

# Shorebird Conservation Plan Surveys 2025/26

## Maroochy River Estuary and Golden Beach

Final Report

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**Cover photo:** Flock of critically endangered Far Eastern Curlew roosting at the entrance to Pumicestone Passage, Golden Beach. Photo: Simone Bosshard.

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## Executive Summary

### Background

Sunshine Coast Council (SCC) has developed a Shorebird Conservation Program that is designed to raise awareness and educate the public around shorebirds, to manage and protect shorebird habitat, and to provide management solutions to reduce threats for shorebird conservation. The Program has a particular focus on important habitat for migratory and resident shorebirds that gather in large numbers on the sandbanks and mudflats of the lower Maroochy River and the northern Pumicestone Passage at Golden Beach, the latter being part of the Moreton Bay Ramsar site of international significance for shorebirds.

The key objectives of the Shorebird Conservation Program are to:

- Recognise and protect current and future high value shorebird habitat.
- Understand and effectively address threats to shorebirds on the Sunshine Coast.
- Ensure management is evidence-based and informed by contemporary research and knowledge of shorebirds on the Sunshine Coast.
- Achieve shorebird conservation through education, advocacy and partnerships with the community and expert advocacy groups.
- Ensure local shorebird conservation supports conservation efforts throughout the EAAF through international collaboration and partnerships.

During the 2020/21 to 2024/25 seasons, BAAM completed several surveys at both low tide (surveying shorebird use of feeding habitat) and high tide (surveying shorebird use of roost sites) in the lower Maroochy River and at the Caloundra Banks at Golden Beach in the northern Pumicestone Passage. At the same time, SCC has implemented strategies to manage disturbance to shorebirds on the lower Maroochy River and the configuration of shorebird habitats has been substantially altered at Golden Beach after heavy seas associated with Tropical Cyclone (TC) Seth broke a new channel entrance through the northern tip of Bribie Island (Breakthrough #1). During the 2025/26 shorebird season, the Office of the Coordinator General (OCG)/Department of State Development, Infrastructure and Planning (DSDIP) implemented the Bribie Island Emergency Works Project to close and manage major coastal breakthroughs (Breakthrough #2 and #3) following March 2025 Tropical Cyclone Alfred that accelerated erosion, vegetation loss, tidal inundation risk, and ecological degradation along the mainland shoreline, particularly at Golden Beach and Diamond Head. The emergency works involved dredging sand from several source locations within Pumicestone Passage to create stockpiles of sand that were then distributed by bulldozer to close Breakthroughs #2 and #3 and repair the landform of the ocean-facing dune system.

### Study Approach

This study aims to implement several key objectives of the Shorebird Conservation Program through a combination of:

- Conducting shorebird surveys of the lower Maroochy River and the Caloundra Banks to determine current shorebird distribution and habitat, identify which shorebird species are present, and determine the type and extent of disturbance; and
- Conducting an updated analysis of trends in shorebird use of high tide roost sites and low tide feeding habitat areas.

To assess whether emergency dredging works in the northern Pumicestone Passage at Golden Beach, Caloundra may be impacting on migratory shorebirds and their habitat, a before-after-control-impact (BACI) testing framework was used, with the ecologically similar lower Maroochy River estuary used as the control site.

## Key Results

### Lower Maroochy River

Tidal flats along the lower Maroochy River supported an average of 161 and a maximum of 253 migratory shorebirds in 2025/26, which is consistent with average counts of 109 to 164 and slightly greater than maximum counts of 146 to 196 over the previous years. Consistent with previous years, four migratory shorebird species dominated the counts: Pacific Golden Plover *Pluvialis fulva*, Eurasian Whimbrel *Numenius phaeopus*, Bar-tailed Godwit *Limosa lapponica baueri* and Far Eastern Curlew *Numenius madagascariensis*. Numbers of critically endangered Far Eastern Curlew decreased from an average of 8 (maximum 13) in 2020/21 to an average of 4.5 (maximum 5) in 2025/26. Numbers of endangered Bar-tailed Godwit have been variable, with averages of between 10 and 21 and maximum counts of between 15 and 52 over the past five years.

Five main roost sites used by shorebirds and other waterbirds occur in the lower Maroochy River: Goat Island (MRGI); Nojoor Road (MRNR); north shore (MRNS); sand bar (MRSB); and tree roost (MRTR). During the four surveys in 2025/26, shorebirds were recorded roosting at only MRGI and MRTR; no birds were recorded at MRNR or MRNS; some Eurasian Whimbrel and Grey-tailed Tattler *Tringa brevipes* appear to move between roosting at MRTR and MRGI, particularly in response to disturbance. The main roosting area at MRGI is a raised sandbank on the eastern side of Goat Island. An average total of 87 migratory shorebirds (range 72 to 97) roosted in the Maroochy River estuary in 2025/26, slightly higher than the averages of between 72 and 80 over the prior four years.

Analysis of Queensland Wader Study Group (QWSG) data shows that the north shore (MRNS) was the most important migratory shorebird roost site in the lower Maroochy River area up until 2004. Thereafter, Goat Island (MRGI) became increasingly used by shorebirds for roosting due to increasing disturbance along the north shore. Over the past six summer seasons, migratory shorebirds have only used Goat Island and MRTR for roosting. Also, the Pacific Golden Plovers that feed in the estuary at low tide have ceased roosting on the north shore and now appear to fly 3.5 km north to roost on the rocky shoreline of Mudjimba Island that lies 1 km offshore of Mudjimba. Disturbance pressure remains high at all roost sites in the lower Maroochy River estuary, with off-leash dogs continuing to disturb birds on Goat Island.

### Golden Beach

Six migratory shorebird species used tidal flats across the Golden Beach study area for foraging at low tide during the 2025/26 surveys, including up to 52 critically endangered Far Eastern Curlew and up to 235 endangered Bar-tailed Godwit. During the summer-season period, the average total migratory shorebird count was 299 birds, with a maximum count of 403. Across all four of the most commonly occurring species, the average number of individuals foraging within the study area through the summer months was substantially greater during the 2025/26 emergency works period than during the baseline surveys prior to the emergency works.

The BACI testing framework found a significant increase in the total migratory shorebird count at low tide at the impact site compared to the control site, controlling for an influence of tide height. Among individual species, there was significant change in the numbers of Bar-tailed Godwit and Pacific Golden Plover, but not for Far Eastern Curlew and Eurasian Whimbrel. For Bar-tailed Godwit, the direction of the change was positive i.e. there was a significant increase in the total during the period of the emergency works. For Pacific Golden Plover, the direction of the change was negative by

comparison with the control site, whereby there was a significant increase at the control site whereas numbers at the impact site remained the same. Overall, the tests found no significant negative impact of the emergency dredging works on use of the study area by migratory shorebirds for foraging at low tide, with some significant positive changes.

Seven migratory shorebird species used the study area for roosting at high tide during the 2025/26 surveys, including up to 52 critically endangered Far Eastern Curlew and up to 177 endangered Bar-tailed Godwit. During the summer-season period, the average total migratory shorebird count was 284 birds, with a maximum count of 347. Total migratory shorebird numbers recorded during the five summer-season surveys while the emergency dredging works were underway through 2025/26 were either within the range of counts recorded over the previous five years, or higher than the previous maximum count.

The BACI testing framework found a significant increase in the total migratory shorebird count at high tide at the impact site compared to the control site, controlling for an influence of tide height. Among individual species, there was significant change in the numbers of Bar-tailed Godwit and Pacific Golden Plover, but not for Far Eastern Curlew and Eurasian Whimbrel. For both Bar-tailed Godwit and Pacific Golden Plover, the direction of the change was positive i.e. there was a significant increase in the total count during the period of the emergency works. Overall, the tests found no significant negative impact of the emergency dredging works on use of the study area by migratory shorebirds for roosting at high tide, with some significant positive changes.

## Recommendations

### Lower Maroochy River

While it was historically one of the most important roost sites for shorebirds on the lower Maroochy River, the north shore (MRNS) has largely been abandoned as a roost site by shorebirds due to the high levels of disturbance by people using the sandy shoreline for recreation and walking dogs off-leash. Consequently, the sandy shoreline and sand bars on the eastern side of Goat Island (MRGI and MRSB) are currently the most important shorebird roost sites, which enjoy a moderate level of protection from disturbance by being accessible at high tide only by watercraft. Nonetheless, boaters with pets on board do regularly come ashore at Goat Island and walk their dogs, often off-leash, despite it being a Conservation Park where dogs are not allowed. The tidal flats on the eastern and western edges of Goat Island (MR06, MR04 and MR07) are also the most important feeding areas on the lower Maroochy River. While the MR04 and MR07 tidal flats are seldom visited by people, people regularly access the MR06 tidal flats via watercraft or wading/swimming across the southern channel at low tide, causing regular disturbance to feeding shorebirds, including by dogs being walked off-leash. The MR05 tidal flat is located close to a well-used sandy beach in a cove on the northern shore of the river. These disturbance pressures are expected to continue to increase as the human population of the region continues to grow. Recommended approaches for reducing disturbance to feeding and roosting shorebirds are provided.

Over the past several years, Sunshine Coast Council has worked to increase public awareness of shorebirds through temporary information signage and a variety of other approaches to raising public awareness, including information on Council's website, funding local artists to paint large murals of various shorebird species including interpretive signage on public toilet blocks, and presentations at a variety of community events. Continuation of these activities is encouraged. Given the high dependency of migratory shorebirds on a single roost site in the lower Maroochy River estuary, namely the sandbank on the eastern side of Goat Island, proactive management of disturbance to this location is recommended. Since Goat Island is part of the Maroochy River Conservation Park and managed by the Queensland Parks and Wildlife Service (QPWS), a collaborative approach involving QPWS is recommended.

## Golden Beach

The surveys through 2025/26 confirmed that the two most important migratory shorebird roost sites in the northern Pumicestone Passage are currently SBN2 and SBN3. Both the western and eastern sandbanks at SBN2 continue to be subject to regular human disturbance by recreational users of the area that can cause birds to move across the channel to SBN3 where they are generally subject to less disturbance risk. This highlights the importance of having at least two suitable roost sites in this area, so that the one can serve as an alternative roost site should birds be disturbed off the other. Recreational disturbance pressure is predicted to continue to increase as the region becomes more developed. Consequently, there is a need for proactive management of disturbance to shorebirds at the important roosting and feeding habitats at Caloundra that are identified above. Site-specific signage that clearly indicates the locations of the most frequently used high tide roosting areas to be avoided within the SBN1, SBN2, SBN3 and NTBI roost sites, together with an explanation of why disturbance to flocks of roosting birds should be avoided would be particularly useful in this context.

Given the importance of maintaining a suitable roosting area on SBN3, the final landform for this area that is being subject to restoration by the emergency works is recommended to include a broad, open sandy area on the water's edge that has a shallow slope to ensure birds can roost in shallow water on the shoreline edge on all high tides. The most suitable location for this roosting area would be at the northern tip of the final landform, bordering the new ocean entrance to Pumicestone Passage that was created by the first breakthrough. Natural coastal processes are likely to maintain a suitable open sandy area at this location.

The emergency dredging works avoided direct impacts on migratory shorebird foraging habitat by dredging sand from sub-tidal waters and not from adjoining tidal flat areas that are exposed at low tide. Future dredging works to maintain the restored coastal landforms is recommended to similarly focus on dredging sand from sub-tidal waters to avoid any direct impacts on tidal flats that provide important foraging habitat for migratory shorebirds within the Moreton Bay Ramsar site.

The monitoring found no evidence of a significant negative impact of the emergency dredging works over the short term i.e. during the period of the emergency works. Since it is possible that impacts of dredging on migratory shorebird food availability could manifest over a longer term following the completion of dredging, further monitoring is recommended to assess the longer-term impacts.

# Shorebird Conservation Plan Surveys 2025/26

## Maroochy River Estuary and Golden Beach

### Contents

|            |                                                         |           |
|------------|---------------------------------------------------------|-----------|
| <b>1.0</b> | <b>INTRODUCTION.....</b>                                | <b>1</b>  |
| 1.1        | Background.....                                         | 1         |
| 1.2        | Objectives of this Study .....                          | 2         |
| <b>2.0</b> | <b>STUDY APPROACH.....</b>                              | <b>2</b>  |
| 2.1        | Shorebird Survey Approach .....                         | 3         |
| 2.2        | Additional Surveys by SCC Staff.....                    | 3         |
| 2.3        | Assessment of Impacts .....                             | 3         |
| <b>3.0</b> | <b>RESULTS AND DISCUSSION.....</b>                      | <b>4</b>  |
| 3.1        | Survey Timing and Conditions.....                       | 4         |
| 3.2        | Lower Maroochy River .....                              | 4         |
| 3.2.1      | <i>Low tide surveys</i> .....                           | 4         |
| 3.2.2      | <i>High tide surveys</i> .....                          | 10        |
| 3.2.3      | <i>Disturbance</i> .....                                | 13        |
| 3.3        | Golden Beach, Caloundra .....                           | 14        |
| 3.3.1      | <i>Low tide surveys</i> .....                           | 14        |
| 3.3.2      | <i>Assessment of dredging impacts at low tide</i> ..... | 18        |
| 3.3.3      | <i>Disturbance at low tide</i> .....                    | 20        |
| 3.3.4      | <i>High tide surveys</i> .....                          | 20        |
| 3.3.5      | <i>Assessment of dredging impacts high tide</i> .....   | 24        |
| 3.3.6      | <i>Disturbance at high tide</i> .....                   | 26        |
| 3.4        | Sunshine Coast Council Surveys .....                    | 27        |
| <b>4.0</b> | <b>RECOMMENDATIONS .....</b>                            | <b>30</b> |
| 4.1        | Lower Maroochy River .....                              | 30        |
| 4.2        | Golden Beach .....                                      | 31        |
| <b>5.0</b> | <b>REFERENCES.....</b>                                  | <b>32</b> |

### Figures

- Figure 3.1: Locations of tidal flat shorebird feeding habitat areas on the lower Maroochy River
- Figure 3.2: Average migratory shorebirds using each of seven tidal flat areas in the lower Maroochy River estuary over the past four years
- Figure 3.3: Average total migratory shorebirds recorded roosting at high tide and feeding at low tide in the lower Maroochy River each summer and winter season
- Figure 3.4: Average total count of different shorebird species recorded roosting at high tide and feeding at low tide in the lower Maroochy River each summer, winter or throughout the year
- Figure 3.5: Locations of shorebird roost sites on the lower Maroochy River
- Figure 3.6: Average annual summer-season count of migratory shorebirds at high tide at each of four roost sites in the lower Maroochy River

- Figure 3.7: Locations of tidal flat shorebird feeding habitat areas at Golden Beach, Caloundra
- Figure 3.8: Average annual total migratory shorebird counts at Golden Beach at low tide during the summer non-breeding period over the years 1992/93 to 2024/25
- Figure 3.9: Predicted influence of site (impact, control), period (before, after) and low tide height on the total migratory shorebird count at low tide
- Figure 3.10: Predicted influence of site (impact, control) and period (before, after) controlling for low tide height on the total count at low tide of Far Eastern Curlew (A), Eurasian Whimbrel (B), Bar-tailed Godwit (C) and Pacific Golden Plover (D)
- Figure 3.11: Locations of shorebird roost sites at Caloundra
- Figure 3.12: Predicted influence of site (impact, control), period (before, after) and high tide height on the total migratory shorebird count at high tide
- Figure 3.13: Predicted influence of site (impact, control) and period (before, after) controlling for high tide height on the total count at high tide of Far Eastern Curlew (A), Eurasian Whimbrel (B), Bar-tailed Godwit (C) and Pacific Golden Plover (D)

## Appendices

- Appendix 1: Shorebird survey conditions

## Terms and Abbreviations

|          |                                                                                   |
|----------|-----------------------------------------------------------------------------------|
| BAAM     | Biodiversity Assessment and Management Pty Ltd                                    |
| DSDIP    | Department of State Development, Infrastructure and Planning                      |
| EAAF     | East Asian-Australasian Flyway                                                    |
| EPBC Act | Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> |
| GLM      | General Linear Model                                                              |
| NC Act   | Queensland <i>Nature Conservation Act 1992</i>                                    |
| OCG      | Office of the Coordinator General                                                 |
| QPWS     | Queensland Parks and Wildlife Service                                             |
| QWSG     | Queensland Wader Study Group                                                      |
| REMP     | Receiving Environment Monitoring Plan                                             |
| SCC      | Sunshine Coast Council                                                            |

# 1.0 INTRODUCTION

## 1.1 Background

Sunshine Coast Council (SCC) has developed a Shorebird Conservation Program that is designed to raise awareness and educate the public around shorebirds, to manage and protect shorebird habitat, and to provide management solutions to reduce threats for shorebird conservation. The Program has a particular focus on important habitat for migratory and resident shorebirds that gather in large numbers on the sandbanks and mudflats of the lower Maroochy River and the northern Pumicestone Passage at Golden Beach, the latter being part of the Moreton Bay Ramsar site of international significance for shorebirds.

The key objectives of the Shorebird Conservation Program are to:

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- Ensure local shorebird conservation supports conservation efforts throughout the EAAF through international collaboration and partnerships.

During the 2020/21 to 2024/25 seasons, BAAM completed several surveys at both low tide (surveying shorebird use of feeding habitat) and high tide (surveying shorebird use of roost sites) in the lower Maroochy River and at the Caloundra Banks at Golden Beach in the northern Pumicestone Passage. At the same time, SCC has implemented strategies to manage disturbance to shorebirds on the lower Maroochy River, and the configuration of shorebird habitats has been substantially altered at Golden Beach after heavy seas associated with Tropical Cyclone (TC) Seth broke a new channel entrance through the northern tip of Bribie Island in January 2022 (Breakthrough #1). In March 2025, heavy seas associated with another cyclone, TC Alfred caused a further two breakthroughs (Breakthrough #2 and #3) of Bribie Island to the south of Breakthrough #1. These breakthroughs altered the hydrological dynamics of the northern Pumicestone Passage and accelerated erosion, vegetation loss, tidal inundation risk, and ecological degradation along the mainland shoreline, particularly at Golden Beach and Diamond Head. In response to these risks, the Coordinator General (OCG)/Department of State Development, Infrastructure and Planning (DSDIP) implemented the Bribie Island Emergency Works Project to close and manage the coastal breakthroughs of Bribie Island ahead of the 2025/26 storm season. The OCG engaged Hall Contracting to perform emergency dredging works to close the breakthroughs as follows (International Coastal Management 2025, BMT 2025):

- Close Breakthroughs #2 and #3 by reconstructing dunes and forming erodible buffer zones stabilised with vegetation, requiring approximately 145,000 m<sup>3</sup> of sand (excluding losses).
- Reinstall the heavily eroded island segment between the new breakthroughs (Breakthrough #2 & #3) and Breakthrough #1, requiring approximately 450,000 m<sup>3</sup> of sand.
- Reopen the channel towards the old Caloundra Bar at the northern end of the Island to address navigational, water quality challenges and sediment accumulation, requiring approximately 17,000m<sup>3</sup> of sand to be removed.

The emergency works involved dredging sand from several source locations within Pumicestone Passage to create stockpiles of sand that were then distributed by bulldozer to close Breakthroughs #2 and #3 and repair the landform of the ocean-facing dune system. Vegetation plantings will

subsequently be undertaken to revegetate and stabilise the resulting dune landform. The dredging works commenced on 27 September 2025 and moved to 24/7 operations on 30 September. A second dredger was deployed on 29 November 2025. Dredging to reopen the channel towards the old Caloundra Bar commenced on 9 February 2026. Dredging works were completed on 19 March 2026 after over 1.1 million cubic metres of sand had been dredged to close the island breakthroughs and construct and reprofile an extensive sand erosion buffer standing approximately 5 m high (Office of the Coordinator-General 2026).

To monitor shorebird responses to management measures implemented by SCC, ongoing maintenance dredging at the Maroochy River mouth and the emergency works dredging at Golden Beach, SCC engaged BAAM to conduct further shorebird surveys of the lower Maroochy River estuary and Caloundra Banks at Golden Beach during the 2025/2026 summer period to monitor shorebird use of roost sites at high tide and tidal flat feeding habitats at low tide.

## 1.2 Objectives of this Study

The primary objectives of the study were to:

- conduct four high tide surveys and four low tide surveys across the lower Maroochy River estuary to monitor shorebird use of roost sites at high tide and tidal flat feeding habitats at low tide
- conduct five surveys of the Caloundra Banks at Golden Beach during the 2025/2026 summer period to monitor shorebird use of roost sites at high tide and tidal flat feeding habitats at low tide
- assess the type and extent of disturbance during the surveys; and
- conduct an updated analysis of trends in shorebird use of high tide roost sites and low tide feeding habitat areas, combining the survey data with historical data for the SCC local government area collected by the Queensland Wader Study Group (QWSG).

The QWSG is a special interest group of the Queensland Ornithological Society Incorporated that monitors shorebird populations in Queensland and conducts regular shorebird surveys of different parts of the Queensland coast that have large shorebird populations. The QWSG maintains a database of these shorebird survey data that is updated monthly. The surveys and review of count data supplied by the QWSG aims to provide information on the following:

- Shorebird statistics: total abundance; species observed; and species abundance;
- Shorebird behaviour: activity (roosting/foraging); and spatial data of foraging locations; and
- Frequency and type of disturbance observed.

## 2.0 STUDY APPROACH

The QWSG has historical data for roost sites and feeding areas monitored at both Golden Beach and the lower Maroochy River and still currently undertakes monthly monitoring of many of these sites. Therefore, the study approach combined an analysis of updated QWSG high tide and low tide data for the study area with field surveys of shorebirds using roost sites at high tide and tidal flat feeding habitats at low tide, as outlined in more detail below. Updated QWSG data were provided free of charge based on a data sharing agreement with the QWSG, whereby the raw data collected by the BAAM surveys are also provided to the QWSG for incorporation into the long-term QWSG database. This ensures the shorebird assessment is based on the best and most comprehensive available data, and data collected with SCC support contributes to appropriate and well curated long-term datasets.

## 2.1 Shorebird Survey Approach

Shorebird monitoring surveys were conducted at high tide (to record roosting birds at roost sites) and low tide (to record birds foraging on tidal flats). The surveys covered all known roost sites and tidal flat foraging habitat areas in the study area and combined observations conducted from a boat with observations from the shoreline. The use of a boat allowed access to areas that are problematic to survey from the shoreline due to the width of the open water channels. The surveys were not undertaken during periods of high rainfall or strong winds.

The surveys were conducted in accordance with migratory shorebird survey guidelines (Commonwealth of Australia 2015); specifically:

- The surveys for foraging shorebirds were conducted as close to the time of low tide as practicable and at a maximum of no more than two hours either side of low tide;
- The surveys for roosting shorebirds were conducted as close to the time of high tide as practicable and at a maximum of no more than two hours either side of high tide;
- The surveys were not undertaken during periods of high rainfall or strong winds;
- The surveys determined the total number of individuals of each species present, to enable assessment of site and habitat importance; and
- The surveys collected spatial data of the area used by shorebirds for roosting and feeding to facilitate mapping of roosting and foraging habitat.

Shorebirds were surveyed using a combination of a high-powered spotting telescope mounted on a secure tripod (on land) and high quality 10x40 binoculars (on the boat). The surveys determined the total number of individuals of each species present, to enable assessment of site and habitat importance, and collected spatial data of the area used by shorebirds for roosting to facilitate mapping of roost site extents. Sources of actual or potential disturbance observed within or close to each survey site (close enough to cause disturbance) were recorded as a count of people, dogs on leash, dogs off leash, drones and watercraft during a single observation sweep of the survey site to provide a snapshot in time as per the approach of Stigner *et al.* (2016). Disturbance is an event that causes birds to cease foraging or resting activities to become alert, start walking away from the source of disturbance or take flight in response to the disturbance.

The low tide surveys of the lower Maroochy River covered the full length and width of the lower Maroochy River from 1 km upstream of the Sunshine Motorway bridge through to the river mouth. The low tide surveys at Golden Beach covered the tidal flats on both sides of Pumicestone Passage from the Caloundra Bar south to Bell's Creek.

The surveys were undertaken by Dr Peter Driscoll (a shorebird specialist) with the assistance of Dr Simone Bosshard (Coastal Conservation and Planning Team Leader, SCC).

## 2.2 Additional Surveys by SCC Staff

SCC staff, under the supervision of Dr Simone Bosshard, conducted additional shorebird surveys at various locations along the Sunshine Coast. These surveys were conducted in accordance with the general survey methods outlined in **Section 2.1** above.

## 2.3 Assessment of Impacts

To assess whether the emergency dredging works in the northern Pumicestone Passage at Golden Beach, Caloundra may be impacting on migratory shorebirds and their habitat, a before-after-control-

impact (BACI) testing framework was used (Smokorowski & Randall 2017). The BACI framework requires a control monitoring site(s) outside the zone of potential impact. Given past evidence of the extensive movements of shorebirds between the different tidal flat areas within the northern Pumicestone Passage study area in response to tidal variation and in response to the relatively high levels of disturbance by recreational users of the study area, the whole of the study area was treated as the impact site. The ecologically similar lower Maroochy River estuary was used as the control site. The Maroochy River estuary has a similar ecological context to the Golden Beach, supporting tidal flats close the mouth of a major estuary. Located adjacent to major urban centres, the two sites share similar disturbance pressures. The species composition of the migratory shorebird community using the Maroochy River estuary is also more similar to that at Golden Beach than most other areas of Moreton Bay (Driscoll 1991, Thompson 1993, Lloyd et al. 2021, BAAM 2022b).

To test whether the emergency dredging works has influenced migratory shorebird use of the area, a general linear modelling (GLM) statistical testing approach implemented in R (R Core Team 2026) was used. The total number of shorebirds was treated as the dependent variable, with site (control, impact), treatment (before, after) and tide height as fixed effects. Tide height was included since shorebird use of an area may vary between neap and spring tide conditions. A site\*treatment interaction term was included to specifically test for an impact; when the interaction term is significant, it indicates a significant difference in the treatment (before impact vs after impact) between the impact site and control site.

## 3.0 RESULTS AND DISCUSSION

### 3.1 Survey Timing and Conditions

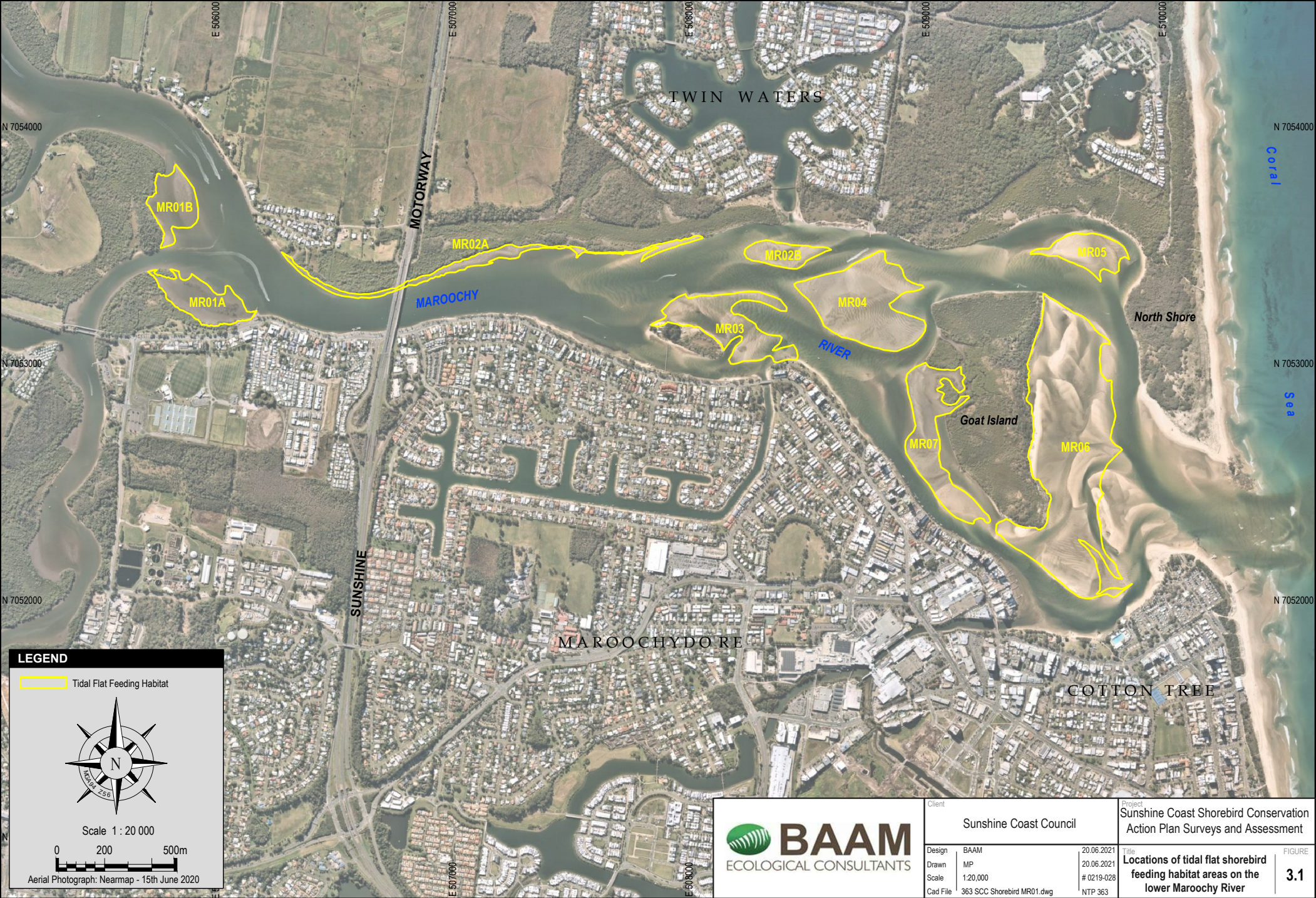
The survey dates and survey conditions during the surveys of the lower Maroochy River and Golden Beach are summarised in **Appendix 1**. All surveys were conducted during conditions that were suitable for conducting a shorebird survey.

### 3.2 Lower Maroochy River

#### 3.2.1 Low tide surveys

The four summer surveys of foraging shorebirds covered seven different areas of tidal flat exposed at low tide. The locations of these areas are shown in **Figure 3.1**. **Table 3.1** summarises the summer-season survey results over five seasons between 2020/21 and 2025/26. Tidal flats along the lower Maroochy River supported an average of 161 and a maximum of 253 migratory shorebirds in 2025/26, which is consistent with average counts of 109 to 164 and slightly greater than maximum counts of 146 to 196 over the previous years. Consistent with previous years, four migratory shorebird species dominated the counts: Pacific Golden Plover, Eurasian Whimbrel, Bar-tailed Godwit and Far Eastern Curlew. Numbers of critically endangered Far Eastern Curlew decreased from an average of 8 (maximum 13) in 2020/21 to an average of 4.5 (maximum 5) in 2025/26. Numbers of vulnerable Bar-tailed Godwit have been variable, with averages of between 10 and 21 and maximum counts of between 15 and 52 over the past five years (**Table 3.1**).

The most important tidal flat area for foraging migratory shorebirds has consistently been MR06 on the eastern side of two vegetated sand islands (Channel Island and Goat Island, hereafter referred to collectively as Goat Island) (**Table 3.1**, **Figure 3.2**). Other important tidal flats are MR04 and MR07, both on the western side of Goat Island.

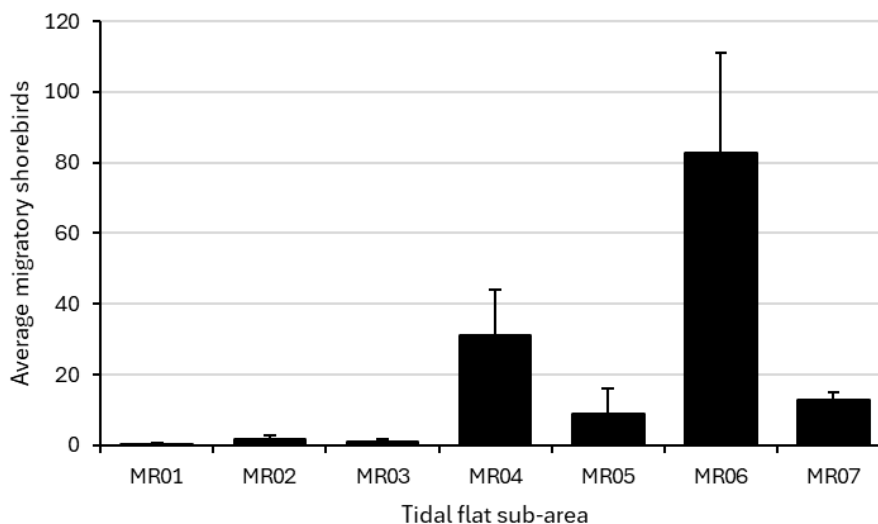


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**Table 3.1. Summary of migratory shorebird species and the average  $\pm$  1 standard deviation and maximum (in brackets) numbers recorded in each of the seven low tide survey areas (MR01 to MR07) during summer season surveys of the lower Maroochy River in 2020/21 (top row, 5 surveys), 2022/23 (second row, 4 surveys), 2023/24 (third row, 4 surveys), 2024/25 (fourth row, 4 surveys) and 2025/26 (fifth row, 4 surveys).**

| Name                          | EPBC* | NCA* | MR01              | MR02              | MR03              | MR04                 | MR05                 | MR06                  | MR07               | Total                 |
|-------------------------------|-------|------|-------------------|-------------------|-------------------|----------------------|----------------------|-----------------------|--------------------|-----------------------|
| Far Eastern Curlew            | M, CE | E    | 0                 | 1.0 $\pm$ 1.2 (3) | 0.2 $\pm$ 0.4 (1) | 1.2 $\pm$ 1.3 (3)    | 0                    | 4.4 $\pm$ 2.7 (8)     | 1.2 $\pm$ 0.8 (2)  | 8.0 $\pm$ 3.7 (13)    |
|                               |       |      | 0                 | 0                 | 0                 | 0.5 $\pm$ 0.6 (1)    | 0.3 $\pm$ 0.5 (1)    | 2.8 $\pm$ 1.3 (4)     | 1.0 $\pm$ 1.2 (2)  | 4.5 $\pm$ 1.3 (6)     |
|                               |       |      | 0                 | 0.3 $\pm$ 0.5 (1) | 0                 | 0.5 $\pm$ 0.6 (1)    | 0                    | 2.8 $\pm$ 0.5 (3)     | 0.5 $\pm$ 0.6 (1)  | 4.0 $\pm$ 0.8 (5)     |
|                               |       |      | 0                 | 0                 | 0                 | 0.5 $\pm$ 0.6 (1)    | 0.3 $\pm$ 0.5 (1)    | 1.8 $\pm$ 1.0 (3)     | 0.8 $\pm$ 0.5 (1)  | 3.3 $\pm$ 1.0 (4)     |
|                               |       |      | 0                 | 0                 | 0                 | 1.5 $\pm$ 1.3 (3)    | 0.3 $\pm$ 0.6 (1)    | 2.3 $\pm$ 0.5 (3)     | 0.5 $\pm$ 0.6 (1)  | 4.5 $\pm$ 0.6 (5)     |
| Eurasian Whimbrel             | M     | S    | 0.4 $\pm$ 0.9 (2) | 0.6 $\pm$ 0.5 (1) | 0.2 $\pm$ 0.4 (1) | 7.0 $\pm$ 2.5 (9)    | 1.2 $\pm$ 1.3 (3)    | 22.4 $\pm$ 5.3 (29)   | 3.4 $\pm$ 3.2 (8)  | 35.2 $\pm$ 8.5 (46)   |
|                               |       |      | 0.8 $\pm$ 1.0 (2) | 1.0 $\pm$ 0.8 (2) | 1.0 $\pm$ 1.4 (3) | 7.0 $\pm$ 2.9 (11)   | 0                    | 36.5 $\pm$ 24.1 (72)  | 6.5 $\pm$ 3.7 (9)  | 52.8 $\pm$ 21.3 (82)  |
|                               |       |      | 0                 | 1.0 $\pm$ 1.4 (3) | 1.5 $\pm$ 1.7 (3) | 11.5 $\pm$ 10.7 (27) | 1.0 $\pm$ 0.8 (2)    | 27.5 $\pm$ 5.9 (32)   | 8.3 $\pm$ 3.1 (11) | 50.8 $\pm$ 14.5 (71)  |
|                               |       |      | 0.3 $\pm$ 0.5 (1) | 1.3 $\pm$ 1.3 (3) | 0.5 $\pm$ 0.6 (1) | 12.5 $\pm$ 6.8 (20)  | 1.5 $\pm$ 1.0 (3)    | 17.0 $\pm$ 6.7 (27)   | 6.8 $\pm$ 0.5 (7)  | 39.8 $\pm$ 10.9 (55)  |
|                               |       |      | 0                 | 0                 | 0                 | 11.8 $\pm$ 14.9 (34) | 1.7 $\pm$ 1.5 (3)    | 30.3 $\pm$ 10 (42)    | 6.3 $\pm$ 4 (11)   | 49.5 $\pm$ 20.4 (80)  |
| Bar-tailed Godwit (W Alaskan) | M, E  | E    | 0                 | 1.0 $\pm$ 1.4 (3) | 0.6 $\pm$ 1.3 (3) | 13.4 $\pm$ 6.1 (23)  | 0                    | 4.2 $\pm$ 2.5 (6)     | 1.8 $\pm$ 2.7 (6)  | 21.0 $\pm$ 9.0 (35)   |
|                               |       |      | 0                 | 0                 | 0                 | 3.0 $\pm$ 2.4 (5)    | 0.3 $\pm$ 0.5 (1)    | 4.0 $\pm$ 6.2 (13)    | 3.3 $\pm$ 3.9 (8)  | 10.5 $\pm$ 8.2 (21)   |
|                               |       |      | 0                 | 0                 | 0.5 $\pm$ 1 (2)   | 7.3 $\pm$ 7.3 (17)   | 0                    | 10.0 $\pm$ 15.6 (33)  | 0                  | 17.8 $\pm$ 22.9 (52)  |
|                               |       |      | 0                 | 0.3 $\pm$ 0.5 (1) | 0                 | 7.3 $\pm$ 3.9 (13)   | 0                    | 2.3 $\pm$ 2.8 (6)     | 1.5 $\pm$ 1.9 (4)  | 11.8 $\pm$ 3.1 (16)   |
|                               |       |      | 0                 | 0                 | 0                 | 4.3 $\pm$ 1.3 (6)    | 0                    | 5.5 $\pm$ 4 (9)       | 0                  | 9.8 $\pm$ 5.1 (15)    |
| Pacific Golden Plover         | M     | S    | 0                 | 0                 | 0                 | 4.8 $\pm$ 6.7 (14)   | 0                    | 36.6 $\pm$ 24.1 (58)  | 2.8 $\pm$ 6.3 (14) | 44.2 $\pm$ 20.8 (65)  |
|                               |       |      | 0.3 $\pm$ 0.5 (1) | 1.5 $\pm$ 3.0 (6) | 0.3 $\pm$ 0.5 (1) | 10.5 $\pm$ 15.6 (33) | 11.5 $\pm$ 20.4 (42) | 22.5 $\pm$ 36.3 (76)  | 3.5 $\pm$ 7.0 (14) | 50.0 $\pm$ 52.1 (111) |
|                               |       |      | 0                 | 0                 | 0                 | 13.8 $\pm$ 24.3 (50) | 0                    | 72.3 $\pm$ 56.1 (133) | 2.3 $\pm$ 4.5 (9)  | 88.3 $\pm$ 60 (138)   |
|                               |       |      | 0                 | 1.0 $\pm$ 2.0 (4) | 0                 | 32.0 $\pm$ 24.8 (53) | 13.0 $\pm$ 20.8 (44) | 31.3 $\pm$ 40.1 (84)  | 0                  | 77.3 $\pm$ 52.0 (113) |
|                               |       |      | 0                 | 0                 | 0                 | 4.8 $\pm$ 7.1 (15)   | 11.7 $\pm$ 16.9 (31) | 75.3 $\pm$ 68.7 (153) | 4.5 $\pm$ 9 (18)   | 93.3 $\pm$ 65 (153)   |
| Greater Sand Plover           | M, V  | V    | 0                 | 0                 | 0                 | 0.4 $\pm$ 0.9 (2)    | 0                    | 0                     | 0                  | 0.4 $\pm$ 0.9 (2)     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
| Great Knot                    | M, V  | E    | 0                 | 0                 | 0                 | 0                    | 0                    | 0.4 $\pm$ 0.9 (2)     | 0                  | 0.4 $\pm$ 0.9 (2)     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
| Grey-tailed Tattler           | M     | S    | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 0                  | 0                     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 1.3 $\pm$ 2.5 (5)    | 0                     | 0.3 $\pm$ 0.5 (1)  | 1.5 $\pm$ 2.4 (5)     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 2.8 $\pm$ 3.8 (8)  | 2.8 $\pm$ 3.8 (8)     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 0                    | 0                     | 4.5 $\pm$ 4.1 (8)  | 4.5 $\pm$ 4.1 (8)     |
|                               |       |      | 0                 | 0                 | 0                 | 0                    | 1 $\pm$ 1.7 (3)      | 0                     | 2.8 $\pm$ 5.5 (11) | 3.5 $\pm$ 5.2 (11)    |

| Name                                      | EPBC* | NCA* | MR01               | MR02               | MR03                | MR04                  | MR05                  | MR06                    | MR07                  | Total                   |
|-------------------------------------------|-------|------|--------------------|--------------------|---------------------|-----------------------|-----------------------|-------------------------|-----------------------|-------------------------|
| Curlew<br>Sandpiper                       | M, CE | CE   | 0                  | 0                  | 0                   | 0                     | 0                     | 0                       | 0                     | 0                       |
|                                           |       |      | 0                  | 0                  | 0                   | 0                     | 0                     | 0                       | 0                     | 0                       |
|                                           |       |      | 0                  | 0                  | 0                   | 0                     | 0                     | 0                       | 0                     | 0                       |
|                                           |       |      | 0.3±0.5 (1)        | 0                  | 0                   | 0                     | 0                     | 0                       | 0                     | 0.3±0.5 (1)             |
|                                           |       |      | 0                  |                    |                     | 0                     | 0                     | 0                       | 0                     | 0                       |
| <b>Total<br/>migratory<br/>shorebirds</b> |       |      | <b>0.4±0.9 (2)</b> | <b>2.6±2.3 (5)</b> | <b>1±2.2 (5)</b>    | <b>26.8±10 (35)</b>   | <b>1.2±1.3 (3)</b>    | <b>68.0±29.8 (96)</b>   | <b>9.2±9.4 (25)</b>   | <b>109.2±36.3 (146)</b> |
|                                           |       |      | <b>1.0±1.2 (2)</b> | <b>2.5±2.4 (6)</b> | <b>1.3±1.3 (3)</b>  | <b>21.0±14.6 (42)</b> | <b>13.3±22.6 (47)</b> | <b>65.8±44.7 (115)</b>  | <b>14.5±10.8 (27)</b> | <b>119.3±42.4 (173)</b> |
|                                           |       |      | <b>0</b>           | <b>1.3±1.5 (3)</b> | <b>2.0±.2.4 (5)</b> | <b>33.0±20.3 (63)</b> | <b>1.3±1.0 (2)</b>    | <b>113.0±48.6 (167)</b> | <b>13.8±9.6 (28)</b>  | <b>164.3±47.8 (196)</b> |
|                                           |       |      | <b>0.5±1.0 (2)</b> | <b>2.5±2.6 (6)</b> | <b>0.5±0.6 (1)</b>  | <b>52.3±18.1 (66)</b> | <b>14.8±20.3 (45)</b> | <b>52.8±34.6 (99)</b>   | <b>13.5±4.8 (18)</b>  | <b>136.8±43.4 (181)</b> |
|                                           |       |      | <b>0</b>           |                    |                     | <b>22.3±13.6 (42)</b> | <b>14.7±18.9 (36)</b> | <b>113.3±75.7 (206)</b> | <b>14.0±10.5 (29)</b> | <b>160.5±76.3 (253)</b> |



**Figure 3.2. Average ( $\pm 1$  standard error) migratory shorebirds using each of seven tidal flat areas (MR1 to MR7) in the lower Maroochy River estuary over the past four years.**

Five species of migratory terns have been recorded using the lower Maroochy River estuary over the past five years (**Table 3.2**). This has mostly involved flocks of terns roosting on the MRGI and MRSB sand bars at both high tide and low tide, although a few individuals do also forage for fish over the open waters of the estuary. Large flocks of up to 3900 Common Tern and up to 350 Little Tern were regularly recorded. No breeding by terns occurs within or adjoining the estuary.

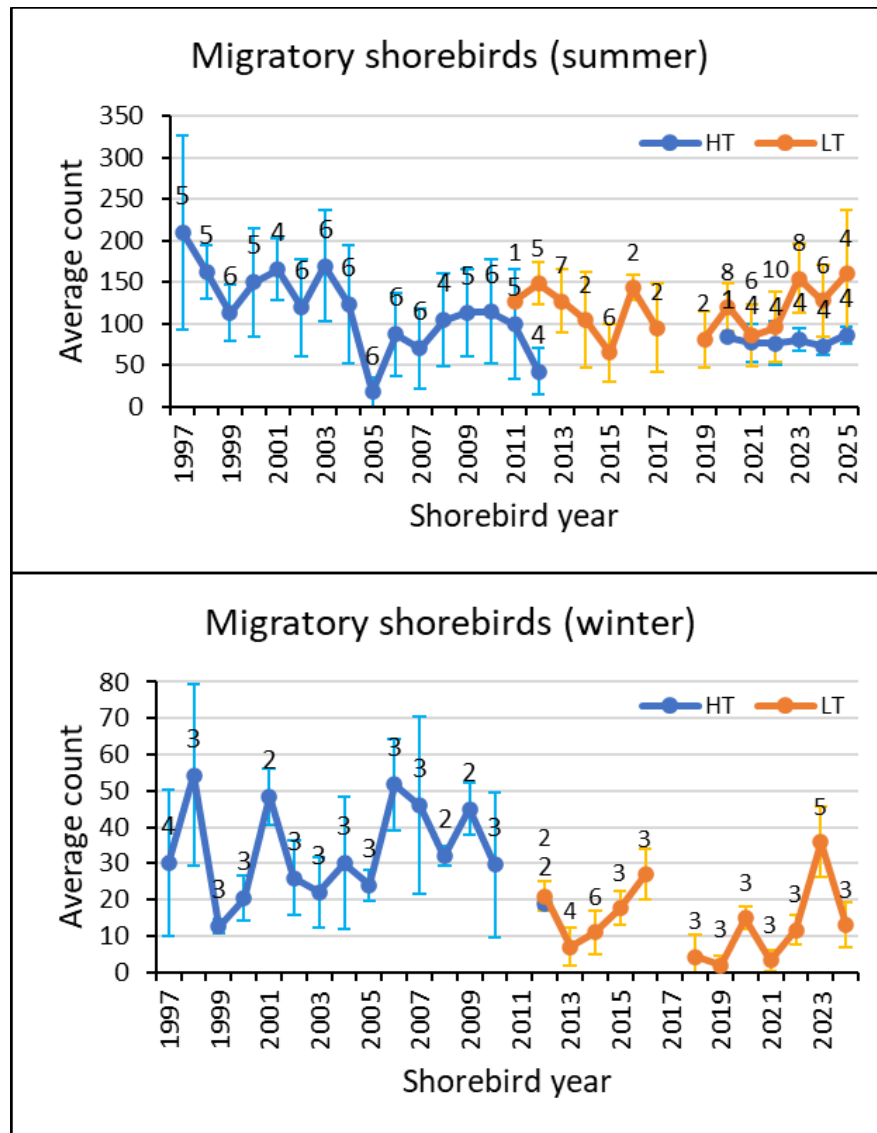
**Table 3.2. Summary of the average ( $\pm 1$ SD, with maximum count in parentheses) total number of migratory terns in the lower Maroochy River estuary during 44 summer surveys (including surveys by BAAM on behalf of SCC, and QWSG) at high tide and low tide over the past five years since 2020/21.**

| Common name       | Species                       | EPBC* | NCA* | High tide                | Low tide                  |
|-------------------|-------------------------------|-------|------|--------------------------|---------------------------|
| White-winged Tern | <i>Chlidonias leucopterus</i> | M     | SL   | 0                        | 12.4 $\pm$ 58.6 (304)     |
| Caspian Tern      | <i>Hydroprogne caspia</i>     | M     | SL   | 0.4 $\pm$ 1.5 (6)        | 0                         |
| Common Tern       | <i>Sterna hirundo</i>         | M     | SL   | 161.9 $\pm$ 441.9 (1700) | 702.2 $\pm$ 1044.8 (3900) |
| Little Tern       | <i>Sternula albifrons</i>     | V, M  | V    | 17.4 $\pm$ 38 (110)      | 53.3 $\pm$ 97.2 (350)     |
| Crested Tern      | <i>Thalasseus bergii</i>      | M     | SL   | 34.1 $\pm$ 37.6 (106)    | 128 $\pm$ 236.3 (865)     |

\* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): M = migratory; SL = special least concern (migratory); V = vulnerable.

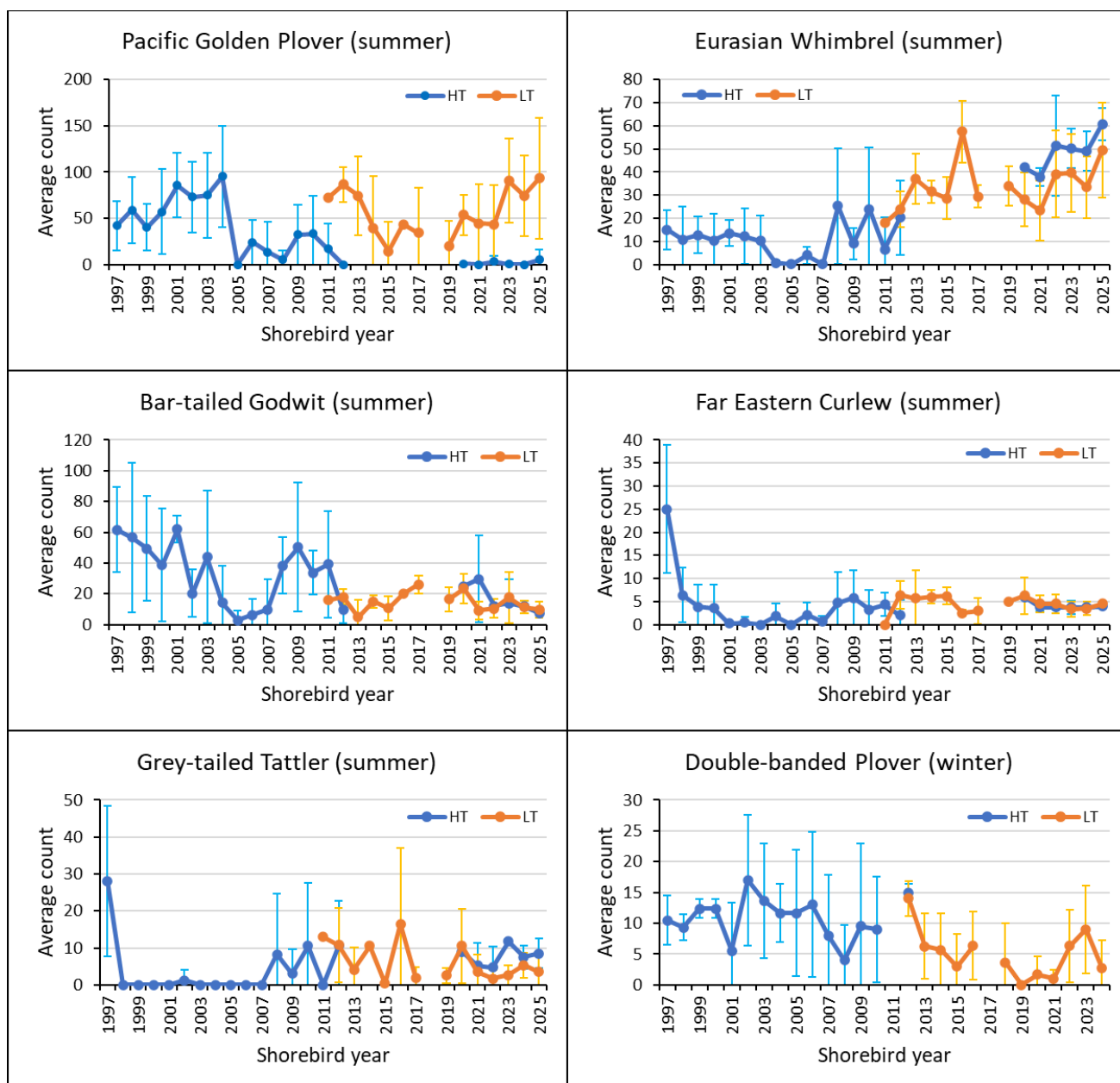
Estuaries along the Sunshine Coast, including at Caloundra, Noosa and Maroochydhore, are internationally significant roosting sites for both Common Tern and Little Tern, particularly at night, with most terns flying in from the ocean to roost in the late afternoon and early evening (Chan and Denning 2006, Chan *et al.* 2008).

The QWSG has undertaken regular low tide surveys of shorebirds feeding on the tidal flats of the lower Maroochy River (including areas MR02 to MR07) since the 2011 shorebird year. Combining the QWSG (including only counts within two hours of either low tide or high tide) and BAAM survey data, **Figure 3.3** shows the average total count of migratory shorebirds each summer (October to mid-March) and winter (May to August) season. Low tide counts have been variable between years, with no apparent trend (**Figure 3.3**). In years in which surveys at both low tide and high tide were undertaken, the average abundance of migratory shorebirds was generally greater at low tide than at high tide, suggesting that at least some of the birds that feed on the tidal flats along the lower Maroochy River do not roost within the lower Maroochy River.



**Figure 3.3. Average ( $\pm 1$  standard deviation) total migratory shorebirds recorded roosting at high tide (HT) and feeding at low tide (LT) in the lower Maroochy River each summer (October to mid-March) and winter (May to August) season based on QWSG data and this study. Number of counts each year shown above each point.**

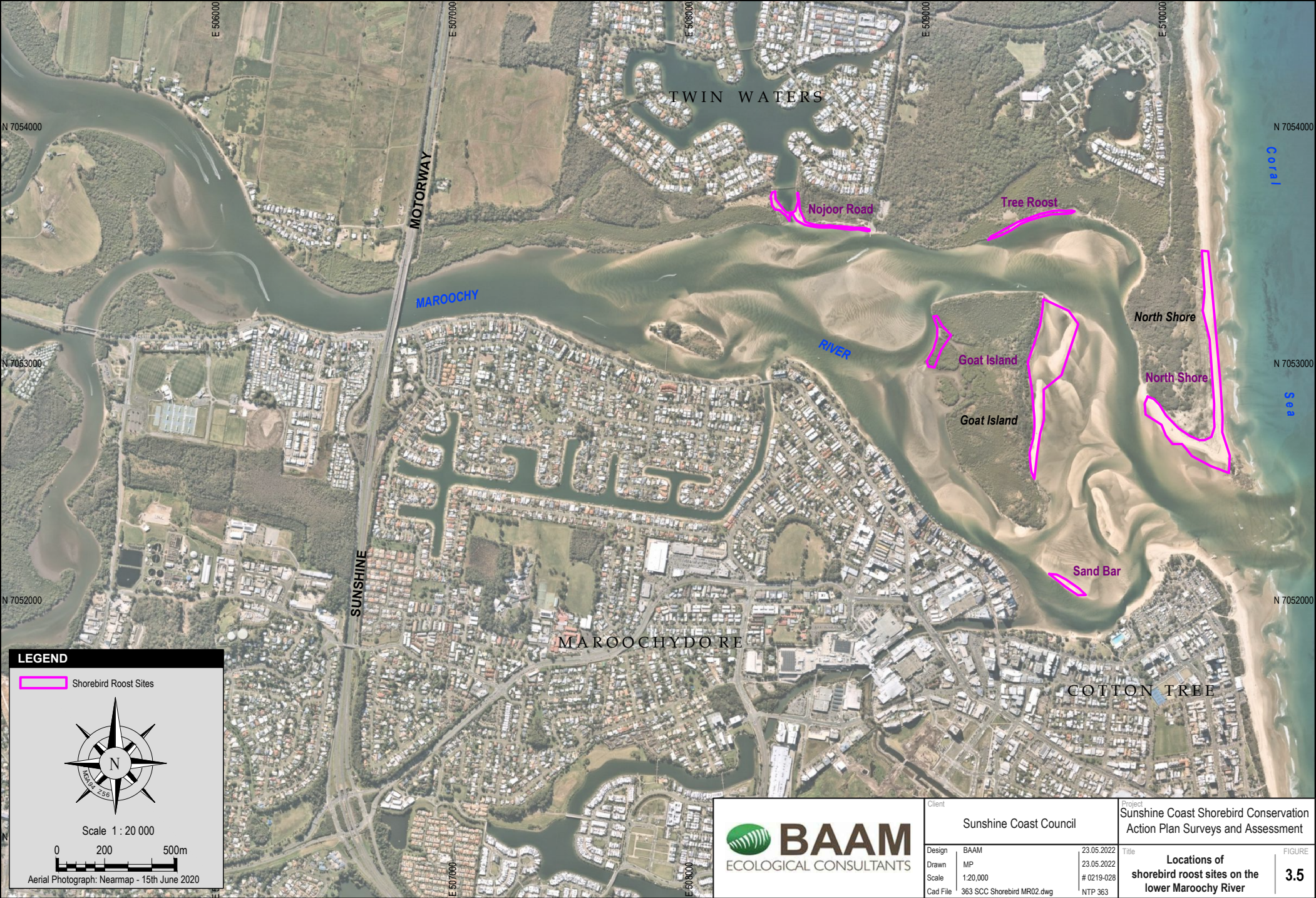
**Figure 3.4** shows the long-term trends in the average total counts of the most common migratory shorebirds each summer (October to mid-March: migratory shorebirds excluding Double-banded Plover) and winter (May to August: only Double-banded Plover). Low tide counts have been variable between years, with no apparent trends (**Figure 3.4**).



**Figure 3.4. Average (±1 standard deviation) total count of different shorebird species recorded roosting at high tide (HT) and feeding at low tide (LT) in the lower Maroochy River each summer (October to mid-March), winter (May to August) or throughout the year based on QWSG data and this study. Number of counts each year shown above each point.**

### 3.2.2 High tide surveys

Five main roost sites used by shorebirds and other waterbirds occur in the lower Maroochy River (see **Figure 3.5** for their current locations): Goat Island (MRGI); Nojoor Road (MRNR); north shore (MRNS); sand bar (MRSB); and tree roost (MRTR). During the four surveys in 2025/26, shorebirds were recorded roosting at only MRGI and MRTR; no birds were recorded at MRNR or MRNS; some Eurasian Whimbrel and Grey-tailed Tattler appear to move between roosting at MRTR and MRGI, particularly in response to disturbance (see **Table 3.4**). The main roosting area at MRGI is a raised sandbank on the eastern side of Goat Island. An average total of 87 migratory shorebirds (range 72 to 97) roosted in the Maroochy River estuary in 2025/26, slightly higher than the averages of between 72 and 80 over the prior four years (**Table 3.3**).



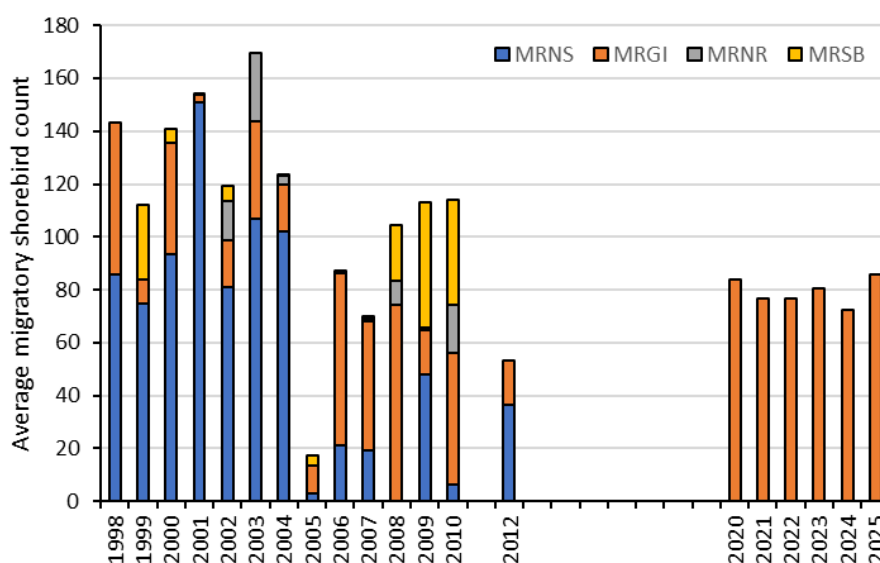
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**Table 3.3. Summary of the average ( $\pm 1SD$ , with maximum count in parentheses) total number of migratory shorebirds roosting at the MRGI and MRTR roost sites (combined) in the lower Maroochy River during summer high tide surveys each year since 2020/21.**

| Common name                   | Species                          | EPBC* | NCA* | 2021/22               | 2022/23               | 2023/24              | 2024/25              | 2025/26              |
|-------------------------------|----------------------------------|-------|------|-----------------------|-----------------------|----------------------|----------------------|----------------------|
| Far Eastern Curlew            | <i>Numenius madagascariensis</i> | M, CE | CE   | 3.8 $\pm$ 1.0 (5)     | 3.8 $\pm$ 0.5 (4)     | 3.8 $\pm$ 1.5 (5)    | 3.8 $\pm$ 0.5 (4)    | 4 $\pm$ 0 (4)        |
| Eurasian Whimbrel             | <i>Numenius phaeopus</i>         | M     | SL   | 33.3 $\pm$ 11.4 (43)  | 51.5 $\pm$ 21.8 (72)  | 50.3 $\pm$ 8.5 (59)  | 49 $\pm$ 8.4 (59)    | 60.8 $\pm$ 6.8 (69)  |
| Bar-tailed Godwit (W Alaskan) | <i>Limosa lapponica baueri</i>   | M, E  | E    | 29.8 $\pm$ 28.2 (71)  | 12.3 $\pm$ 1.0        | 14.0 $\pm$ 15.3 (36) | 11.8 $\pm$ 0.5 (12)  | 7.5 $\pm$ 0.6 (8)    |
| Pacific Golden Plover         | <i>Pluvialis fulva</i>           | M     | SL   | 0                     | 3.25 $\pm$ 6.5 (13)   | 0.3 $\pm$ 0.5 (1)    | 0                    | 5.3 $\pm$ 10.5 (21)  |
| Red-necked Stint              | <i>Calidris ruficollis</i>       | M     | SL   | 0                     | 1.0 $\pm$ 2.0 (4)     | 0.3 $\pm$ 0.5 (1)    | 0.5 $\pm$ 1 (2)      | 0                    |
| Grey-tailed Tattler           | <i>Tringa brevipes</i>           | M     | SL   | 5.3 $\pm$ 6.1 (11)    | 2.8 $\pm$ 5.5 (11)    | 11.8 $\pm$ 0.5 (12)  | 7.5 $\pm$ 3.1 (11)   | 8.5 $\pm$ 4 (12)     |
| Total migratory shorebirds    |                                  |       |      | 72.0 $\pm$ 24.8 (109) | 74.5 $\pm$ 25.0 (100) | 80.3 $\pm$ 13.7 (95) | 72.5 $\pm$ 10.9 (86) | 86.0 $\pm$ 10.4 (97) |

\* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Four of the Maroochy River roost sites (MRGI, MRNR, MRNS and MRSB) were regularly monitored by the QWSG from 1997 to 2012. **Figure 3.6** shows the average annual summer-season (October to mid-March) count of migratory shorebirds at each of the four roost sites that monitoring of high tide roost sites has been undertaken since 1998. The north shore (MRNS) was the most important migratory shorebird roost site in the lower Maroochy River area up until 2004 (**Figure 3.6**). As public use of north shore increased, including for walking dogs, use of the north shore by shorebirds declined and Goat Island (MRGI) became increasingly used by shorebirds for roosting. The QWSG discontinued monitoring of roost sites on the lower Maroochy River after 2012 due to increasing levels of disturbance affecting the counts. Based on QWSG data, the north shore has experienced the highest frequency of disturbance across all categories, including the presence of dogs (see **Section 3.2.3** below).



**Figure 3.6. Average annual summer-season (October to mid-March) count of migratory shorebirds at high tide (within 2 hrs either side of high tide) at each of four roost sites in the lower Maroochy River since 1998 based on QWSG data and this study. Counts at MRTR are included within MRGI.**

Over the past six summer seasons, migratory shorebirds have only used Goat Island for roosting, with no birds observed using the north shore (MRNS), Nojoor Road (MRNR) or sand bar (MRSB) roost sites (**Figure 3.6**), besides a flock of Far Eastern Curlew and Bar-tailed Godwit that alighted at MRNS for a short period after being disturbed off Goat Island during a survey in 2024/25. While migratory shorebirds regularly used all four roost sites in earlier years, they now appear to rely almost exclusively on Goat Island for roosting, probably due to increased disturbance at the alternative roost sites. The restriction of birds to using a single roost site reduces the resilience of shorebirds to disturbance since there are fewer alternative roost sites available should disturbance cause them to leave a particular roost site.

Analyses of data for the period 2011 to 2022 found that abundance at roost sites at high tide through the summer period had declined significantly for Pacific Golden Plover, Bar-tailed Godwit, Far Eastern Curlew and Red-capped Plover, but increased significantly for Eurasian Whimbrel and Pied Oystercatcher, whereas there had been no trend in Grey-tailed Tattler and Double-banded Plover (Lloyd *et al.* 2024); the 2024 data were consistent with these trends (**Figure 3.4**). During the previous surveys in 2022/23 (BAAM 2023), flocks of Pacific Golden Plovers that had been feeding on tidal flat sites MR05 and MR04 gathered on sandbars as the tide rose, before leaving the Maroochy River estuary heading in north-easterly direction. Pacific Golden Plover used to regularly use the north shore for roosting (**Figure 3.4**). Although Pacific Golden Plover were present foraging on the tidal flats in relatively large numbers, their substantially reduced counts at high tide relative to low tide since 2011 (**Figure 3.4**) indicates that they have shifted to roosting at an alternative site to the north. Lloyd *et al.* (2024) hypothesized they may be using Mudjimba Island, a small (1.3 ha), infrequently visited island with a rocky shoreline located 1 km offshore and 3.5 km north of the Maroochy River mouth. On 26 November 2024, a Sunshine Coast Council team photographed a flock of Pacific Golden Plover roosting on the rocky shoreline of Mudjimba Island, confirming their use of the island for roosting.

### 3.2.3 Disturbance

Shorebird roost sites and tidal flat feeding habitat areas in the lower Maroochy River are subject to multiple sources of potential disturbance to roosting or feeding shorebirds, including people using the area for recreation, dogs being walked on and off-leash, and various watercraft. The intensity of potential sources of disturbance and observations of actual disturbances recorded during the surveys is summarized in **Table 3.4**.

**Table 3.4. Summary of the numbers of people, dogs and watercraft observed in the vicinity of roosts at high tide (HT) and tidal flats at low tide (LT) during the surveys of the lower Maroochy River estuary.**

| Date       | Tide | People | Dogs | Boats/kayaks/boards | Jetskis | Observations                                                                                                                                                                                                            |
|------------|------|--------|------|---------------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 21/11/2025 | HT   | 9      | 5    | 6                   | 2       | 2 passing jetskis startled birds roosting on MRGI but they did not take flight. 2 people and a dog alighted from a boat onto MRGI; although the birds stayed, they had less bank to move around on and seemed agitated. |
| 19/12/2025 | HT   | 21     | 13   | 15                  | 1       | 2 kayakers put flock of 5 roosting Grey-tailed Tattler to flight at MRTR.                                                                                                                                               |
| 19/01/2026 | HT   | 8      | 2    | 4                   |         |                                                                                                                                                                                                                         |
| 17/02/2026 | HT   | 1      |      |                     |         |                                                                                                                                                                                                                         |
| 21/11/2025 | LT   | 45     | 12   | 9                   |         |                                                                                                                                                                                                                         |
| 19/12/2025 | LT   | 82     | 17   | 3                   |         |                                                                                                                                                                                                                         |
| 19/01/2026 | LT   | 48     | 6    | 3                   |         | 2 people walked through a small flock of Whimbrel on MR06.                                                                                                                                                              |
| 17/02/2026 | LT   |        |      |                     |         |                                                                                                                                                                                                                         |

## 3.3 Golden Beach, Caloundra

### 3.3.1 Low tide surveys

Six main areas of tidal flat feeding habitat occur in the northern Pumicestone Passage to the north of Bell's Creek mouth (see **Figure 3.7** for locations):

- a large tidal flat on the eastern side of the passage along the north-western tip of Bribie Island (SBN1);
- a large tidal flat on the western side of the passage opposite Golden Beach (SBN2);
- a small tidal flat connected to SBN2 opposite Pelican Waters (PEWA);
- several small patches of tidal flat at Bell's Creek (BECK);
- a new tidal flat (SBN3) on the south side of the new opening into Pumicestone Passage where sediment has gradually built up on the outer southern side of the new entrance following the Bribie Island break-through; and
- a new tidal flat (NTBI) that has established across the old entrance to Pumicestone Passage, between the northern tip of Bribie Island and Caloundra, following the Bribie Island break-through.

**Table 3.5** summarises the migratory shorebird survey results for each of the tidal flat areas on each of the six surveys, which comprised five summer season surveys (within the period October to February), and one winter season survey. Also shown in **Table 3.5** are the average count, standard deviation (a measure of variability) and maximum count of the summer season surveys in 2025/26 compared to baseline surveys over the previous five years.

During surveys prior to the 2025/26 season, there had been a generally even distribution of migratory shorebirds between the SBN1 and SBN2 tidal flat areas, with birds moving readily between the two areas depending on sources of disturbance. A notable change during the first four surveys in 2025/26 was a reduction in the numbers of migratory shorebirds using SBN2, with a corresponding increase in the numbers using SBN1 (**Table 3.5**). This change did not appear to result from changed disturbance pressures. Instead, it is more likely that the altered shorebird distribution relates to altered tidal flat extents and/or shorebird food availability across these two tidal flat areas due to the ongoing changes to the deposition of sediments in Pumicestone Passage following the breakthrough. However, there was a more even distribution of birds between SBN1 and SBN2 again during the February 2026 survey.

Most of the dredging removed sediment from sub-tidal waters to the west of SBN3. Consequently, the dredging has had limited impact on the total area of tidal flat habitat available to shorebirds. SBN3 is the closest tidal flat to the remediation works and therefore potentially the most susceptible to impacts from the emergency works. Yet, the numbers of migratory shorebirds foraging on SBN3 was substantially greater during the 2025/26 emergency works period than during the baseline surveys prior to the emergency works; for example, the average migratory shorebird total during 2025/26 was 36.8 (maximum 70), compared to an average of 9.9 (maximum 24) over the previous five years (**Table 3.5**).

Migratory shorebird numbers were substantially reduced during the winter season survey in April 2026; this is an expected result of most birds having left Australia to migrate to their breeding grounds in the northern hemisphere. The observation of a flock of 15 Double-banded Plovers that was moving between SBN2 and SBN3 confirms the presence of this species in the study area during the winter months. This species migrates from its breeding grounds in New Zealand to overwinter in Australia.



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**Table 3.5. Summary of migratory shorebird species recorded during six surveys at low tide and the summer season (October to February) average, standard deviation (SD) and maximum (max) count over the 5-year period 2020/21 to 2024/25 compared to 2025/26 on each of five tidal flat areas: Sandbank No. 1 to 3 (SBN1, SBN2, SBN3) including Pelican Waters (PEWA); Bells Creek (BECK); and Northern Tip of Bribie Island (NTBI).**

| Common name            | EPB<br>C* | NCA<br>* | 09/10/2025 | 20/11/2025 | 20/12/2025 | 21/01/2026 | 19/02/2026 | 17/04/2026 | 2020/21<br>to<br>2024/25 | 2025/26                 |
|------------------------|-----------|----------|------------|------------|------------|------------|------------|------------|--------------------------|-------------------------|
| <b>SBN1</b>            |           |          |            |            |            |            |            |            |                          |                         |
| Far Eastern Curlew     | M,CE      | E        | 7          | 27         | 23         | 17         | 9          | 0          | 14.1±11.4 (34)           | 16.6±8.6 (27)           |
| Eurasian Whimbrel      | M         | S        | 14         | 39         | 57         | 65         | 46         | 0          | 22.3±13.5 (63)           | 44.2±19.6 (65)          |
| Bar-tailed Godwit      | M,E       | E        | 32         | 129        | 122        | 169        | 39         | 0          | 38.1±24.8 (84)           | 98.2±60 (169)           |
| Pacific Golden Plover  | M         | S        | 0          | 1          | 0          | 0          | 15         | 0          | 17.2±24.9 (67)           | 3.2±6.6 (1)             |
| Common Sandpiper       | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 0.3±1 (4)                | 0±0 (0)                 |
| <b>Total migratory</b> |           |          | <b>53</b>  | <b>196</b> | <b>202</b> | <b>251</b> | <b>109</b> | <b>0</b>   | <b>91.9±48.7 (162)</b>   | <b>162.2±79.6 (251)</b> |
| <b>SBN2</b>            |           |          |            |            |            |            |            |            |                          |                         |
| Far Eastern Curlew     | M,CE      | E        | 7          | 15         | 9          | 32         | 32         | 0          | 13.3±12.2 (39)           | 19±12.2 (32)            |
| Eurasian Whimbrel      | M         | S        | 7          | 24         | 10         | 7          | 28         | 0          | 26.7±20.9 (67)           | 15.2±10 (24)            |
| Bar-tailed Godwit      | M,E       | E        | 12         | 19         | 7          | 4          | 77         | 0          | 22.4±19.9 (48)           | 23.8±30.3 (19)          |
| Pacific Golden Plover  | M         | S        | 0          | 10         | 0          | 15         | 29         | 0          | 14.7±22 (70)             | 10.8±12.1 (15)          |
| Greater Sand Plover    | M,V       | V        | 0          | 0          | 0          | 0          | 0          | 0          | 0.1±0.5 (2)              | 0±0 (0)                 |
| Siberian Sand Plover   | M,E       | E        | 0          | 0          | 0          | 1          | 0          | 0          | 0±0 (0)                  | 0.2±0.4 (1)             |
| Double-banded Plover   | M         | S        | 0          | 0          | 0          | 0          | 0          | 15         | n/a                      | n/a                     |
| Red Knot               | M,V       | V        | 0          | 0          | 0          | 0          | 0          | 0          | 0.1±0.3 (1)              | 0±0 (0)                 |
| Curlew Sandpiper       | M,CE      | CE       | 0          | 0          | 0          | 0          | 0          | 0          | 0.9±3 (12)               | 0±0 (0)                 |
| Red-necked Stint       | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 0.8±1.6 (5)              | 0±0 (0)                 |
| Grey-tailed Tattler    | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 1.1±3.8 (15)             | 0±0 (0)                 |
| Common Sandpiper       | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 0.1±0.3 (1)              | 0±0 (0)                 |
| <b>Total migratory</b> |           |          | <b>26</b>  | <b>68</b>  | <b>26</b>  | <b>59</b>  | <b>166</b> | <b>15</b>  | <b>80±47.4 (183)</b>     | <b>69±57.5 (68)</b>     |
| <b>SBN3</b>            |           |          |            |            |            |            |            |            |                          |                         |
| Far Eastern Curlew     | M,CE      | E        | 13         | 0          | 0          | 0          | 0          | 10         | 0.9±1.3 (4)              | 3.3±5.8 (13)            |
| Eurasian Whimbrel      | M         | S        | 3          | 0          | 3          | 0          | 5          | 0          | 2.1±1.6 (5)              | 2.2±2.2 (3)             |
| Bar-tailed Godwit      | M,E       | E        | 13         | 4          | 12         | 22         | 12         | 29         | 5±6 (18)                 | 12.6±6.4 (22)           |
| Pacific Golden Plover  | M         | S        | 41         | 0          | 24         | 26         | 6          | 11         | 1.9±4.9 (15)             | 19.4±16.5 (41)          |
| <b>Total migratory</b> |           |          | <b>70</b>  | <b>4</b>   | <b>39</b>  | <b>48</b>  | <b>23</b>  | <b>50</b>  | <b>9.9±8.3 (24)</b>      | <b>36.8±25 (70)</b>     |
| <b>BECK</b>            |           |          |            |            |            |            |            |            |                          |                         |
| Far Eastern Curlew     | M,CE      | E        | 0          | 0          | 2          | 3          | 2          | 0          | 1.1±1.4 (5)              | 1.3±1.3 (3)             |
| Eurasian Whimbrel      | M         | S        | 0          | 0          | 3          | 2          | 3          | 1          | 1.6±1.7 (5)              | 1.3±1.5 (3)             |
| Bar-tailed Godwit      | M,E       | E        | 38         | 15         | 7          | 40         | 37         | 17         | 4±5.5 (18)               | 25±15.3 (40)            |
| Pacific Golden Plover  | M         | S        | 0          | 0          | 0          | 0          | 1          | 0          | 0±0 (0)                  | 0±0.4 (0)               |
| Red-necked Stint       | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 0.2±0.8 (3)              | 0±0 (0)                 |
| <b>Total migratory</b> |           |          | <b>38</b>  | <b>15</b>  | <b>12</b>  | <b>45</b>  | <b>43</b>  | <b>18</b>  | <b>6.2±6.8 (23)</b>      | <b>27.5±15.9 (45)</b>   |
| <b>NTBI</b>            |           |          |            |            |            |            |            |            |                          |                         |
| Far Eastern Curlew     | M,CE      | E        | 0          | 1          | 0          | 0          | 0          | 0          | 1.2±1 (3)                | 0.3±0.4 (1)             |
| Eurasian Whimbrel      | M         | S        | 0          | 0          | 0          | 0          | 0          | 0          | 0.2±0.4 (1)              | 0±0 (0)                 |
| <b>Total migratory</b> |           |          | <b>0</b>   | <b>1</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>1.3±1 (3)</b>         | <b>0.3±0.4 (1)</b>      |

\*Status under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC) or Queensland Nature Conservation Act 1992 (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

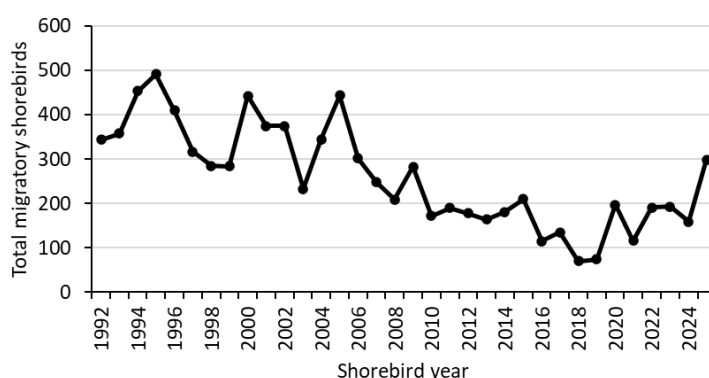
The configurations of the tidal flat areas have undergone substantial change since 2020/21 following the initial break-through (Breakthrough #2), with further rapid change following the additional breakthroughs (Breakthrough #2 and #3) that occurred after the 2024/25 summer season. Also, the birds move freely between some adjacent areas, especially SBN1 and SBN2 in response to tidal variation and disturbance. Consequently, the total counts across all tidal flats within the study area provide a simpler summary of migratory shorebird use of the area, as summarised in **Table 3.6**.

**Table 3.6. Summary of migratory shorebird species recorded during six surveys at low tide and the summer season (October to February) average, standard deviation (SD) and maximum (max) count over the 5-year period 2020/21 to 2024/25 compared to 2025/26.**

| Common name            | EPBC* | NCA* | 09/10/2025 | 20/11/2025 | 20/12/2025 | 21/01/2026 | 19/02/2026 | 17/04/2026 | 2020/21 to 2024/25      | 2025/26                 |
|------------------------|-------|------|------------|------------|------------|------------|------------|------------|-------------------------|-------------------------|
| Bar-tailed Godwit      | M, E  | E    | 95         | 167        | 148        | 235        | 165        | 46         | 66.8±28.6 (123)         | 162±50.1 (235)          |
| Common Sandpiper       | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 0.3±1.3 (5)             | 0±0 (0)                 |
| Curlew Sandpiper       | M, CE | CE   | 0          | 0          | 0          | 0          | 0          | 0          | 0.9±3 (12)              | 0±0 (0)                 |
| Eurasian Whimbrel      | M     | S    | 24         | 63         | 73         | 74         | 82         | 1          | 51.6±21.5 (91)          | 63.2±22.9 (74)          |
| Far Eastern Curlew     | M, CE | E    | 27         | 43         | 34         | 52         | 43         | 10         | 29±10.3 (42)            | 39.8±9.6 (52)           |
| Greater Sand Plover    | M, V  | V    | 0          | 0          | 0          | 0          | 0          | 0          | 0.1±0.5 (2)             | 0±0 (0)                 |
| Grey-tailed Tattler    | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 1.1±3.8 (15)            | 0±0 (0)                 |
| Pacific Golden Plover  | M     | S    | 41         | 11         | 24         | 41         | 51         | 11         | 32.9±27.1 (70)          | 33.6±15.9 (41)          |
| Red Knot               | M, V  | E    | 0          | 0          | 0          | 0          | 0          | 0          | 0.1±0.3 (1)             | 0±0 (0)                 |
| Red-necked Stint       | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 0.8±1.6 (5)             | 0±0 (0)                 |
| Siberian Sand Plover   | M, E  | E    | 0          | 0          | 0          | 1          | 0          | 0          | 0±0 (0)                 | 0.2±0.4 (1)             |
| Double-banded Plover   | M     | S    | 0          | 0          | 0          | 0          | 0          | 15         | n/a                     | n/a                     |
| <b>Total migratory</b> |       |      | <b>187</b> | <b>284</b> | <b>279</b> | <b>403</b> | <b>341</b> | <b>68</b>  | <b>183.6±60.5 (297)</b> | <b>298.8±80.2 (403)</b> |

\* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

**Figure 3.8** shows the long-term variation in the annual average total migratory shorebird count at low tide during the summer non-breeding period. The total migratory shorebird counts each year over the period 1992 to 2019 and 2021 were derived by summing the average counts across all the monitored tidal flats at Golden Beach from QWSG data. The total migratory shorebird counts each year over the years 2020 and 2022 to 2024 were derived by summing the average counts across all the monitored tidal flats at Golden Beach from the BAAM surveys. These data suggest that there was a decline in total count of migratory shorebirds foraging on tidal flats at Golden Beach over the period 1992 to around 2010, and a slight increase thereafter (**Figure 3.8**).



**Figure 3.8. Average annual total migratory shorebird counts at Golden Beach at low tide during the summer non-breeding period over the years 1992/93 to 2025/26.**

### 3.3.2 Assessment of dredging impacts at low tide

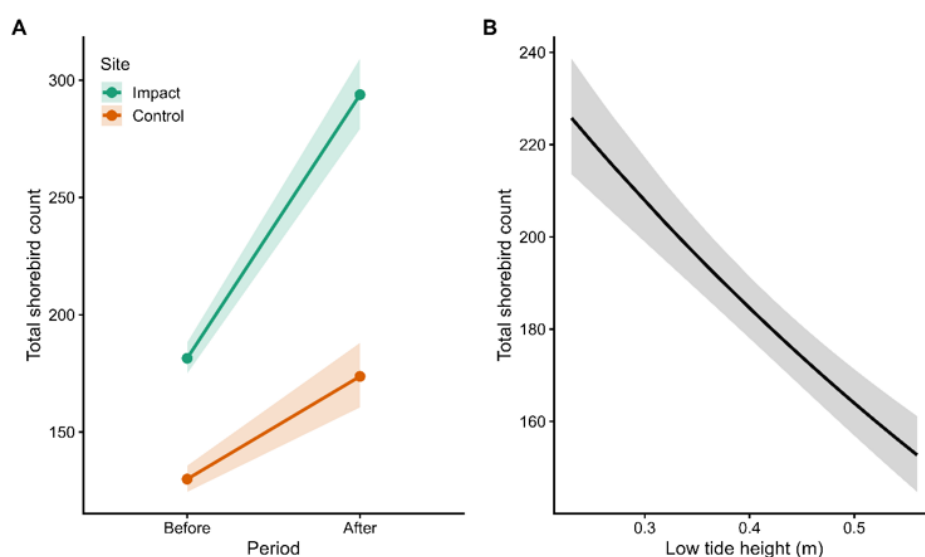
The GLM testing for an impact of the emergency works dredging on the total number of migratory shorebirds foraging at low tide found significant effects of site, period and tide height with the site\*period interaction also significant (**Table 3.7**).

**Table 3.7. Model estimates and standard errors (SE) for a GLM testing factors influencing the total summer-season (October-February) migratory shorebird counts during low tide at each of the northern Pumicestone Passage (impact site) and lower Maroochy River estuary (control site) before (2020/21 to 2024/25) and after (2025/26) the start of the emergency dredging works at the impact site.**

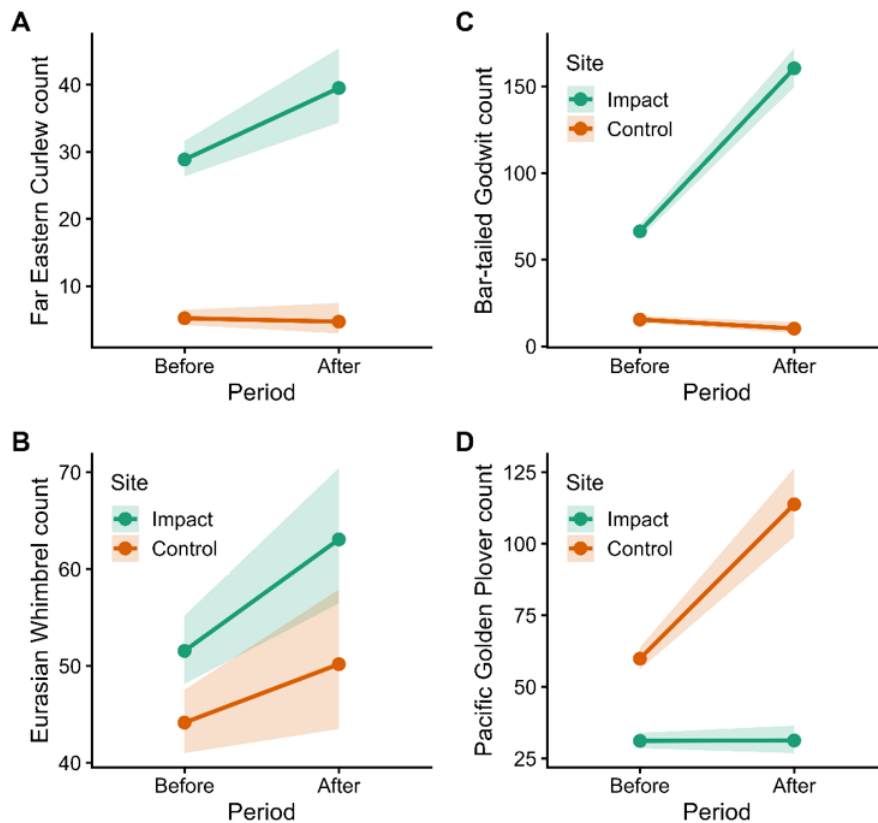
| Model term                      | Estimate | SE   | z-value | P      |
|---------------------------------|----------|------|---------|--------|
| (Intercept)                     | 5.69     | 0.05 | 105.97  | <0.001 |
| Site (Control)                  | -0.33    | 0.03 | -11.71  | <0.001 |
| Period (After)                  | 0.48     | 0.03 | 15.17   | <0.001 |
| Tide height                     | -1.18    | 0.13 | -9.38   | <0.001 |
| Site (Control) : Period (After) | -0.19    | 0.06 | -3.4    | <0.001 |

The result of the BACI test indicates that the emergency works were associated with a significant difference in the total migratory shorebird count at the impact site compared to the control site, controlling for an influence of tide height. The direction of this difference was positive i.e. there was a significant increase in the total migratory shorebird count during the period of the emergency works (**Figure 3.9**). The effect of tide height (**Figure 3.9B**) indicates that more shorebirds are present foraging in the area on spring tides compared to neap tides.

Among individual species, the site\*period interaction was significant for Bar-tailed Godwit *Limosa lapponica baueri* and Pacific Golden Plover *Pluvialis fulva*, but not for Far Eastern Curlew *Numenius madagascariensis* and Eurasian Whimbrel *Numenius phaeopus* (**Appendix 1, Figure 3.10**). For Bar-tailed Godwit, the direction of change was positive i.e. there was a significant increase in the total during the period of the emergency works (**Figure 3.10C**). For Pacific Golden Plover, the direction of the change was negative by comparison with the control site, whereby there was a significant increase at the control site but not at the impact site (**Figure 3.10D**).



**Figure 3.9. Predicted influence of site (impact, control), period (before, after) and low tide height on the total migratory shorebird count at low tide. The predicted marginal means and 95% confidence intervals are from the predictions of the minimal model including a 2-way interaction site\*period (illustrated in panel A) and tide height (illustrated in panel B).**



**Figure 3.10. Predicted influence of site (impact, control) and period (before, after) controlling for low tide height on the total count at low tide of Far Eastern Curlew (A), Eurasian Whimbrel (B), Bar-tailed Godwit (C) and Pacific Golden Plover (D). The predicted marginal means and 95% confidence intervals are from the predictions of full models including a 2-way interaction site\*period and tide height.**

Overall, the tests found no significant negative impact of the emergency dredging works on use of the study area by migratory shorebirds for foraging at low tide, with some significant positive changes. This result raises the question of how a major dredging project might be associated with a positive impact (under the BACI testing framework) on the numbers of migratory shorebirds using the study area. Factors that might be responsible for a significant increase in migratory shorebird numbers over one year could include geomorphic change after the most recent breakthroughs increasing habitat availability, redistribution of birds in the region, natural annual variation in shorebird populations, changes in disturbance patterns, or increased migratory shorebird food availability as a consequence of the dredging works. If geomorphic change within the year after the most recent breakthroughs in early 2025 was responsible for the increase in shorebird numbers, then a similar increase should have accompanied the initial, larger breakthrough that took place in early 2022, but no such increase was apparent in the data. The inclusion of a control site in the BACI testing framework explicitly controls for factors such as a redistribution of birds, annual variation in shorebird numbers or disturbance patterns. Also, there was no evidence of a reduction in disturbance pressure across the Golden Beach study area during the period of the emergency works.

The disturbance and movement of sediments within the Pumicestone Passage because of the dredging works is expected to release nutrients stored in the sediments, and this increase in nutrients over the short term may result in an increase the abundance or availability of the benthic invertebrates that shorebirds feed on over the short term. For example, O'Mara et al. (2021) found that nutrients entering Moreton Bay from a large cyclone-driven flood of the Logan River stimulated benthic primary production that was transferred through the food web with positive impacts on condition of Brown Tiger Prawn *Penaeus esculentus*, a benthic invertebrate. Similarly, nutrient inputs from riverine flooding increase the biomass of Common Banana Prawn *Penaeus merguensis* and mud crabs *Scylla* spp. in nearshore waters of the Gulf of Carpentaria (Plagányi et al. 2024, 2026). This process might explain the apparent positive impact of the dredging works on the total numbers of migratory shorebirds foraging in the impact site at low tide if the dredging increased the availability of the benthic invertebrates that shorebirds feed on. However, data on estuary nutrient availability and benthic invertebrate biomass would be required to confirm such a hypothesis.

### 3.3.3 Disturbance at low tide

Potential sources of disturbance to migratory shorebirds during low tide surveys were greatest on NTBI and SBN2 and mainly comprised people walking across tidal flat areas (**Table 3.8**). Being less accessible to the public, fewer people were observed on SBN3. The only disturbance event observed at low tide was a drone that was flown across the passage channel from the mainland and caused all shorebirds present on SBN3 to take flight.

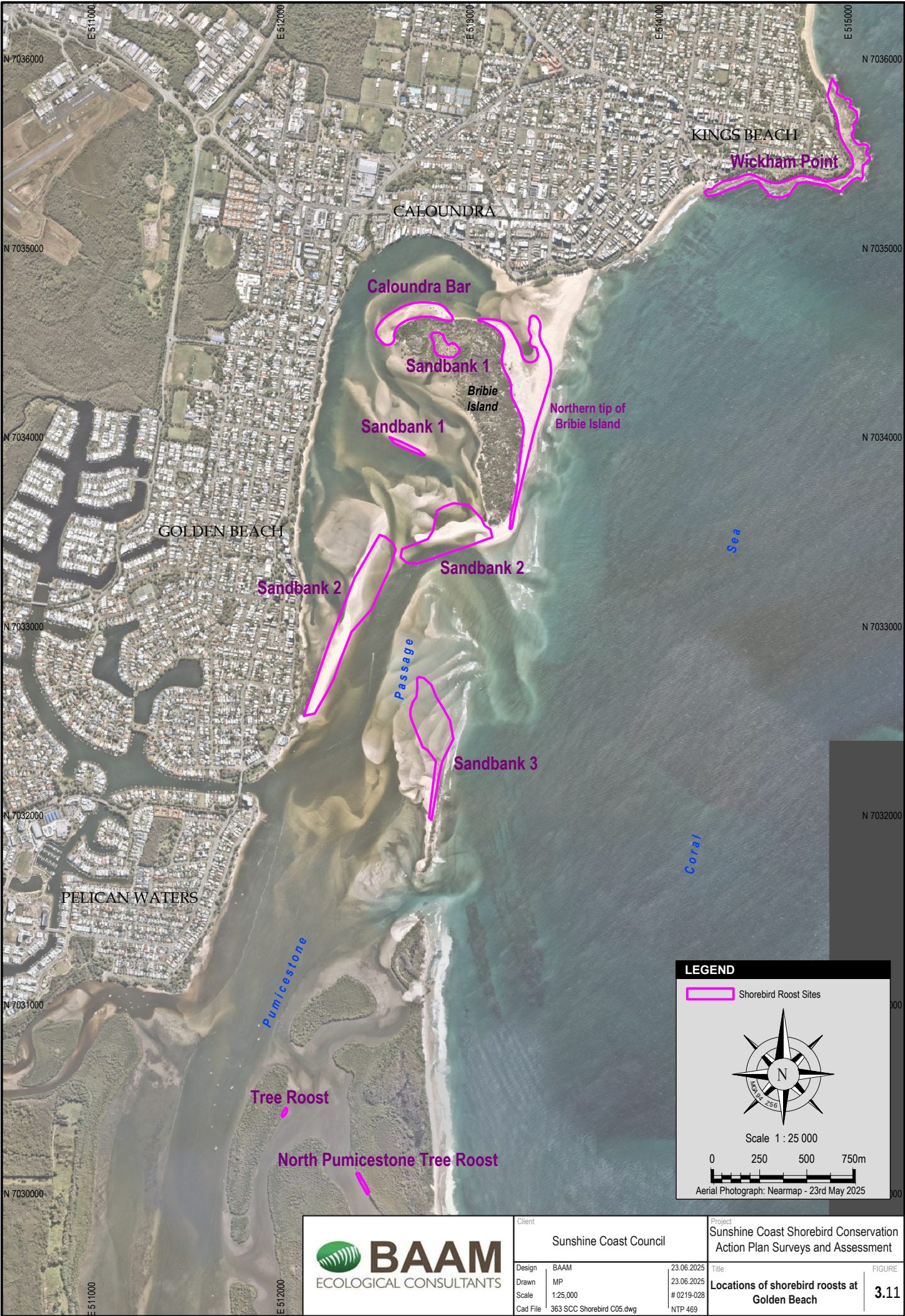
**Table 3.8. Summary of potential sources of disturbance and details of observed disturbance events during low tide surveys.**

| Site | Date       | Total | People | Dog | W/craft | Drone | Actual disturbance events                                                                                                                                       |
|------|------------|-------|--------|-----|---------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NTBI | 09/10/2025 | 13    | 11     | 1   |         |       | Nil                                                                                                                                                             |
| NTBI | 21/01/2026 | 15    | 10     |     | 5       |       | Nil                                                                                                                                                             |
| NTBI | 20/12/2025 | 8     | 6      |     | 2       |       | Nil                                                                                                                                                             |
| SBN2 | 20/12/2025 | 26    | 11     |     | 15      |       | Nil                                                                                                                                                             |
| BECK | 17/04/2026 | 4     | 4      |     |         |       | Nil                                                                                                                                                             |
| NTBI | 17/04/2026 | 60    | 60     |     |         |       | Nil                                                                                                                                                             |
| SBN1 | 17/04/2026 | 13    | 11     |     | 2       |       | Nil                                                                                                                                                             |
| SBN2 | 17/04/2026 | 54    | 53     |     | 1       |       | Nil                                                                                                                                                             |
| SBN3 | 17/04/2026 | 11    | 10     |     |         | 1     | Drone being operated in the area caused all birds to take flight, some returned later. Eight workers on restoration area well away from birds, nil disturbance. |

### 3.3.4 High tide surveys

Eight shorebird roost sites are currently recognised at Caloundra (see **Figure 3.11**):

- Caloundra bar (CBAR), a sand bank at the Pumicestone Passage entrance;
- Northern tip of Bribie Island (NTBI, part of Bribie Island National Park), along the beach between the old and new entrances to Pumicestone Passage (prior to the 2021/22 season, the northern portion of this site was included in CBAR);
- Sandbank 1 (SBN1), including a sandbank in the passage (used on the rising tide and neap high tides), a sandbank on the north-western shoreline of Bribie Island and an adjoining area of saltmarsh on the shoreline of Bribie Island;
- Sandbank 2 (SBN2), two raised portions of sandbank on the northern side of the new entrance to Pumicestone Passage;
- Sandbank 3 (SBN3), a new sandbank on the southern side of the new entrance to Pumicestone Passage that was first seen used by shorebirds for roosting in February 2023;
- A mangrove tree roost (BCTR) on the opposite side of Pumicestone Passage from Bell's Creek;
- North Pumicestone mangrove tree roost (NPTR) in a blind ending channel on the western side of Bribie Island, south of BCTR, identified for the first time in 2024; and
- Wickham Point (WICK), a rock platform on the mainland coastline north of the Pumicestone Passage entrance, where small numbers of shorebirds regularly roost.



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A high bank has established between the southern end of the isolated northern tip of Bribie Island and Golden Beach. The bank runs westwards to within about 150m of the Golden Beach shoreline. Birds can roost here now on most high tides because the top of the bank does not usually become submerged. This high bank is now treated as an extension of SBN2. All roost sites except Wickham Point were surveyed by BAAM during the 2025/26 season.

**Table 3.9** summarises the migratory shorebird survey results for each of the roost sites on each of the six surveys in 2025/26, which comprised five summer season surveys (within the period October to February), and one winter season survey. Also shown in **Table 3.9** are the average count, standard deviation (a measure of variability) and maximum count of the summer season surveys in 2025/26 compared to baseline surveys over the previous two years that are most representative of baseline conditions prior to the start of the emergency works.

**Table 3.9. Summary of migratory shorebird species recorded during six surveys at high tide and the summer season (October to February) average, standard deviation (SD) and maximum (max) count over the 2-year period 2023/24 to 2024/25 compared to 2025/26 at each of six roost sites: Sandbank No. 1 to 3 (SBN1, SBN2, SBN3); Northern Tip of Bribie Island (NTBI); Caloundra Bar (CBAR) and tree roost opposite Bells Creek (BCTR).**

| Common name            | EPBC* | NCA* | 09/10/2025 | 20/11/2025 | 20/12/2025 | 21/01/2026 | 19/02/2026 | 17/04/2026 | 2020/21 to 2024/25      | 2025/26                  |
|------------------------|-------|------|------------|------------|------------|------------|------------|------------|-------------------------|--------------------------|
| <b>SBN1</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Far Eastern Curlew     | M, CE | E    | 0          | 0          | 0          | 0          | 0          | 0          | 0.6±1.8 (5)             | 0±0 (0)                  |
| Eurasian Whimbrel      | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 0.8±2.1 (6)             | 0±0 (0)                  |
| <b>Total migratory</b> |       |      | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>1.4±3.9 (11)</b>     | <b>0±0 (0)</b>           |
| <b>SBN2</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Far Eastern Curlew     | M, CE | CE   | 0          | 41         | 49         | 46         | 52         | 0          | 26.9±16.7 (47)          | 37.6±21.4 (49)           |
| Eurasian Whimbrel      | M     | S    | 0          | 0          | 0          | 47         | 7          | 0          | 39.8±29.4 (90)          | 10.8±20.5 (47)           |
| Bar-tailed Godwit      | M, E  | E    | 0          | 0          | 0          | 177        | 91         | 0          | 58.1±46.1 (135)         | 53.6±79.4 (177)          |
| Red Knot               | M, V  | E    | 0          | 0          | 0          | 0          | 0          | 0          | 0.4±1.1 (3)             | 0±0 (0)                  |
| Red-necked Stint       | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 0.3±0.7 (2)             | 0±0 (0)                  |
| Pacific Golden Plover  | M     | S    | 0          | 0          | 0          | 63         | 0          | 0          | 0±0 (0)                 | 12.6±28.2 (63)           |
| Siberian Sand Plover   | M, E  | E    | 0          | 0          | 0          | 2          | 0          | 0          | 0±0 (0)                 | 0.4±0.9 (2)              |
| <b>Total migratory</b> |       |      | <b>0</b>   | <b>41</b>  | <b>49</b>  | <b>335</b> | <b>150</b> | <b>0</b>   | <b>125.4±87.1 (255)</b> | <b>115±134.8 (335)</b>   |
| <b>SBN3</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Far Eastern Curlew     | M, CE | CE   | 0          | 7          | 2          | 0          | 0          | 10         | 11.3±18.1 (45)          | 1.8±3 (7)                |
| Eurasian Whimbrel      | M     | S    | 78         | 109        | 72         | 0          | 27         | 19         | 14.6±21.6 (58)          | 57.2±43.4 (109)          |
| Bar-tailed Godwit      | M, E  | E    | 38         | 148        | 147        | 0          | 79         | 23         | 15.6±21.5 (49)          | 82.4±65.7 (148)          |
| Red-necked Stint       | M     | S    | 0          | 0          | 0          | 0          | 0          | 2          | 0±0 (0)                 | 0±0 (0)                  |
| Pacific Golden Plover  | M     | S    | 0          | 0          | 51         | 0          | 33         | 11         | 18±20.2 (48)            | 16.8±23.9 (51)           |
| Double-banded Plover   | M     | S    | 0          | 0          | 0          | 0          | 0          | 15         | n/a                     | n/a                      |
| Curlew Sandpiper       | M, CE | CE   | 0          | 0          | 0          | 0          | 0          | 0          | 1.4±3.2 (9)             | 0±0 (0)                  |
| <b>Total migratory</b> |       |      | <b>116</b> | <b>264</b> | <b>272</b> | <b>0</b>   | <b>139</b> | <b>80</b>  | <b>60.9±55.2 (144)</b>  | <b>158.2±113.3 (272)</b> |
| <b>NTBI</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Far Eastern Curlew     | M, CE | E    | 0          | 0          | 0          | 0          | 0          | 0          | 3.4±9.5 (27)            | 0±0 (0)                  |
| Eurasian Whimbrel      | M     | S    | 0          | 0          | 0          | 0          | 0          | 0          | 7.6±21.2 (60)           | 0±0 (0)                  |
| Bar-tailed Godwit      | M, E  | E    | 0          | 0          | 0          | 0          | 0          | 0          | 6.3±17.7 (50)           | 0±0 (0)                  |
| <b>Total migratory</b> |       |      | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>17.3±48.4 (137)</b>  | <b>0±0 (0)</b>           |
| <b>CBAR</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Total migratory        |       |      | 0          | 0          | 0          | 0          | 0          | 0          | 0±0 (0)                 | 0±0 (0)                  |
| <b>BCTR</b>            |       |      |            |            |            |            |            |            |                         |                          |
| Eurasian Whimbrel      | M     | S    | 0          | 0          | 0          | 22         | 33         | 0          | 13.8±13 (34)            | 11±15.6 (22)             |

| Common name            | EPBC* | NCA* | 09/10/2025 | 20/11/2025 | 20/12/2025 | 21/01/2026 | 19/02/2026 | 17/04/2026 | 2020/21 to 2024/25  | 2025/26             |
|------------------------|-------|------|------------|------------|------------|------------|------------|------------|---------------------|---------------------|
| <b>Total migratory</b> |       |      | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>22</b>  | <b>33</b>  | <b>0</b>   | <b>13.8±13 (34)</b> | <b>11±15.6 (22)</b> |

\*Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Despite the emergency works activity being largely focussed on SBN3 during the surveys, SBN3 was the preferred roost site for migratory shorebirds on most surveys, except for Far Eastern Curlew, which preferred roosting on SBN2 (**Table 3.9**). The birds were observed to move freely between SBN2 and SBN3 depending on disturbance events, with disturbance pressure greater on SBN2 due to its greater accessibility to the public. Both the mid-western edge and northern tip of SBN3 were the preferred roosting areas when the banks at the water's edge had a shallow incline. During a spring tide on the January 2026 survey, migratory shorebirds were observed trying to use SBN3 after being repeatedly disturbed off SBN2 but appeared unable to do so because the banks there were being transformed to steep sided masses of sand by the foredune reprofiling works at the time.

The surveys through 2025/26 confirmed that the two most important migratory shorebird roost sites in the northern Pumicestone Passage are SBN2 and SBN3. Both the western and eastern sandbanks at SBN2 continue to be subject to regular human disturbance by recreational users of the area that can cause birds to move across the channel to SBN3 where they are generally subject to less disturbance risk. This highlights the importance of having at least two suitable roost sites in this area, so that the one can serve as an alternative roost site should birds be disturbed off the other. The maintenance of a network of suitable roost sites is a recommendation for the management of the impacts of disturbance on shorebirds in Moreton Bay (Fuller *et al.* 2021).

Seven migratory shorebird species used the study area for roosting at high tide during the 2025/26 surveys, including up to 52 critically endangered Far Eastern Curlew and up to 177 endangered Bar-tailed Godwit. During the summer-season period, the average total migratory shorebird count was 284 birds, with a maximum count of 347 (**Table 3.10**). Total migratory shorebird numbers recorded during the five summer-season surveys while the emergency dredging works were underway through 2025/26 were either within the range of counts recorded over the previous five years, or higher than the previous maximum count (**Table 3.10**). This indicates that the emergency works have not had a significant negative impact on migratory shorebird use of the study area for roosting.

Across all four of the most commonly occurring species, the average number of individuals foraging within the study area through the summer months was substantially greater during the 2025/26 emergency works period than during the baseline surveys prior to the emergency works (**Table 3.6**). This included two listed threatened species, the critically endangered Far Eastern Curlew, which is regarded as the species most sensitive and susceptible to disturbance, as well as the endangered Bar-tailed Godwit. The Bar-tailed Godwit is a case in point; the average during 2025/26 exceeded the maximum count over the previous five years (**Table 3.10**). This result indicates that the emergency works have not had a negative impact on migratory shorebird use of roost sites across the study area.

**Table 3.10. Summary of migratory shorebird species recorded during six surveys at high tide and the summer season (October to February) average, standard deviation (SD) and maximum (max) count over the 5-year period 2020/21 to 2024/25 compared to 2025/26.**

| Common name            | EPBC* | NCA* | 09/10/2025 | 20/11/2025 | 20/12/2025 | 21/01/2026 | 19/02/2026 | 17/04/2026 | 2020/21 to 2024/25    | 2025/26                 |
|------------------------|-------|------|------------|------------|------------|------------|------------|------------|-----------------------|-------------------------|
| Bar-tailed Godwit      | M, E  | E    | 38         | 148        | 147        | 177        | 170        | 23         | 64.4±38.7 (135)       | 136±56.4 (177)          |
| Curlew Sandpiper       | M, CE | CE   | 0          | 0          | 0          | 0          | 0          | 0          | 0.6±2 (9)             | 0±0 (0)                 |
| Eurasian Whimbrel      | M     | S    | 78         | 109        | 72         | 69         | 67         | 19         | 63.4±35.2 (132)       | 79±17.3 (109)           |
| Far Eastern Curlew     | M, CE | CE   | 0          | 48         | 51         | 46         | 52         | 10         | 37.5±15.1 (68)        | 39.4±22.2 (51)          |
| Pacific Golden Plover  | M     | S    | 0          | 0          | 51         | 63         | 33         | 11         | 11.8±20.1 (66)        | 29.4±28.9 (63)          |
| Red Knot               | M, V  | V    | 0          | 0          | 0          | 0          | 0          | 0          | 0.2±0.7 (3)           | 0±0 (0)                 |
| Red-necked Stint       | M     | S    | 0          | 0          | 0          | 0          | 0          | 2          | 0.1±0.4 (2)           | 0±0 (0)                 |
| Siberian Sand Plover   | M, E  | E    | 0          | 0          | 0          | 2          | 0          | 0          | 0±0 (0)               | 0.4±0.9 (2)             |
| Double-banded Plover   | M     | S    | 0          | 0          | 0          | 0          | 0          | 15         | n/a                   | n/a                     |
| <b>Total migratory</b> |       |      | <b>116</b> | <b>338</b> | <b>321</b> | <b>357</b> | <b>322</b> | <b>80</b>  | <b>177.8±82 (324)</b> | <b>284.2±95.9 (357)</b> |

\*Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

### 3.3.5 Assessment of dredging impacts high tide

The GLM testing for an impact of the emergency dredging works on the total number of migratory shorebirds roosting at high tide found significant effects of site, period and tide height with the site\*period interaction also significant (**Table 3.11**).

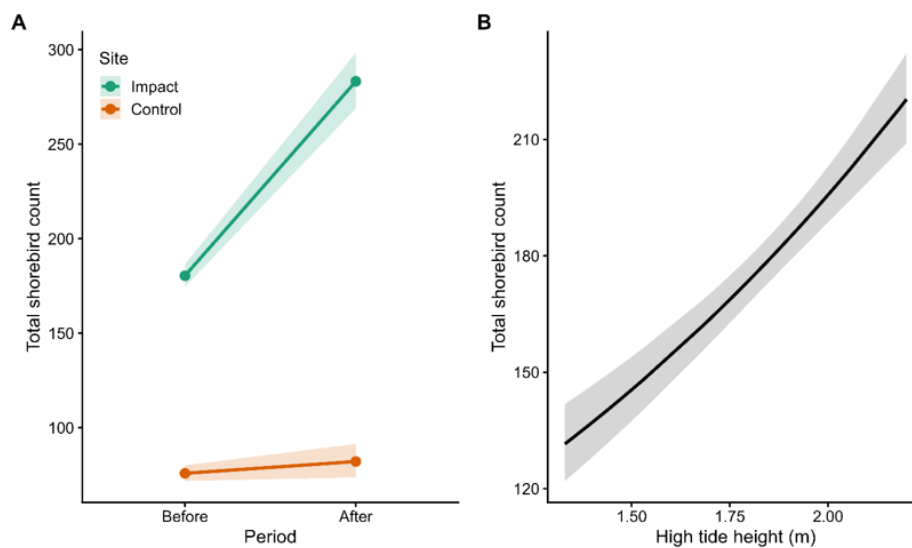
**Table 3.11. Model estimates and standard errors (SE) for a GLM testing factors influencing the total summer-season (October-February) migratory shorebird counts during high tide at each of the northern Pumicestone Passage (impact site) and lower Maroochy River estuary (control site) before (2020/21 to 2024/25) and after (2025/26) the start of the emergency dredging works at the impact site.**

| Model term                      | Estimate | SE   | z-value | P      |
|---------------------------------|----------|------|---------|--------|
| (Intercept)                     | 4.09     | 0.12 | 33.9    | <0.001 |
| Site (Control)                  | -0.87    | 0.03 | -26.77  | <0.001 |
| Period (After)                  | 0.45     | 0.03 | 14.47   | <0.001 |
| Tide height                     | 0.59     | 0.06 | 9.28    | <0.001 |
| Site (Control) : Period (After) | -0.37    | 0.07 | -5.4    | <0.001 |

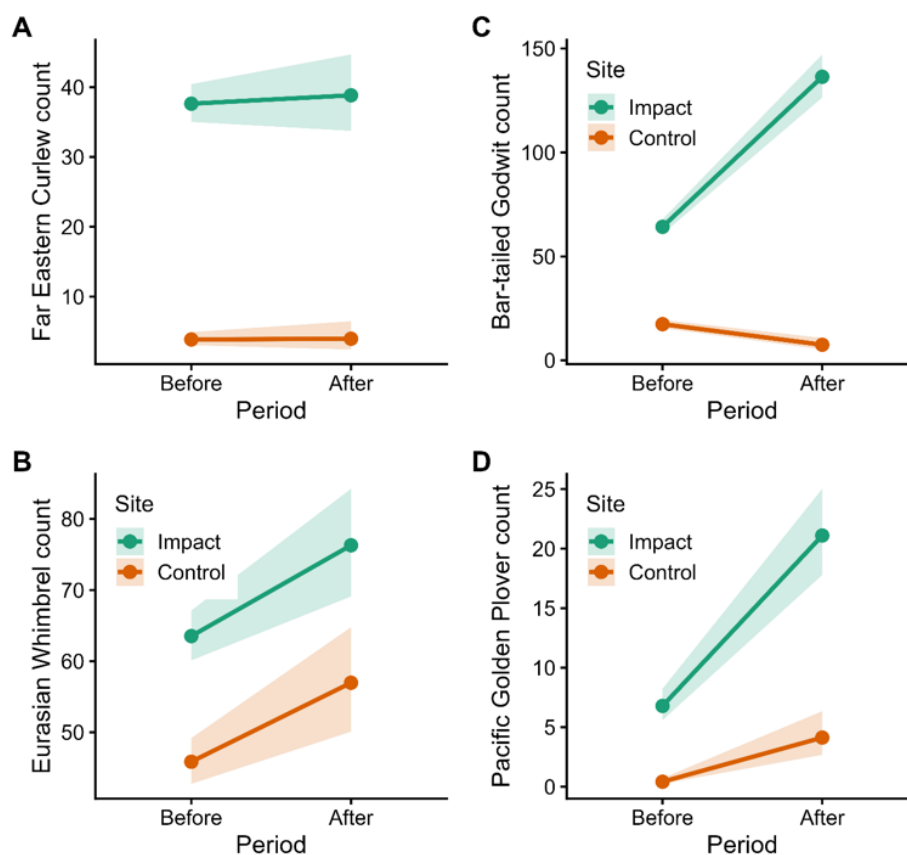
The result of the BACI test indicates that the emergency works were associated with a significant difference in the total migratory shorebird count at the impact site compared to the control site, controlling for an influence of tide height. The direction of this change was positive i.e. there was a significant increase in the total migratory shorebird count during the period of the emergency works (**Figure 3.12A**). The effect of tide height (**Figure 3.12B**) indicates that more shorebirds are present roosting in the area on spring tides compared to neap tides, consistent with shorebird use of the area for foraging at low tide.

Among individual species, the site\*period interaction was significant for Bar-tailed Godwit and Pacific Golden Plover, but not for Far Eastern Curlew and Eurasian Whimbrel (**Appendix 1, Figure 3.13**). For both Bar-tailed Godwit (**Figure 3.13C**) and Pacific Golden Plover (**Figure 3.13D**), the direction of the

change was positive i.e. there was a significant increase in the total count during the period of the emergency works.



**Figure 3.12. Predicted influence of site (impact, control), period (before, after) and high tide height on the total migratory shorebird count at high tide. The predicted marginal means and 95% confidence intervals are from the predictions of the minimal model including a 2-way interaction site\*period (illustrated in panel A) and tide height (illustrated in panel B).**



**Figure 3.13. Predicted influence of site (impact, control) and period (before, after) controlling for high tide height on the total count at low tide of Far Eastern Curlew (A), Eurasian Whimbrel (B), Bar-tailed Godwit (C) and Pacific Golden Plover (D). The predicted marginal means and 95% confidence intervals are from the predictions of full models including a 2-way interaction site\*period and tide height.**

Overall, the tests found no significant negative impact of the emergency dredging works on migratory shorebird use of the study area by migratory shorebirds for roosting at tide, with some significant positive changes. The positive changes mirrored the changes in migratory shorebird numbers foraging at low tide (see **Section 3.3.2** above). Since migratory shorebirds prefer to roost close to their foraging areas, the significant increase in the counts of birds foraging at low tide is expected to also increase the numbers using roost sites in the area (Finn *et al.* 2002).

### 3.3.6 Disturbance at high tide

Potential sources of disturbance to migratory shorebirds during high tide surveys were greatest on NTBI and SBN2 and mainly comprised people walking across exposed sand banks (**Table 3.12**). Two e-bikers were observed riding along the beach at NTBI on one occasion. Being less accessible to the public, fewer people were observed on SBN3. Members of the public accompanied by a dog caused repeated disturbance to shorebirds roosting on SBN2 during one of the surveys. The only disturbance event caused by emergency works activity occurred when workmen walking to the dredge area near the channel bisecting SBN2 caused a mixed flock of Far Eastern Curlew and Bar-tailed Godwit roosting there to take flight.

**Table 3.12. Summary of potential sources of disturbance and details of observed disturbance events during high tide surveys.**

| Site | Date       | Total | People | Dog | W/craft | Drone | Actual disturbance events                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|------------|-------|--------|-----|---------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SBN2 | 21/01/2026 | 13    | 12     | 1   |         |       | The Pacific Golden Plover and most of the Red-capped Plover were on the NE tip of SBN2 where they were put to flight twice by walkers and a dog before moving to the inner section of SBN2 with the other species. Here the entire flock was disturbed again, left and split with large numbers heading to the SBN3 northern tip but the shallows were too deep, and the birds turned back to scatter along SBN2. Some Far Eastern Curlew stayed on SBN3 for a while, but rising water pushed them off. The shorebird flock on the inner section of SBN2 was put to flight two more times by people but kept coming back to SBN2. SBN3 did not seem to be a roosting option perhaps because the banks there were being transformed to steep sided masses of sand by the works. |
| NTBI | 21/01/2026 | 6     | 5      | 1   |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| NTBI | 20/11/2025 | 35    | 35     |     |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN1 | 20/11/2025 | 1     |        |     | 1       |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN2 | 20/11/2025 | 9     | 7      |     | 2       |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| NTBI | 20/12/2025 | 19    | 8      | 1   | 10      |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN2 | 20/12/2025 | 30    | 21     |     | 9       |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| BCTR | 17/04/2026 | 0     |        |     |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| BECK | 17/04/2026 | 0     |        |     |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| CBAR | 17/04/2026 | 2     |        |     | 2       |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| NTBI | 17/04/2026 | 26    | 24     | 1   |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN1 | 17/04/2026 | 0     |        |     |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN2 | 17/04/2026 | 8     | 8      |     |         |       | Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| SBN3 | 17/04/2026 | 8     | 8      |     |         |       | Workers on restoration area well away from birds, nil disturbance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| SBN2 | 19/02/2026 | 4     | 2      |     | 2       |       | A mixed flock of Far Eastern Curlew and Bar-tailed Godwit put to flight by workmen walking to the dredge area near channel; the Eastern Curlew flew in circles for several minutes before alighting back on SBN2 western section north face whereas the Bar-tailed Godwits flew across to SBN3. Also, disturbance by kayaks on this same shoreline.                                                                                                                                                                                                                                                                                                                                                                                                                            |

## 3.4 Sunshine Coast Council Surveys

The results of additional surveys conducted by SCC staff at various locations are presented in **Table 3.13**.

**Table 3.13. Summary of surveys conducted by SCC staff.**

| Site                                | Date       | Tide | Total migratory shorebirds | Total resident shorebirds | Total other waterbirds | Dogs on leash | Dogs off leash | People | Jetskis | Boats | Observations                                                                                                                  |
|-------------------------------------|------------|------|----------------------------|---------------------------|------------------------|---------------|----------------|--------|---------|-------|-------------------------------------------------------------------------------------------------------------------------------|
| SBN1, Golden Beach                  | 2/09/2025  | Low  | 12                         | 0                         | 27                     |               |                |        |         | 2     |                                                                                                                               |
| SBN2, Golden Beach                  | 2/09/2025  | Low  | 17                         | 4                         | 9                      | 1             |                | 3      |         | 1     |                                                                                                                               |
| SBN3, Golden Beach                  | 2/09/2025  | Low  | 4                          | 0                         | 13                     |               |                |        |         | 1     |                                                                                                                               |
| BECK, Golden Beach                  | 2/09/2025  | Low  | 0                          | 0                         | 0                      |               |                |        |         | 8     |                                                                                                                               |
| Moffat headland                     | 22/10/2026 | Low  | 0                          | 0                         | 1                      | 0             | 0              | 0      | 0       | 0     |                                                                                                                               |
| Caloundra headland                  | 22/10/2026 | Low  | 0                          | 3                         | 11                     | 0             | 0              | 5      | 0       | 0     |                                                                                                                               |
| Caloundra headland                  | 16/01/2026 | Low  | 2                          | 4                         | 30                     | 0             | 0              | 6      | 0       | 0     | Most birds on the Shelly side of the headland                                                                                 |
| Pt Cartwright                       | 19/01/2026 | Low  | 0                          | 2                         | 9                      | 1             | 0              | 42     | 2       | 0     |                                                                                                                               |
| Coolum                              | 21/01/2026 | Low  | 0                          | 2                         | 2                      | 2             | 0              | 55     | 0       | 0     | Lots of helicopter activity                                                                                                   |
| Maroochy North Shore                | 19/03/2026 | Low  | 0                          | 0                         | 2                      | 7             | 2              | 16     | 4       | 2     |                                                                                                                               |
| Pt Cartwright                       | 15/04/2026 | Low  | 0                          | 0                         | 10                     | 1             | 4              | 63     | 1       | 3     | Lots of foot traffic with school holidays                                                                                     |
| Coolum                              | 16/04/2026 | Low  | 0                          | 0                         | 1                      | 0             | 0              | 46     | 0       | 0     | Busy through all the bays on the school holidays.                                                                             |
| Caloundra headland                  | 17/04/2026 | Low  | 2                          | 3                         | 35                     | 0             | 0              | 26     | 0       | 0     | Most birds on the Shelly side of the headland. School holidays. Pied Cormorants and Sooty Oystercatchers disturbed by people. |
| SBN1, Golden Beach                  | 8/09/2025  | High | 9                          | 4                         | 69                     |               |                |        |         |       |                                                                                                                               |
| SBN2, Golden Beach                  | 8/09/2025  | High | 0                          | 0                         | 0                      |               |                | 2      |         |       |                                                                                                                               |
| SBN3, Golden Beach                  | 8/09/2025  | High | 51                         | 0                         | 470                    |               |                | 5      | 1       | 1     |                                                                                                                               |
| BECK, Golden Beach                  | 8/09/2025  | High | 0                          | 0                         | 21                     |               |                |        |         | 10    |                                                                                                                               |
| Between SBN2 and SBN3, Golden Beach | 8/09/2025  | High | 2                          | 0                         | 1                      |               |                |        |         | 2     |                                                                                                                               |

| Site               | Date       | Tide | Total migratory shorebirds | Total resident shorebirds | Total other waterbirds | Dogs on leash | Dogs off leash | People | Jetskis | Boats | Observations                                                                                                                                                                                                                                                                                                                                                       |
|--------------------|------------|------|----------------------------|---------------------------|------------------------|---------------|----------------|--------|---------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NTBI               | 8/09/2025  | High | 2                          | 4                         | 4                      |               |                | 15     |         |       | 2 recently hatched Red-capped Plover chicks                                                                                                                                                                                                                                                                                                                        |
| Caloundra Bar      | 30/09/2025 | High | 0                          | 0                         | 0                      |               |                | 6      | 1       |       | No shorebirds. 1 jetski doing donuts close to shore. 4 People fishing on GB side, 2 on HV side.                                                                                                                                                                                                                                                                    |
| SBN2, Golden Beach | 30/09/2025 | High | 25                         | 0                         | 43                     |               |                | 1      |         | 1     | 20-25 terns disturbed but returned. ~25 Eastern Curlews disturbed by kitesurfer, flew to middle Bribie sandbank, south of breakthrough; 1 fisherman.                                                                                                                                                                                                               |
| SBN3, Golden Beach | 30/09/2025 | High | 105                        | 11                        | 514                    |               |                |        |         |       | 300 – 500 terns, mostly Common Terns, some Caspian Terns.                                                                                                                                                                                                                                                                                                          |
| BECK, Golden Beach | 30/09/2025 | High | 0                          | 0                         | 20                     |               |                |        |         |       | No shorebirds. Australian Pelicans swimming in the water near boat ramp.                                                                                                                                                                                                                                                                                           |
| SBN2, Golden Beach | 19/03/2026 | High | 313                        | 0                         | 0                      | 0             | 0              | 3      | 0       | 0     | Mixed flock of approximately 300 Bar-tailed Godwit and Eurasian Whimbrel on SBN2. All birds were within exclusion zone on SBN2. Most on the very spit of SBN2. Disturbance (birds taking flight and returning) by paddleboarder and 2 walkers which ignored 'Beach closed' signage. Approx. 40 birds moved to SBN3 after disturbances, remainder returned to SBN2. |

## 4.0 Recommendations

### 4.1 Lower Maroochy River

While it was historically one of the most important roost sites for shorebirds on the lower Maroochy River, the north shore (MRNS) has largely been abandoned as a roost site by shorebirds due to the high levels of disturbance by people using the sandy shoreline for recreation and walking dogs off-leash. Consequently, the sandy shoreline and sand bars on the eastern side of Goat Island (MRGI and MRSB) are currently the most important shorebird roost sites, which enjoy a moderate level of protection from disturbance by being accessible at high tide only by watercraft. Nonetheless, boaters with pets on board do regularly come ashore at Goat Island and walk their dogs, often off-leash, despite it being a Conservation Park where dogs are not allowed. The tidal flats on the eastern and western edges of Goat Island (MR06, MR04 and MR07) are also the most important feeding areas on the lower Maroochy River. While the MR04 and MR07 tidal flats are seldom visited by people, people regularly access the MR06 tidal flats via watercraft or wading/swimming across the southern channel at low tide, causing regular disturbance to feeding shorebirds, including by dogs being walked off-leash. The MR05 tidal flat is located close to a well-used sandy beach in a cove on the northern shore of the river. These disturbance pressures are expected to continue to increase as the human population of the region continues to grow. Research has shown that off-leash dogs in particular cause severe disturbance to shorebirds, reducing their use of important habitats (Dhanjal-Adams *et al.* 2016), and are a key threat to migratory shorebirds in Moreton Bay (Fuller *et al.* 2019).

Recommended approaches for reducing disturbance to feeding and roosting shorebirds include a combination of:

- Site-specific information signage to raise awareness of the presence of shorebirds in the area and the importance of the key habitat areas for shorebirds, particularly migratory shorebirds (Dowling and Weston 1999, Antos *et al.* 2006, Williams *et al.* 2009);
- Other approaches to raising public awareness of how the migration and feeding ecology of shorebirds are impacted by disturbances to try to change public awareness of, and attitudes towards disturbing shorebirds, particularly among dog-owners that exercise their dogs along foreshore areas (Dowling and Weston 1999, Antos *et al.* 2006, Williams *et al.* 2009);
- Planning to ensure suitable dog-walking facilities such as dog-off leash areas are situated in locations convenient and attractive to the public but separated from important shorebird foreshore habitats (Stigner *et al.* 2016);
- Planning to limit access to important feeding or roosting areas by people and/or dogs (Weston *et al.* 2012, Stigner *et al.* 2016); and
- Effective enforcement of access restrictions and dog on-leash areas, given that compliance to access restrictions or on-leash laws is strongly dependent on the extent of enforcement (Dowling and Weston 1999, Dhanjal-Adams *et al.* 2016, Stigner *et al.* 2016).

Lloyd *et al.* (2024) outline how, over the past several years, Sunshine Coast Council has worked to increase public awareness of shorebirds through temporary information signage and a variety of other approaches to raising public awareness, including information on Council's website, funding local artists to paint large murals of various shorebird species including interpretive signage on public toilet blocks, and presentations at a variety of community events. Continuation of these activities is encouraged. Given the high dependency of migratory shorebirds on a single roost site in the lower Maroochy River estuary, namely the sandbank on the eastern side of Goat Island, proactive management of disturbance to this location is recommended. Since Goat Island is part of the Maroochy River Conservation Park and managed by the Queensland Parks and Wildlife Service (QPWS), a collaborative approach involving QPWS is recommended.

## 4.2 Golden Beach

The surveys through 2025/26 confirmed that the two most important migratory shorebird roost sites in the northern Pumicestone Passage are currently SBN2 and SBN3. Both the western and eastern sandbanks at SBN2 continue to be subject to regular human disturbance by recreational users of the area that can cause birds to move across the channel to SBN3 where they are generally subject to less disturbance risk. This highlights the importance of having at least two suitable roost sites in this area, so that the one can serve as an alternative roost site should birds be disturbed off the other. The maintenance of a network of suitable roost sites is a recommendation for the management of the impacts of disturbance on shorebirds in Moreton Bay (Fuller *et al.* 2021). Recreational disturbance pressure is predicted to continue to increase as the region becomes more developed. Consequently, there is a need for proactive management of disturbance to shorebirds at the important roosting and feeding habitats at Caloundra that are identified above. Approaches for reducing disturbance to feeding and roosting shorebirds are as recommended under **Section 4.1** above. Site-specific signage that clearly indicates the locations of the most frequently used high tide roosting areas to be avoided within the SBN1, SBN2, SBN3 and NTBI roost sites, together with an explanation of why disturbance to flocks of roosting birds should be avoided would be particularly useful in this context.

Given the importance of maintaining a suitable roosting area on SBN3, the final landform for this area that is being subject to restoration by the emergency works is recommended to include a broad, open sandy area on the water's edge that has a shallow slope to ensure birds can roost in shallow water on the shoreline edge on all high tides. The most suitable location for this roosting area would be at the northern tip of the final landform, bordering the new ocean entrance to Pumicestone Passage that was created by the first breakthrough. Natural coastal processes are likely to maintain a suitable open sandy area at this location.

The emergency dredging works avoided direct impacts on migratory shorebird foraging habitat by dredging sand from sub-tidal waters and not from adjoining tidal flat areas that are exposed at low tide. Future dredging works to maintain the restored coastal landforms is recommended to similarly focus on dredging sand from sub-tidal waters to avoid any direct impacts on tidal flats that provide important foraging habitat for migratory shorebirds within the Moreton Bay Ramsar site.

The monitoring found no evidence of a significant negative impact of the emergency dredging works over the short term i.e. during the period of the emergency works. Since it is possible that impacts of dredging on migratory shorebird food availability could manifest over a longer term following the completion of dredging, further monitoring is recommended to assess the longer-term impacts.

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## **APPENDIX 1**

### **Shorebird survey conditions**

**Table A1.1. Tide and weather conditions during surveys at Maroochy River.**

| Date       | LT time | LT ht (m) | HT time | HT ht (m) | Low tide (LT) |       |      | High tide (HT) |       |      |
|------------|---------|-----------|---------|-----------|---------------|-------|------|----------------|-------|------|
|            |         |           |         |           | Wind          | Cloud | Rain | Wind           | Cloud | Rain |
| 21/11/2025 | 15:01   | 0.49      | 08:34   | 1.82      | ESE 19        | 7/8   | nil  | SE 15          | 6/8   | nil  |
| 19/12/2025 | 14:15   | 0.54      | 07:44   | 1.83      | NE 20         | 1/8   | nil  | SE 13          | 1/8   | nil  |
| 19/01/2026 | 15:40   | 0.45      | 09:13   | 1.96      | SE 35         | 7/8   | nil  | SSE 28         | 8/8   | nil  |
| 17/02/2026 | 14:36   | 0.42      | 08:13   | 1.97      | ESE 24        | 7/8   | nil  | SSE 22         | 7/8   | nil  |

**Table A1.2. Tide and weather conditions during surveys at Golden Beach.**

| Date             | Tide time | Tide height (m) | Wind direction | Wind speed (kph) | Rain | Works description                                                                                                   |
|------------------|-----------|-----------------|----------------|------------------|------|---------------------------------------------------------------------------------------------------------------------|
| <b>High tide</b> |           |                 |                |                  |      |                                                                                                                     |
| 09/10/2025       | 10:07     | 1.93            | NNW            | 22               | Nil  | Dredging subtidal sand from west of SBN3 onto the southern portion of the restoration area.                         |
| 20/11/2025       | 08:54     | 1.77            | SE             | 15               | Nil  | Dredging subtidal sand from west of SBN3 onto the southern portion of the restoration area.                         |
| 20/12/2025       | 09:09     | 1.79            | NE             | 22               | Nil  | Dredging subtidal sand from west of SBN3 onto the restoration area. Dozers working at the N end of SBN3.            |
| 21/01/2026       | 10:33     | 1.84            | SSE            | 15               | Nil  | Dredging subtidal sand onto the north of SBN3. Dozers active within 80m of the N end of SBN3.                       |
| 19/02/2026       | 10:02     | 1.89            | NNW            | 13               | Nil  | Dredging subtidal sand in channel bisecting SBN2, pumped onto N end of restoration area. Dozers active on foredune. |
| 17/04/2026       | 08:21     | 1.79            | W              | 4                | Nil  | No dredging. Workers on foot erecting sand stabilisation fencing on formed foredune.                                |
| <b>Low tide</b>  |           |                 |                |                  |      |                                                                                                                     |
| 09/10/2025       | 17:08     | 0.36            | NNE            | 35               | Nil  | Dredging subtidal sand from west of SBN3 onto the southern portion of the restoration area.                         |
| 20/11/2025       | 16:01     | 0.52            | E              | 19               | Nil  | Dredging subtidal sand from west of SBN3 onto the southern portion of the restoration area.                         |
| 20/12/2025       | 16:24     | 0.47            | NNE            | 31               | Nil  | Dredging subtidal sand from west of SBN3 onto the restoration area. Dozers working at the N end of SBN3.            |
| 21/01/2026       | 17:44     | 0.36            | SE             | 17               | Nil  | Dredging subtidal sand onto the north of SBN3. Dozers active within 80m of the N end of SBN3.                       |
| 19/02/2026       | 17:09     | 0.25            | NNE            | 22               | Nil  | Dredging subtidal sand in channel bisecting SBN2, pumped onto N end of restoration area. Dozers active on foredune. |
| 17/04/2026       | 15:23     | 0.16            | N              | 13               | Nil  | No dredging. Workers on foot erecting sand stabilisation fencing on formed foredune.                                |