2**).

4.2.3 Habitats and use patterns

Overview

Within the developed section of the PoT study area, the terrestrial habitats are man-made environments created by land reclamation. The fill material used in the reclamation areas includes marine sediments obtained during dredging for the PoT. Land reclamation is a gradual process and the PoT contains areas at various stages of reclamation. For example, the Eastern Reclamation Area contains areas at, or approaching, final ground surface levels as well as areas just below final levels. The lower lying habitats within the reclamation area are therefore transitional habitats and the use of these areas by birds will change throughout the reclamation process.

Seven general habitat types are identifiable within the study area. These habitats are listed below.

- Habitats within the developed sections of PoT:
 - Rock wall
 - Low lying areas subject to rainfall inundation
 - Sparsely vegetated raised ground
 - Grasslands
- Habitats immediately adjacent to the developed sections of PoT:
 - Estuarine and marine coastal waters
 - Intertidal banks
 - Sand spit.

The seven habitat types are described in more detail below.

Rock wall

The rock wall contains irregular-shaped boulders placed together to form a wall. As previously described, the seaward edge of the rock wall provides favourable habitat for molluscs and crabs, which are a food source for a variety of coastal bird species, and may also be used by waterbirds as perches for hunting, feeding and resting. The study area contains about 4.5 km of rock wall. A similar size area of rock wall occurs directly west of

the study area, near the mouth of Ross Creek (**Figure 1**). These man-made structures provide very similar habitats to naturally occurring rocky headlands and foreshores.

During the survey period, the rock walls along the Eastern Reclamation Area were used very little by birds. The recorded bird activity was limited to a single Sooty Oystercatcher. Small numbers of Common Greenshank (*Tringa nebularia*), Common Sandpiper and Whimbrel were regularly seen roosting along the rock walls of the Marine Precinct.

Low lying areas subject to rainfall inundation

Lower lying areas are present in sections of count areas ER3, ER5, ER6 and MP2 (**Figure 2**). These sites temporarily hold shallow water (for a period of weeks) following rainfall and are generally devoid of vegetation or support a very sparse coverage of ground cover species. Migratory shorebirds, such as Red-necked Stint and Whimbrel, were observed roosting regularly at high tide on the exposed clay pan in MP2. The latter species was only present in small numbers, while the former species was present in small numbers except in October 2018 when it was present in nationally significant abundance. These shorebirds were sighted irrespective of whether the site was holding water. A variety of waterbirds (eg Australian Pelican, Pacific Black Duck, Black-winged Stilt, Grey Teal and Caspian Tern⁵) were observed roosting, resting and feeding in the waters and exposed banks of ER3, ER5 and ER6 and their presence appeared unrelated to tides.

An Australian Pied Oystercatcher nest was observed in MP2. Australian Pied Oystercatchers are resident shorebirds that are not listed as Migratory, Threatened or Near Threatened.

Sparsely vegetated raised ground

This habitat includes count areas ER1, ER2, ER4, MP1 and sections of ER3 (**Figure 2**). ER1, ER2 and sections of ER3 were lower lying than ER4 and MP1 and hold shallow (<10 cm deep) water for short periods (days to weeks) after heavy rainfall. Ground surface levels in parts of ER1 and ER2 were raised higher between the October and December 2018 surveys, thereby reducing their water holding capacity. Small sections within these sites were lightly vegetated with various samphire species⁶ and Saltwater Couch (*Sporobolus virginicus*). Greater Sand-plover, Lesser Sand-plover, Red-capped Plover (*Charadrius ruficapillus*) and Sharp-tailed Sandpiper (*Calidris acuminata*) were regularly observed roosting at high tide on bare rubble in ER1 and/or ER2. The data suggests that this area was the primary roost for these smaller shorebird species in the local area during the 2018/19 survey period.

MP1 and ER4 are raised areas, which contain patchy vegetation and only contain puddles of surface water after heavy rain. MP1 was used infrequently by birds, except for Beach Stone-curlew, which was sighted regularly. Bird activity at ER4 was more erratic. Migratory shorebirds (Red-necked Stint and Sharp-tailed Sandpiper) were recorded there on one occasion. During the December 2018 survey, the area contained large numbers of other wetland birds (Silver Gull, Caspian Tern, Grey Teal) when standing water was present after sustained rainfall. This suggests that these areas might be a suitable secondary roost site for birds, including shorebirds.

⁵ Australian Pelican (*Pelecanus conspicillatus*), Pacific Black Duck (*Anas superciliosa*), Black-winged Stilt (*Himantopus himantopus*), Grey Teal (*Anas gracilis*) and Caspian Tern (*Hydroprogne caspia*).

⁶ Salt tolerant, low-growing, semi-woody plants many of which have succulent stems.

A subadult Beach Stone-curlew (NC Act, Vulnerable) was observed in MP1, which suggests that the species may breed in developed sections of PoT. A Red-capped Plover nest was observed in ER2. Red-capped Plovers are resident shorebirds that are not listed as Migratory, Threatened or Near Threatened.

Grasslands

The grassland areas comprise the sections of the Eastern Reclamation Area not described above. These areas contain dense patches of native and exotic grasses and forbs, and rarely contain ponded water. This habitat is mostly used by ground-dwelling specialist bird species, *eg* Golden-headed Cisticola (*Cisticola exilis*) and Australian Pipit (*Anthus novaeseelandiae*) and birds that hunt on the wing, *eg* Nankeen Kestrel (*Falco cenchroides*) and Welcome Swallow (*Hirundo neoxena*). Migratory shorebirds are unlikely to use this habitat. Many of the ground-dwelling specialist birds probably breed in the grasslands.

Estuarine and marine coastal waters

This habitat type refers to the inshore waters immediately adjacent to the PoT land. The marine waters adjacent to the rock wall were used infrequently and by very small numbers of birds; mainly Little Tern, Crested Tern and Silver Gull (*Chroicocephalus novaehollandiae*).

Intertidal banks/flats

Intertidal banks/flats (mud and sand with some areas of dense mangrove) occur along the northern and southern banks of the Ross River mouth and to the south in Cleveland Bay. These intertidal areas are predominantly used by shorebirds that forage at low tide. The only intertidal area surveyed during the current study was the section of Lot 773 on SP223346 between the Marine Precinct and Benwell Road, *ie* sites STB1a to STB1c (**Figure 2**). The exposed mud banks provide foraging habitat for migratory shorebirds. STB1c is mostly covered by mangrove forest and STB1b is partly covered by mangrove forest. This forest coverage reduces its suitability as foraging habitat for Migratory shorebirds. Migratory shorebirds were present in very small numbers in count areas STB1a to STB1c.

Sand spit

Suitable roost sites are important for the persistence of shorebirds in an area. During high tides, shorebirds congregate in mixed-species groups at their roost. The sand spit in the Ross River mouth is approximately 1.8 km long and divides into two sections during spring high tides. Most birds congregate at the south-eastern end of the sand spit though large numbers, especially Great Knots, also roost at the north-western end. The size of the sand spit allowed birds to move to different parts of the spit when disturbed. Over a thousand birds were recorded on the sand spit during each survey, except in January 2019 when 883 birds were recorded. The lower number in January 2019 was probably due to the very high tide that covered most of the sand spit. Seven shorebird species were present in nationally significant abundances during the survey period.

5. Discussion

5.1 Summary of results

Migratory shorebirds continue to use PoT during the spring and summer months, primarily at high tide when they are roosting. Foraging was rarely observed, suggesting the Migratory shorebirds using PoT acquire most of their sustenance from sites external to PoT. During the October 2018 to January 2019 survey period, the observed species richness of Migratory shorebirds (all species) at high tide on PoT ranged between seven and 13 species, and abundances ranged between 360 and 836 individuals. The smaller Migratory shorebird species were most abundant, with Red-necked Stint and Greater Sand Plover present in nationally significant abundances during the October 2018 and January 2019 surveys respectively.

5.2 Comparison with previous survey results and expected future changes

The total abundance of shorebirds recorded on PoT during the 2018/19 survey period are comparable to the abundances recorded by NRA (2012) in 2011/12 (**Table 7**). Comparison of abundances between the two studies should be interpreted with caution, largely because the survey timing and survey effort was not identical between the respective survey periods (2011/12: six surveys between November and February; 2018/19: four surveys between October and January). Further, the assessment of population trends is limited by the fact that only two data points (2011/12 and 2018/19) are available.

Table 7: Total abundance of Migratory shorebirds recorded on PoT during high tide and low tide surveys in the spring and summer months of 2011/12 (NRA 2012) and 2018/19 (this study)^A

	Survey Month							Total	Average
	Oct	Nov	Nov	Nov	Dec	Jan	Feb		
2011/12	NA	552	312	85	423	993	1001	3366	561
2018/19	564		600		840	376	NA	2380	595

^A: The timing and number of surveys for the 2011/12 study and the 2018/19 study differed. 'NA' = months where survey data is not available because no survey was conducted in that month.

The most abundant Migratory shorebird species on PoT across both 2011/12 and 2018/19 studies were Red-necked Stint, Sharp-tailed Sandpiper, Greater Sand Plover and Lesser Sand Plover (in order of highest to lowest abundance). Notable abundances of Western Alaskan Bar-tailed Godwit and Caspian Tern were also present during at least one survey event. All other species were present in relatively low abundances (*ie* <20 individuals per survey event) (**Appendix B**).

With respect to the above-mentioned species on PoT, Caspian Tern and Greater Sand Plover abundances in 2018/19 were higher than those recorded in 2011/12, Red-necked Stint abundances were comparable between the studies, and abundances of Lesser Sand Plover, Sharp-tailed Sandpiper and Western Alaskan Bar-tailed Godwit were lower. The apparent decline in Sharp-tailed Sandpiper and Western Alaskan Bar-tailed Godwit was particularly prominent, and most likely due to the substantial reduction (post-2011/12) in the area of their preferred foraging habitat (*ie* lower-lying and wet substrates) on PoT (in response to the land reclamation process). This habitat change also explains the absence during the 2018/19 study of Red-necked Stint on PoT at low tide (*ie* better foraging habitat occurred outside PoT).

There is no obvious explanation for the apparent changes in abundances for the other species or if the apparent changes fall within natural variation.

Migratory shorebird species composition and abundance is expected to continue to change on PoT in response to site-specific conditions and external influences. External influences include the likely continued decline of the EAA flyway shorebird population. As described in Clemens *et al.* (2016), factors outside of Australia are primarily responsible for this decline. This decline is evident locally, with the Migratory shorebird abundances on the Ross River sand spit showing a steady decrease (**Table 8**). With respect to site-specific conditions on PoT, the changes in habitat that will occur as the land reclamation and development process progresses will have the greatest impact on shorebird abundances. The end state of the Migratory shorebird population on PoT will depend on conditions, most notably the landforms, which remain once development is complete. The smaller Migratory shorebirds using PoT are relatively tolerant of human activity, and if suitable landforms remain in the final development landscape, then these species may continue to use PoT.

Table 8: Total abundance of Migratory shorebirds roosting at high tide on the sand spit in the mouth of Ross River

Survey Year and Reference	Months Sampled	Abundance Range	Average Abundance
2004 (NRA 2005)	November & December	3,243 – 6,552	4,898
2007/08 (NRA 2008)	December & January	2,541 – 5,392	3,655
2011/12 (NRA 2012)	November, December, January & February	1,277 – 2,765	1,878
2018/19 (this study)	October, November, December & January	833 – 2,028	1,598

The apparent tolerance that some of the smaller Migratory shorebirds have to human activity and disturbance was observed during the 2018/19 surveys. **Plates 1 to 3** show mixed-species flocks of small Migratory shorebirds roosting at high tide in a section of the Eastern Reclamation Area where recent earthworks had occurred and where active earthworks were occurring nearby. The birds showed no obvious sign of concern to the surrounding activities.

5.3 Monitoring program review and future considerations

The sampling intensity implemented in this baseline assessment is generally consistent with the minimum effort recommended by DoEE (2017) for determining the presence of ‘important habitat’, *ie* four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area. DoEE (2017) recognises that replicate surveys over this period are important to measure population variability, and that in most cases one survey in December, two surveys in January, and one survey in February will be adequate. However, measuring local scale population changes at locations like the Ross River mouth, where shorebird populations may vary substantially daily or weekly, requires higher intensity sampling. Examples of this variability can be seen in the surveys conducted on the sand spit on 23 and 25 October 2018 (**Appendix A**) and in data collected by NRA (2008)⁷. Application of the sampling intensity reported in this baseline assessment during the construction period, together with general observations, will allow for detection of gross scale changes in, or impacts concerning, the Migratory bird population using PoT. However, the ability to decipher finer scale impacts from the natural background variation will be limited. Given development of the area and subsequent impacts on Migratory birds are

⁷ NRA (2008) reported variation in Migratory shorebird abundances on the Ross River mouth sand spit in December 2007 (four surveys) and January 2008 (six surveys) as being between 2541 and 4466, and between 2838 and 5392, respectively.

approved under the EPBC Act, the existing sampling intensity may be acceptable; this should be determined in consultation with DoEE.

With regard to survey timing, the data collected at the Ross River sand spit during the current and previous studies (NRA 2005, 2008, 2012; and historical data⁸) indicates that Migratory bird abundance (all species combined) is greatest between September and January, peaking between November and January. On this basis the current survey timing (October to January) is appropriate. However, NRA (2012) reported the highest Migratory bird abundances on PoT during the January-February period (**Table 7**). The smaller Migratory shorebird species⁹ were the most abundant in this period and were recorded in nationally significant numbers (NRA 2012). There is insufficient data to know if these relatively high abundances late in the season are regular or unusual. Extending the sampling period to include February will help address this uncertainty.

⁸ NRA (2008) reviewed historical Migratory bird data for the period 1979 to 1998.

⁹ Red-necked Stint, Lesser Sand Plover and Sharp-tailed Sand Piper.



Plate 1: Mixed-species flock of Migratory shorebirds (mostly Greater Sand Plover) amongst construction work in the PoT Eastern Reclamation Area (20 December 2018)



Plate 2: Part of mixed-species flock of Migratory shorebirds (mostly Greater Sand Plover) shown in Plate 1 (20 December 2018)



Plate 3: Part of mixed-species flock of Migratory shorebirds (mostly Red-necked Stint and Sharp-tailed Sandpiper) amongst construction work in the PoT Eastern Reclamation Area (20 December 2018)

6. References

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Appendix A:
2018/19 Port Of Townsville
Shorebird Monitoring Project Raw
Data

Shorebird monitoring 2018/19 raw data for the Port of Townsville Eastern Reclamation Area count areas (ER1 to ER6; Figure 2)

Common Name	Scientific Name	Status ¹		Relevant Thresholds ²		October 2018 ³		November 2018 ³		December 2018 ³		January 2019 ³	
		EPBC Act	NC Act	Internationally Significant	Nationally Significant	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	850	85	0	0	5	0	51	0	42	0
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	4750	475	0	0	339	0	436	0	10	0
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2000	200	0	0	97	0	181	0	274	0
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	1800	180	0	0	64	0	115	0	0	0
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	N/A	N/A	7	0	1	0	0	0	5	0
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	N/A	N/A	8	0	20	0	22	1	27	11
Lesser Crested Tern	<i>Thalasseus bengalensis</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Australasian Pipit	<i>Anthus novaeseelandiae</i>	-	LC	-	-	1	0	1	0	0	0	0	0
Australian Pelican	<i>Pelecanus conspicillatus</i>	-	LC	-	-	10	0	3	0	9	0	5	2
Australian White Ibis	<i>Threskiornis molucca</i>	-	LC	-	-	0	1	0	0	0	0	0	0
Black-winged Stilt	<i>Himantopus himantopus</i>	-	LC	-	-	2	0	0	0	12	6	12	10
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Golden-headed Cisticola	<i>Cisticola exilis</i>	-	LC	-	-	0	0	0	0	0	0	0	2
Grey Teal	<i>Anas gracilis</i>	-	LC	-	-	1	0	0	0	28	27	173	214
Hardhead	<i>Aythya australis</i>	-	LC	-	-	0	0	0	0	0	0	0	1
Little Bronze-Cuckoo	<i>Chrysococyx minutillus</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Mangrove Gerygone	<i>Gerygone levigaster</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Masked Lapwing	<i>Vanellus miles</i>	-	LC	-	-	0	0	0	0	1	4	4	2
Nankeen Kestrel	<i>Falco cenchroides</i>	-	LC	-	-	0	2	1	1	0	0	0	0
Pacific Black Duck	<i>Anas superciliosa</i>	-	LC	-	-	2	5	0	0	0	1	2	19
Pied Cormorant	<i>Phalacrocorax varius</i>	-	LC	-	-	0	0	0	0	0	0	0	1
Plumed Whistling-duck	<i>Dendrocygna eytoni</i>	-	LC	-	-	0	0	0	0	19	2	0	0
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	LC	-	-	0	0	60	0	14	0	10	3
Rock Dove	<i>Columba livia</i>	-	I	-	-	0	0	0	3	0	2	0	0
Royal Spoonbill	<i>Platelea regia</i>	-	LC	-	-	0	1	4	0	0	0	0	0
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	-	-	0	0	0	0	237	41	184	92
Welcome Swallow	<i>Hirundo neoxena</i>	-	LC	-	-	0	0	0	0	2	0	0	0
All species	Species richness					7	4	11	2	17	8	12	11
	Max abundance					10	5	339	3	436	41	274	214
EPBC Act Migratory species	Species richness					2	0	6	0	5	1	5	1
	Max abundance					8	0	339	0	436	1	274	11
	All species abundance					15	0	526	0	805	1	358	11

¹ Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Introduced / not a native species (I).

² Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). N/A = no threshold value available for this species. ‘-’ = No EAA flyway threshold applicable to this species.

³ Species counts in bold exceed the 0.1% EAA flyway population threshold.

Shorebird monitoring 2018/19 raw data for the Port of Townsville Marine Precinct Area count areas (MP1 and MP2; Figure 2)

Common Name	Scientific Name	Status ¹		Relevant Thresholds ²		October 2018 ³		November 2018 ³		December 2018 ³		January 2019 ³	
		EPBC Act	NC Act	Internationally Significant	Nationally Significant	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	850	85	1	0	0	0	0	0	0	0
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	4750	475	522	0	52	0	9	0	0	0
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2000	200	2	0	0	0	0	0	0	0
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	1800	180	5	0	0	0	0	0	0	0
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	N/A	N/A	0	0	1	0	6	0	0	0
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	350	35	0	0	0	0	1	0	0	0
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	650	65	2	0	1	0	2	0	0	0
Little Tern	<i>Sternula albifrons</i>	M	SLC	N/A	N/A	0	0	0	0	2	0	0	0
Common Greenshank	<i>Tringa nebularia</i>	M	SLC	1100	110	0	0	0	0	0	1	0	0
Beach Stone Curlew	<i>Esacus magnirostris</i>	-	V	-	-	2	1	3	0	3	0	0	0
Australasian Pipit	<i>Anthus novaeseelandiae</i>	-	LC	-	-	0	0	1	1	2	2	0	0
Black-winged Stilt	<i>Himantopus himantopus</i>	-	LC	-	-	0	0	0	0	5	5	2	1
Grey Teal	<i>Anas gracilis</i>	-	LC	-	-	0	0	0	0	3	0	5	4
Little Egret	<i>Egretta garzetta</i>	-	LC	-	-	0	0	0	0	0	0	0	1
Masked Lapwing	<i>Vanellus miles</i>	-	LC	-	-	0	0	0	0	0	1	0	1
Pacific Black Duck	<i>Anas superciliosa</i>	-	LC	-	-	0	0	0	0	0	0	2	3
Peaceful Dove	<i>Geopelia striata</i>	-	LC	-	-	0	0	0	0	1	9	0	0
Pied Oystercatcher	<i>Haematopus longirostris</i>	-	LC	-	-	2	2	1	0	0	2	2	0
Plumed Whistling-duck	<i>Dendrocygna eytoni</i>	-	LC	-	-	0	0	0	0	11	7	10	13
Rainbow Bee-eater	<i>Merops ornatus</i>	-	LC	-	-	0	0	1	1	0	0	0	0
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	LC	-	-	312	0	165	0	7	2	20	0
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	-	-	0	0	0	0	23	0	3	2
All species	Species richness					8	2	8	2	13	8	7	7
	Max abundance					522	2	165	1	23	9	20	13
EPBC Act Migratory species	Species richness					5	0	3	0	5	1	0	0
	Max abundance					522	0	52	0	9	1	0	0
	All species abundance					532	0	54	0	20	1	0	0

¹ Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Introduced / not a native species (I).

² Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). N/A = no threshold value available for this species. ‘-’ = No EAA flyway threshold applicable to this species.

³ Species counts in bold exceed the 0.1% EAA flyway population threshold.

Shorebird monitoring 2018/19 raw data for the Port of Townsville Rock Wall count areas (RW1 to RW9; Figure 2)

Common Name	Scientific Name	Status		Relevant Thresholds ²		October 2018 ³		November 2018 ³		December 2018 ³		January 2019 ³	
		EPBC Act	NC Act	Internationally Significant	Nationally Significant	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	N/A	N/A	1	0	0	0	0	0	0	0
Little Tern	<i>Sternula albifrons</i>	M	SLC	N/A	N/A	2	2	3	3	1	1	0	0
Crested Tern	<i>Thalasseus bergii</i>	M	SLC	N/A	N/A	1	0	0	0	1	0	0	4
Brahminy Kite	<i>Haliastur indus</i>	-	LC	-	-	0	2	0	0	0	2	0	1
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	-	-	2	1	1	2	1	0	0	0
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>	-	LC	-	-	0	1	0	1	0	1	0	0
Welcome Swallow	<i>Hirundo neoxena</i>	-	LC	-	-	1	0	0	0	3	0	0	0
White-breasted Woodswallow	<i>Artamus leucorynchus</i>	-	LC	-	-	0	0	0	0	0	1	0	0
All species	Species richness					5	4	2	3	4	4	0	2
	Max abundance					2	2	3	3	3	2	0	4
EPBC Act Migratory species	Species richness					3	1	1	1	2	1	0	1
	Max abundance					2	2	3	3	1	1	0	4
	All species abundance					4	2	3	3	2	1	0	4

¹ Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Introduced / not a native species (I).

² Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). N/A = no threshold value available for this species. ‘-’ = No EAA flyway threshold applicable to this species.

³ Species counts in bold exceed the 0.1% EAA flyway population threshold.

Shorebird monitoring 2018/19 raw data for the Port of Townsville count area between the Marine Precinct and Benwell Road (STB1a to STB1c; Figure 2)

Common Name	Scientific Name	Status ¹		Relevant Thresholds ²		October 2018 ³		November 2018 ³		December 2018 ³		January 2019 ³	
		EPBC Act	NC Act	Internationally Significant	Nationally Significant	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide
Common Sandpiper	<i>Actitis hypoleucos</i>	M	SLC	1900	190	2	0	1	2	2	0	0	0
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2000	200	0	3	0	0	0	0	0	0
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	1800	180	0	1	0	0	0	0	0	0
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	N/A	N/A	0	0	0	1	0	0	0	0
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	350	35	0	1	0	0	0	1	0	0
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	650	65	2	1	1	1	1	0	1	0
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SLC	700	70	0	0	1	1	0	0	0	0
Common Greenshank	<i>Tringa nebularia</i>	M	SLC	1100	110	1	0	3	3	2	0	1	1
Terek Sandpiper	<i>Xenus cinereus</i>	M	SLC	500	50	0	0	0	0	4	0	0	0
Beach Stone Curlew	<i>Esacus magnirostris</i>	-	V	-	-	0	0	0	2	0	0	0	0
Australian White Ibis	<i>Threskiornis molucca</i>	-	LC	-	-	0	2	0	0	1	1	0	0
Black-winged Stilt	<i>Himantopus himantopus</i>	-	LC	-	-	0	3	3	0	0	1	0	0
Brown Honeyeater	<i>Lichmera indistincta</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Eastern Great Egret	<i>Ardea modesta</i>	-	LC	-	-	0	0	0	0	1	0	0	0
Intermediate Egret	<i>Ardea intermedia</i>	-	LC	-	-	0	1	0	0	0	0	0	0
Little Egret	<i>Egretta garzetta</i>	-	LC	-	-	0	2	0	1	0	1	0	0
Mangrove Gerygone	<i>Gerygone levigaster</i>	-	LC	-	-	0	0	0	0	2	2	0	0
Mangrove Honeyeater	<i>Gavicalis fasciogularis</i>	-	LC	-	-	3	0	1	0	3	4	0	2
Masked Lapwing	<i>Vanellus miles</i>	-	LC	-	-	0	2	0	0	0	0	0	0
Pied Oystercatcher	<i>Haematopus longirostris</i>	-	LC	-	-	0	0	1	0	0	0	0	0
Rainbow Bee-eater	<i>Merops ornatus</i>	-	LC	-	-	0	0	0	0	4	0	0	0
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	LC	-	-	0	0	2	2	0	0	0	0
Royal Spoonbill	<i>Platylea regia</i>	-	LC	-	-	0	0	0	0	0	1	0	0
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	-	-	0	2	0	12	0	18	0	0
Striated Heron	<i>Butorides striata</i>	-	LC	-	-	0	1	1	0	1	0	0	1
Welcome Swallow	<i>Hirundo neoxena</i>	-	LC	-	-	0	0	0	0	0	4	0	0
White faced heron	<i>Egretta novaehollandiae</i>	-	LC	-	-	1	1	0	0	0	0	0	0
White-breasted Woodswallow	<i>Artmaus leucorhynchus</i>	-	LC	-	-	0	0	1	0	0	0	0	0
All species	Species richness					5	12	10	9	11	9	2	3
	Max abundance					3	3	3	12	4	18	1	2
EPBC Act Migratory species	Species richness					3	4	4	5	4	1	2	1
	Max abundance					2	3	3	3	4	1	1	1
	All species abundance					5	6	6	8	9	1	2	1

¹ Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Introduced / not a native species (I).

² Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). N/A = no threshold value available for this species. ‘-’ = No EAA flyway threshold applicable to this species.

³ Species counts in bold exceed the 0.1% EAA flyway population threshold.

Shorebird monitoring 2018/19 raw data for the Ross River mouth sand spit (Figure 2)

Common Name	Scientific Name	Status ¹		Relevant Thresholds ²		October 2018 ³	November 2018 ³	December 2018 ³	January 2019 ³
		EPBC Act	NC Act	Internationally Significant	Nationally Significant				
Ruddy Turnstone	<i>Arenaria interpres</i>	M	SLC	300	30	0	0	0	0
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SLC	850	85	313	263	0	0
Red Knot	<i>Calidris canutus</i>	E, M	E	1100	110	2	0	0	0
Red-necked Stint	<i>Calidris ruficollis</i>	M	SLC	4750	475	173	51	0	0
Great Knot	<i>Calidris tenuirostris</i>	CE, M	E	4250	425	750	993	729	576
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2000	200	3	0	0	0
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	1800	180	2	0	0	0
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SLC	N/A	N/A	53	79	10	0
Caspian Tern	<i>Hydroprogne caspia</i>	M	SLC	N/A	N/A	3	6	0	0
Western Alaskan Bar-tailed Godwit	<i>Limosa lapponica baueri</i>	V, M	V	3250	325	216	203	263	218
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	350	35	163	128	174	7
Whimbrel	<i>Numenius phaeopus</i>	M	SLC	650	65	77	232	159	15
Pacific Golden Plover	<i>Pluvialis fulva</i>	M	SLC	1200	120	15	16	34	17
Grey Plover	<i>Pluvialis squatarola</i>	M	SLC	800	80	3	0	0	0
Little Tern	<i>Sternula albifrons</i>	M	SLC	N/A	N/A	33	30	67	0
Crested Tern	<i>Thalasseus bergii</i>	M	SLC	N/A	N/A	58	3	17	0
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SLC	700	70	5	24	0	0
Lesser Crested Tern	<i>Thalasseus bengalensis</i>	-	LC	N/A	N/A	13	2	9	0
Whiskered Tern	<i>Chlidonias hybrida</i>	-	LC	-	-	2	0	0	0
Australian Pelican	<i>Pelecanus conspicillatus</i>	-	LC	-	-	6	0	1	1
Australian White Ibis	<i>Threskiornis molucca</i>	-	LC	-	-	1	0	0	0
Eastern Great Egret	<i>Ardea modesta</i>	-	LC	-	-	0	0	0	0
Grey Teal	<i>Anas gracilis</i>	-	LC	-	-	42	61	0	0
Little Egret	<i>Egretta garzetta</i>	-	LC	-	-	0	0	0	0
Pacific Black Duck	<i>Anas superciliosa</i>	-	LC	-	-	18	0	0	0
Pied Oystercatcher	<i>Haematopus longirostris</i>	-	LC	-	-	7	4	0	12
Red-capped Plover	<i>Charadrius ruficapillus</i>	-	LC	-	-	4	2	0	0
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	-	LC	-	-	37	68	1	0
Striated Heron	<i>Butorides striata</i>	-	LC	-	-	1	0	0	0
White-faced Heron	<i>Egretta novaehollandiae</i>	-	LC	-	-	0	0	0	0
All species	Species richness					26	17	11	7
	Max abundance					750	993	729	576
EPBC Act Migratory species	Species richness					16	12	8	5
	Max abundance					750	993	729	576
	All species abundance					1869	2028	1453	833

¹ Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC), Least Concern (LC), Introduced / not a native species (I).

² Significance thresholds with reference to DEWHA (2009) and Hansen *et al.* (2016). N/A = no threshold value available for this species. ‘-’ = No EAA flyway threshold applicable to this species.

³ Species counts in bold exceed the 0.1% EAA flyway population threshold.

Appendix B:
2011/12 and 2018/19 Migratory
Shorebird Survey Results for Port
of Townsville

2011/12 and 2018/19 Migratory Shorebird Survey Results for Port of Townsville

Common Name	Scientific Name	Status ^A		Survey Month ^C								Total
		EPBC Act	NC Act	Year ^B	Oct	Nov	Nov	Nov	Dec	Jan	Feb	
Red-necked Stint	<i>Calidris ruficollis</i>	M	SL	2011/12	NA	133/170	NA/150	0/NA	6/242	608/10	597/11	1927
				2018/19	522/0	391/0	NA	NA	445/0	10/0	NA	1368
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M	SL	2011/12	NA	20/117	NA/99	40/NA	51/8	93/81	116/21	646
				2018/19	1/0	5/0	NA	NA	51/0	42/0	NA	99
Greater Sand Plover	<i>Charadrius leschenaultii</i>	V, M	V	2011/12	NA	2/0	NA/0	0/NA	1/0	20/3	21/0	47
				2018/19	2/3	97/0	NA	NA	181/0	274/0	NA	557
Lesser Sand Plover	<i>Charadrius mongolus</i>	E, M	E	2011/12	NA	0/5	NA/1	0/NA	2/8	142/0	143/46	347
				2018/19	5/1	64/0	NA	NA	115/0	0/0	NA	185
Western Alaskan Bar-tailed Godwit	<i>Limosa lapponica baueri</i>	V, M	V	2011/12	NA	31/18	NA/37	9/NA	0/14	0/0	1/14	124
				2018/19	0/0	0/0	NA	NA	0/0	0/0	NA	0
Caspian Tern	<i>Hydroprogne caspia</i>	M	SL	2011/12	NA	11/0	NA/3	3/NA	19/1	5/0	7/0	49
				2018/19	9/0	20/0	NA	NA	22/1	27/11	NA	90
Common Greenshank	<i>Tringa nebularia</i>	M	SL	2011/12	NA	2/4	NA/3	11/NA	11/2	7/4	7/1	52
				2018/19	1/0	3/3	NA	NA	2/1	1/1	NA	12
Whimbrel	<i>Numenius phaeopus</i>	M	SL	2011/12	NA	12/4	NA/4	1/NA	6/6	2/1	3/3	42
				2018/19	4/1	2/1	NA	NA	3/0	1/0	NA	12
Grey-tailed Tattler	<i>Tringa brevipes</i>	M	SL	2011/12	NA	2/4	NA/9	11/NA	6/3	0/3	0/3	41
				2018/19	0/0	1/1	NA	NA	0/0	0/0	NA	2
Little Tern	<i>Sternula albifrons</i>	M	SL	2011/12	NA	6/0	NA/1	8/NA	0/2	5/0	0/0	22
				2018/19	2/2	3/3	NA	NA	3/1	0/0	NA	14
Great Knot	<i>Calidris tenuirostris</i>	CE, M	SL	2011/12	NA	0/0	NA/0	0/NA	0/25	0/0	0/0	25
				2018/19	0/0	0/0	NA	NA	0/0	0/0	NA	0
Gull-billed Tern	<i>Gelochelidon nilotica</i>	M	SL	2011/12	NA	0/1	NA/1	0/NA	1/3	0/4	0/3	13
				2018/19	7/0	2/1	NA	NA	6/0	5/0	NA	21
Eastern Curlew	<i>Numenius madagascariensis</i>	CE, M	E	2011/12	NA	2/7	NA/2	1/NA	1/3	0/1	0/3	20
				2018/19	0/1	0/0	NA	NA	1/1	0/0	NA	3
Common Sandpiper	<i>Actitis hypoleucos</i>	M	SL	2011/12	NA	1/0	NA/2	1/NA	0/1	2/0	0/0	7
				2018/19	2/0	1/2	NA	NA	2/0	0/0	NA	7
Beach Stone Curlew	<i>Esacus magnirostris</i>	-	V	2011/12	NA	0/0	NA/0	0/NA	0/0	0/0	2/0	2
				2018/19	2/1	3/2	NA	NA	3/0	0/0	NA	11

Common Name	Scientific Name	Status ^A		Survey Month ^C								Total
		EPBC Act	NC Act	Year ^B	Oct	Nov	Nov	Nov	Dec	Jan	Feb	
Crested Tern	<i>Thalasseus bergii</i>	M	SL	2011/12	NA	0/0	0/0	0/0	0/0	0/0	0/0	0
				2018/19	1/0	0/0	NA	NA	1/0	0/4	NA	6
Terek Sandpiper	<i>Xenus cinereus</i>	M	SL	2011/12	NA	0/0	NA/0	0/NA	0/1	0/1	0/0	2
				2018/19	0/0	0/0	NA	NA	4/0	0/0	NA	4
Marsh Sandpiper	<i>Tringa stagnatilis</i>	M	SL	2011/12	NA	0/0	NA/0	0/NA	0/0	0/0	0/1	1
				2018/19	0/0	0/0	NA	NA	0/0	0/0	NA	0
Curlew Sandpiper	<i>Calidris ferruginea</i>	CE, M	E	2011/12	NA	0/0	NA/0	0/NA	0/0	1/0	0/0	1
				2018/19	0/0	0/0	NA	NA	0/0	0/0	NA	0

^A: Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), Queensland *Nature Conservation Act* 1994 (NC Act): Critically Endangered (CE), Endangered (E), Vulnerable (V), Near Threatened (NT), Migratory (M), Special Least Concern (SLC) and Least Concern (LC). Status at 3 April 2019.

^B: Survey timing. 2011/12 = NRA (2012). 2018/19 = this study.

^C: Abundance data presented for High/Low tide surveys. The timing and number of surveys for the 2011/12 study and the 2018/19 study differed. 'NA' = months where survey data is not available.



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