ANNUAL ANALYSIS OF THE STATUS OF SHOREBIRDS AT THE PORT OF BRISBANE BETWEEN SEPTEMBER 2019 & AUGUST 2020

Includes an analysis of historical trends in counts and a comparison with Moreton Bay populations.

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May 2021

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EXECUTIVE SUMMARY

As in previous reports, the species that are most important at the Port of Brisbane (PoB) are identified and their numbers on the site are compared with their numbers across the whole of Moreton Bay. Counts for each subsection of the site for September 2019 to August 2020 are tabulated and comparisons are made with previous years.

The twelve species of particular importance within the Port are given most attention. They include four plover species (Lesser and Greater Sand Plovers, Pacific Golden Plover and Grey Plover), three larger sandpipers (Far Eastern Curlew, Bar-tailed Godwit and Great Knot) and five smaller sandpipers (Grey-tailed Tattler, Sharp-tailed Sandpiper, Curlew Sandpiper, Red-necked Stint and Ruddy Turnstone). Grouped data for all migratory shorebird species and all resident shorebird species are also presented.

Where practical, monthly counts are made on the same high tide at each of the various subsites within the Port (Figure 1). Mean or maximum count values are given for each of four periods of the year but with an emphasis on the main period of occupancy during the non-breeding season from mid-November to mid-March. Note that for this recent round of sampling only 10 months of data are available for the 12-month period between September 2019 to August 2020, also referred to here as the 2019 "shorebird year". No sampling was done in April and May of 2020 because of Covid constraints. The March count was unusual and almost certainly an undercount because many sites were counted using photographs taken by PoB personnel. In contrast, two full site surveys were made at the start and at the end of September 2019, meaning there were eleven sampling sessions for the yearlong sampling period.

As expected, numbers of migratory shorebirds are highest during the summer months and 16 or more species were regularly recorded at any one time, while 21 species were recorded across the year. The previous year was somewhat unusual with the occurrence of a single Asian Dowitcher and the Buff-breasted Sandpiper on several of the counts. Numbers of resident shorebirds were higher during the summer months (unusual) and eight species were recorded for the year. Over the last decade migratory shorebird numbers have remained at about the same level and the site generally remains the most important single roosting area for shorebirds in the whole of Moreton Bay. Data collected throughout Moreton Bay over a long period of time suggest that the PoB lands have progressively become more important for local shorebird populations, perhaps because other suitable roosting habitat in the Bay has been impacted by disturbance or physical changes. This trend may have stabilised for the present.

The location of sites within the Port area being used by shorebirds changes over time. There is a clear pattern of the way in which birds alter their choice of roosting area as reclamation proceeds. They move to where fresh dredge spoil is being deposited and then move on as deposition stops and the spoil dries out to form a crust.

Over the entire Port area since 2003, the pattern of yearly changes in numbers varies between species. Numbers certainly fluctuate from year to year but without any dramatic changes. However, long- and medium-term trends are apparent and a very long-term reduction in at least the peak number of some species is evident. These patterns are described, and continued sampling will help to establish whether these are cyclical patterns or distinct trends in numbers.

For example, seven of the twelve important migratory shorebird species at the Port have had maximum summer counts at some time prior to 2008. More recently, three species, Red-necked Stint, Curlew Sandpiper and Lesser Sand Plover have shown declining numbers for three consecutive years and the latter two species exhibited critically low counts either once or twice during sampling over the 2019-20 summer period.

The heightened threats to migratory shorebirds from a changing climate and increasing human population throughout the East Asian–Australasian Flyway cannot be underestimated. Local conditions and changes to shorebird habitat in Moreton Bay add to an intricate set of factors that may determine the population size of many of these remarkable migrant species over the coming decades. The detail and time span of shorebird data being gathered at the Port is of great value for developing management strategies for shorebirds, both within the Port area and elsewhere. The PoB must continue to prioritise the management and monitoring of shorebirds. Ideally, there could be provision for substantial habitat for shorebirds into the future on or adjacent to Port lands. In this regard, the PoB could advocate for such an outcome together with other interested and relevant stakeholders and regulators. There needs to be planning

to provide adequate shorebird habitat in Moreton Bay into the future in the face of continued human encroachment along the Bay foreshore and the eventual demise of most of the existing shorebird habitat at the Port.

A. BACKGROUND

For over 30 years, high numbers of migratory shorebirds have been documented using Port of Brisbane (PoB) lands as high tide roosting habitat (Figure 1). The habitat is primarily being created by pumping of dredge material as infill for ongoing reclamation and the birds respond to varying configurations of suitable habitat, as the landscape changes at the Port.

Since 2003, members of the Queensland Wader Study Group (QWSG), have undertaken regular (almost monthly) counts of birds within the Port reclamation area, at a purpose-built shorebird roost site and at a nearby clay pan, all on PoB lands. Yearly reports have been supplied to the PoB. At the same time, QWSG members have also regularly counted between 50 and 65 other high tide roosts in Moreton Bay, which is used here as background information in assessing shorebird numbers at the Port. QWSG and/or the earlier Port administration were collecting data from the Port as early as 1991. Data for the current year from another site, LYN1 or "Lytton Claypan No 1" has been requested for inclusion and is shown in Figure 2 and in Appendix A. That data is not used in any other context within this report.

This is the seventh report in the series since 2013 and addresses the following:

1. Bird numbers by species and site (individually and overall) at the Port for the last year (2019-20) presented as a table of raw numbers and suitable graph(s).
2. Comparisons of shorebird numbers for important species at the Port with Moreton Bay sites generally, noting any species showing striking variation between datasets.
3. Presentation of annual changes in shorebird numbers by species for each subsite within the Port. Groupings of subsites are also compared, although more recently there is only one group of note, Area D (Fig. 1). The artificial roost and the claypan are distinct subsites separate from the reclamation area. Subsites are ranked for importance to shorebirds.
4. Graphical presentation of long-term trends for shorebird numbers at the Port by species are presented. In this context, critically low summer counts, calculated in last year's report are used as threshold values to assess whether the counts of birds may have dropped significantly during the most recent 12 months of survey.

As usual, the report will focus on a group of "important" shorebird species at the Port, that is, those with particularly high numbers, or highly threatened species with good representation at the Port. A few techniques are being used consistently to: (a) rank the status of subsites within the PoB; (b) assess changes in the ratio of birds using the Port versus Moreton Bay as a whole; and (c) evaluate critically low counts of individual species (as noted above).

B. IMPORTANT MIGRATORY SHOREBIRD SPECIES AT THE PORT OF BRISBANE

The following twelve migratory species of shorebird are the focus of this report. They have all been recorded at some time or another on Port lands, in numbers exceeding 0.2 % of their flyway populations, and mostly in numbers exceeding 1% of flyway numbers (Table 1). Note that >1% and > 0.5% of flyway numbers are considered internationally and nationally significant respectively. Further justification for the choice of these species was given in the initial 2013 report on shorebirds at the PoB.

Data in Table 1 are for summer months since 2003. Three species had their highest summer count since 2013 during the 2019-20 summer. Whereas, the peak counts for two of these three species (Bar-tailed Godwit and Grey-tailed Tattler) are not appreciably higher than other maximum summer counts over the last eight years, the recent high count of 1219 Pacific Golden Plovers is 46% higher than the next highest maximum recorded since 2007 (Appendix C). A count of 1090 was recorded in 2006.

This high count of Pacific Golden Plover removes this species from a list of seven species noted in last year's report that had all summer counts below those recorded sometime prior to 2006. The remaining six species are the Far Eastern Curlew, Greater Sand Plover, Grey Plover, Lesser Sand Plover, Red-necked Stint and Sharp-tailed Sandpiper.

Note that the Sharp-tailed Sandpiper can be counted in higher numbers during the migration periods than over the austral summer. Such high counts during migration are likely attributable to birds passing through the Port rather than spending the summer in the area. Average count values for all twelve species in different seasons for each year since 2003 are presented in Appendix C and discussed in Section F as long term trends in numbers of each species (Figure 4), or as migratory shorebirds as a whole (Section C & Figure 2).

Figure 1. Shorebird count sites and site groupings (Areas) within the Port of Brisbane land reclamation zone. The four-character site-codes are used throughout this and previous reports. The claypan roost (FICP), south east of Fisherman Is., is not shown but is used in the compilation of results. The site PBC4 is a newly bunded area that is being occupied by roosting shorebirds. Counts began here on 27th March 2020. Red lettering indicates sites that are no longer used by shorebirds due to the process of reclamation (no longer sampled).

Table 1. *Maximum summer counts of "important species" (see text) at the PoB. With the exception of Great Knot, Greater Sand Plover and Grey Plover, all species have been recorded on every Port wide summer count since 2003. Another measure of prevalence at the Port is the percentage of times each species was recorded from the 193 regular counts that have been made between Sept 2003 & August 2020, including all seasons not just summer.*

Species	Latest max. count for 2019-20	Max. count since 2003 (% flyway pop[n])	Year of maximum	% of all surveys recorded
Grey-tailed Tattler	1434	1434 (2.0)	2019	91
Red-necked Stint	2218	6803 (1.4)	2003	100
Lesser Sand Plover	1672	2433 (1.4)	2003	91
Curlew Sandpiper	1455	2607 (2.9)	2017	99
Sharp-tailed Sandpiper	808	2078 (2.4)	2005	87
Far Eastern Curlew	207	670 (1.2)	2006	91
Pacific Golden Plover	1219	1219 (1.0)	2019	88
Great Knot	389	708 (0.2)	2013	74
Greater Sand Plover	147	441 (0.2)	2006	74
Ruddy Turnstone	190	213 (0.7)	2016	89
Bar-tailed Godwit	1572	1572 (0.5)	2019	96
Grey Plover	41	145 (0.2)	2007	68

C. RECENT COUNTS OF MIGRATORY SHOREBIRD SPECIES AT THE PORT OF BRISBANE.

Table 2 lists the number of shorebird species and total shorebirds recorded in each of the PoB subsites (including the claypan FICP, which is not shown in Figure 1) on each sampling occasion between September 2019 and August 2020. The tabulations are given for migratory and resident species separately. Counts for each of the twelve "important" species for each subsite and month during the past year is given in Appendix A. Appendix B has the 2019-20 monthly totals across all PoB subsites for each shorebird species, not just the twelve "important species".

In Table 2, sampling has been divided into four time periods as follows: "Breeding" (the northern hemisphere breeding season or our winter months June to August); "South Migration" (September to mid-November); "Non breeding" (mid-November to mid-March – approximately our summer) and "North Migration" (mid-March to May). This is because these time periods generally represent a breakdown of the activity of migratory shorebirds throughout the year. Such an approach is consistent with previous reports and allows a better understanding of shorebird population dynamics. Hence, the tables to follow sometimes use "shorebird years", not calendar years, and are labelled accordingly. That is, the "2019" label represents the period from September 2019 to August 2020.

Migratory and resident shorebirds are quite different in their occupancy of local shorebird habitat. Migratory bird numbers are lowest in winter when numbers of resident birds are usually highest. Migratory numbers peak through the summer months but can also be high during the southward, and the northward migrations. As noted in previous reports, the diversity and concentration of shorebirds using the Port makes it the most important area in the Bay for migratory shorebirds (refer to Section E).

The distribution of counts for migratory shorebirds throughout the 2019 "shorebird year" was very similar to that for 2018. The annual pattern for resident waders in each of the past four years was also similar (Figure 2). However, average numbers in summer in both 2018 and 2019 were lower than for most previous years for migratory shorebirds. In contrast, average winter and summer numbers of resident shorebirds were among the highest documented since 2003, albeit only marginally so in the case of 2019 (Figure 3).

There continues a slight downward trend in migratory shorebird numbers for the last three years at the Port, although the magnitude of the shift is not unlike previous variability in annual counts as shown in Figure 3. The results don't necessarily infer the downward trend will continue. If the trend does continue it will be unusual.

The mean 2019 summer count value for migratory shorebirds as a whole (6280 birds, see Figure 3) is the second lowest recorded since 2007, and the 4th lowest since 2003. It is 14% lower than the mean yearly summer value of 7328 birds over 17 years of sampling and very similar to the value reported for the shorebird year of 2018. In contrast, resident shorebird numbers have been quite high in recent years.

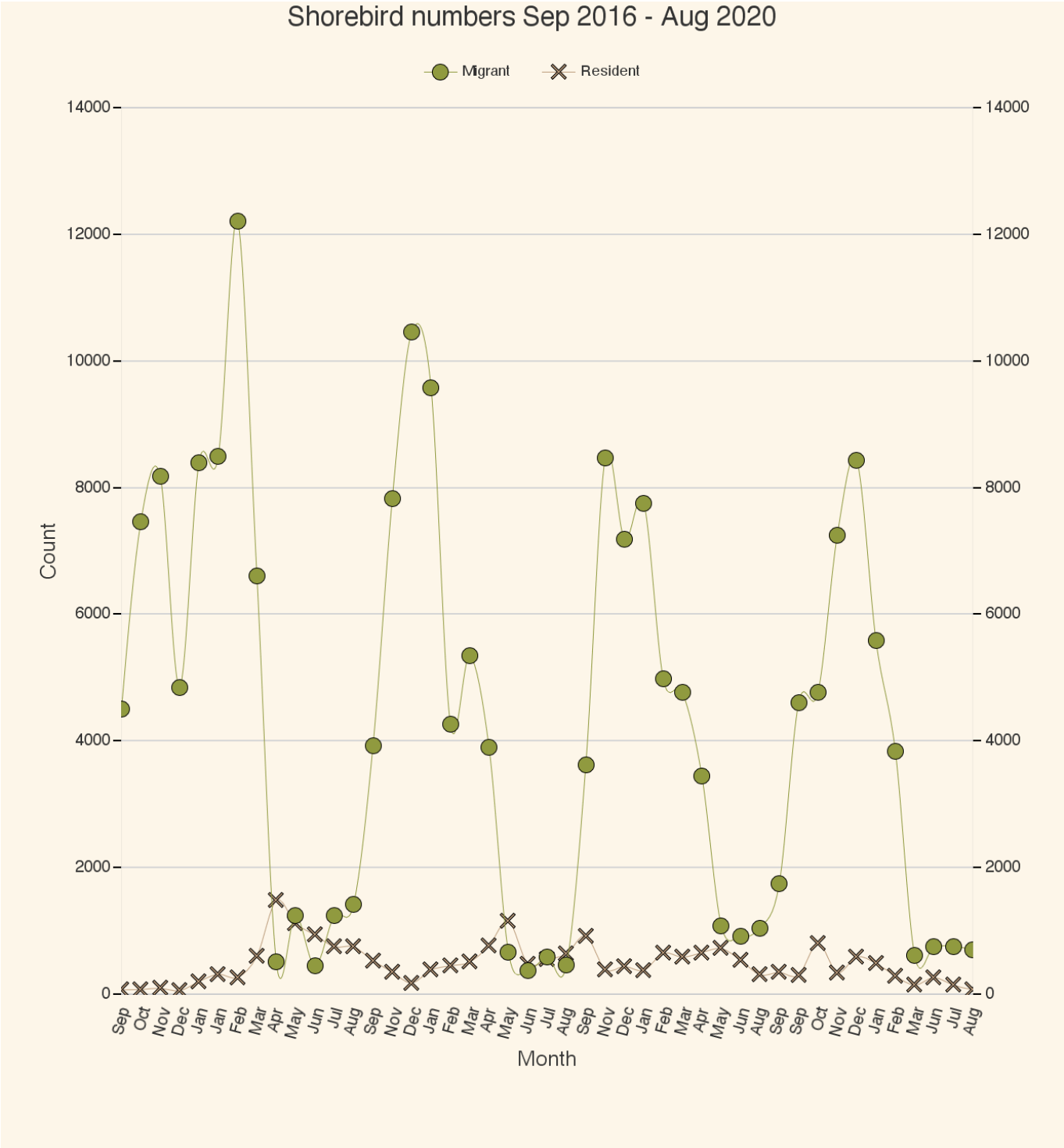


Figure 2. Total migratory and total resident shorebird numbers by month between Sep 2016 & Aug 2020 (total monthly Port counts).

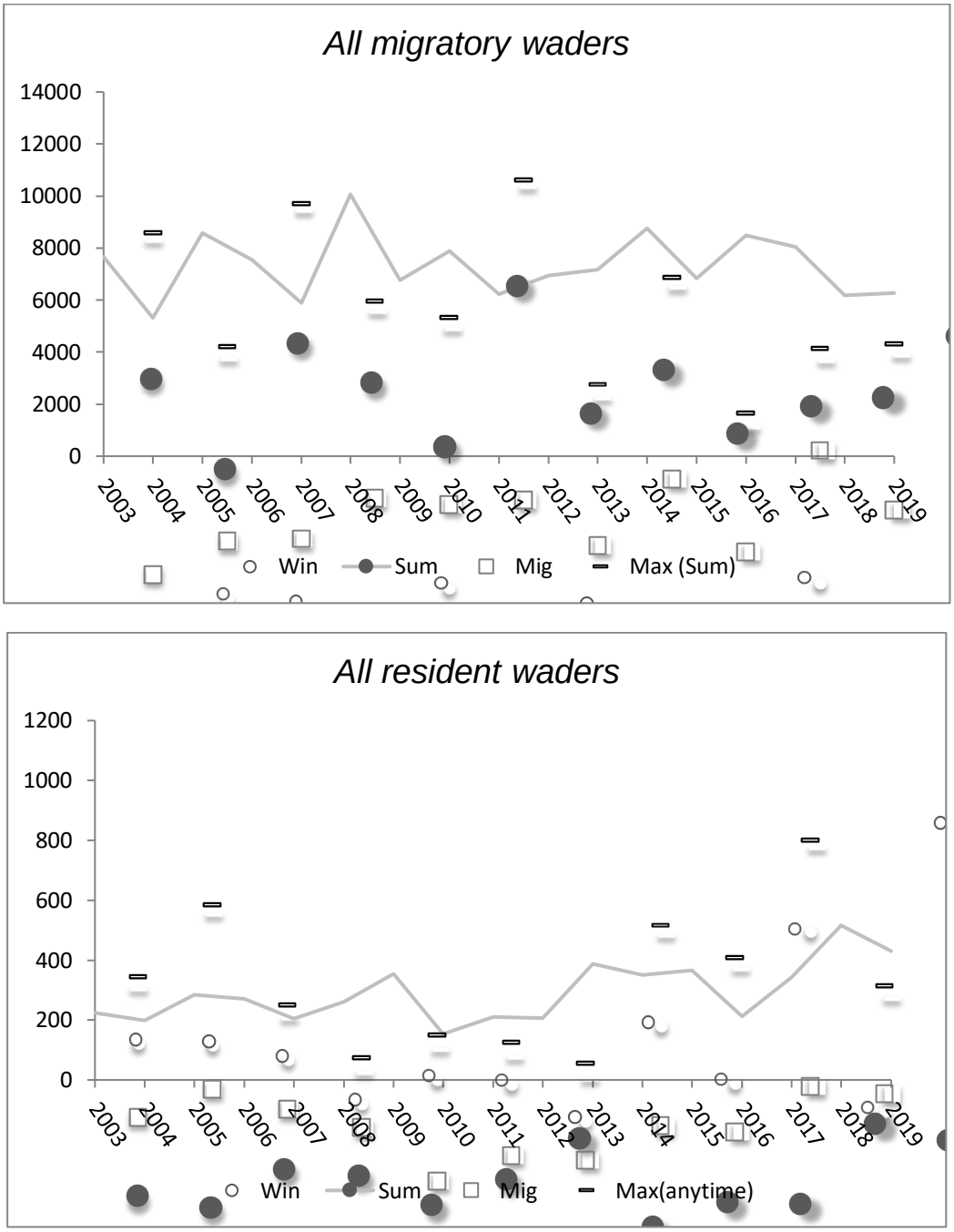


Figure 3. Average counts for each season and "shorebird year" since 2003 for all migratory and all resident shorebirds throughout the Port, including the claypan (FICP). Win (winter or breeding): Jun to Aug; Sum (summer or non-breeding): mid-Nov to mid-March; Mig: migration periods (south – Sep to mid-Nov and north – mid-March to end of May). The "shorebird year" runs from the southward migration through to winter.

D. ANNUAL CHANGES IN SHOREBIRD NUMBERS BETWEEN SUBSITES WITHIN THE POB

There is a wide range in bird numbers recorded at the different PoB subsites, which reflects both the chance occurrence of birds but especially the suitability of the eleven different subsites as roosting habitat for the various species.

Within the PoB reclamation area (Figure 1), shorebirds now only use ponds in Area D. Furthermore, over the last few years they have stopped using pond C1 (site PBC1 within Area D). However, in March 2020, a new subsite was created as part of the reclamation works and has been assigned as Pond C4 (PBC4). Despite any recent changes, Area D, the artificial roost (PBAR) and the claypan (FICP) continue to define the extent of the PoB shorebird habitat (11 subsites)

Table 2. Total migratory and resident shorebird counts and species tallies for each PoB subsite sampled in each month between Sept 2018 and August 2019. The percentage contributions to total numbers made by each subsite are shown in the final column. * denotes a new pond (C4) starting March 2020.

	Month of Survey -->	Sep 2019	Sep 2019	Oct 2019	Nov 2019	DEc 2019	Jan 2020	Feb 2020	Mar 2020	Jun 2020	Jul 2020	Aug 2020		
	Migratory shorebird totals													
Subsites (11 in total)	Season	Sth Migr.	Sth Migr.	Sth Migr.	Non Br.	Non Br.	Non Br.	Non Br.	Nth Migr	Breeding	Breeding	Breeding	**Year Total**	% total counts
Fish. Is Claypan	**FICP**	91	212	1034	222	275	602	1022		91		96	**3645**	9.3%
Artifical roost	**PBAR**	4	176	202	458	148	20		38			5	**1051**	2.7%
Pond C2	**PBC2**			24		236	3	5			4		**272**	0.7%
Pond C3	**PBC3**	4	668	940	4753	3907	1927	280	31	254	483	25	**13272**	34.0%
*Pond C4	**PBC4**								63	173		6	**242**	0.6%
Pond R3	**PBR3**	1545	3308	1600	487	2016	364	202	254	46		478	**10300**	26.4%
Pond B1	**PBS1**				277	39	59	10					**385**	1.0%
Pond B2	**PBS2**			613	15	46	1127	1173		98	173	75	**3320**	8.5%
Pond B3	**PBS3**	10		6	3	37	135	918		14	81		**1204**	3.1%
Pond B4	**PBS4**	6	8	42	1006	1686	54	12	108	14	11	15	**2962**	7.6%
Pond FPE	**PFPE**	89	232	308	32	45	1298	215	121	64	9	6	**2419**	6.2%
	Total	**1749**	**4604**	**4769**	**7253**	**8435**	**5589**	**3837**	**615**	**754**	**761**	**706**	**39072**	
Lytton Claypan # 1	**LYN1**	181	159	1635	1422	1932	924	1042	220	62	132	154	**7863**	
	Migratory shorebird number of species													
	FICP	5	5	6	4	7	9	8	0	1	0	4		
	PBAR	1	9	4	12	10	5	0	2	0	0	1		
	PBC2	0	0	1	0	3	1	1	0	0	1	0		
	PBC3	2	5	4	5	8	9	6	2	3	6	2		
	PBC4	0	0	0	0	0	0	0	2	4	0	1		
	PBR3	3	11	8	6	11	2	7	3	2	0	2		
	PBS1	0	0	0	3	2	3	3	0	0	0	0		
	PBS2	0	0	8	2	2	9	9	0	2	2	1		
	PBS3	1	0	1	1	3	6	11	0	1	2	0		
	PBS4	2	3	7	6	9	4	5	4	2	3	4		
	PFPE	6	8	8	2	4	6	6	3	2	0	4		
	LYN1	6	5	8	8	8	6	7	4	1	4	3		
	Resident shorebird totals													% total counts
	FICP	95	92	41	132	231	146	27	16	50	5	13	**848**	22.3%
	PBAR	195	103	232	126	49	55		1	93	12	21	**887**	23.3%
	PBC2	2	2	2		5	4				3	3	**21**	0.6%
	PBC3	4	47	1	11	148	51	12		18	24	8	**324**	8.5%
	PBC4								108	4		5	**117**	3.1%
	PBR3	6	11	516	40	38	39	95	18	1	10	4	**778**	20.4%
	PBS1	2	9		2	16	12	14		9	10	1	**75**	2.0%
	PBS2	3	3	9	3	10	38	5		45	13	7	**136**	3.6%
	PBS3	4	4			11	2	2			3		**26**	0.7%
	PBS4	8	9	5	5	14	142	118	5	5	4	8	**323**	8.5%
	PFPE	30	24	2	25	72	4	5		42	61	7	**272**	7.1%
	Total	**349**	**304**	**808**	**344**	**594**	**493**	**278**	**148**	**267**	**145**	**77**	**3807**	
	LYN1	314	231	4	41	149	79	19		29	17	44	**927**	
	Resident shorebird number of species													
	FICP	3	2	3	3	3	2	3	2	3	3	2		
	PBAR	3	4	3	6	7	4		1	4	2	1		
	PBC2	1	1	1		1	1				1	1		
	PBC3	1	1	1	1	1	1	2		1	1	1		
	PBC4								1	2		2		
	PBR3	1	1	3	2	3	2	3	1	1	2	1		
	PBS1	1	1		1	2	1	2		1	1	1		
	PBS2	1	1	1	1	1	3	1		1	1	1		
	PBS3	1	1			2	1	1			1			
	PBS4	2	2	1	3	4	1	2	1	1	1	2		
	PFPE	3	2	1	1	1	2	1		2	2	1		
	LYN1	2	2	1	3	3	2	4		3	2	3		

There are now nine subsites in Area D (C2, C3, C4, R3, BS1, BS2, BS3, BS4 & FPE) (Figure 1). Table 2, Figure 3 and Appendix A document the count data from these subsites, and the subsites FICP and PBAR.

Rather than plot the temporal series of count data over several years across the 11 sites (or subsites), which could be done using data from Figure 2 & Appendix C, an alternative approach is taken to understand year to year changes in use of the subsites by migratory shorebirds. Each of the eleven subsites was ranked between 1 to 11 in the following categories with low value equating to high rank (1 the best).

Note that this is the same procedures as adopted for shorebird years 2017 and 2018 when only 10 sites were used, the eleventh now being the new C4 site (PBC4). Since sampling only covered part of the year for C4 it is not included in this analysis. The categories used for ranking the sites are:

(a) total number of migratory shorebirds recorded for the shorebird year (from Table 2),
(b) average number of migratory shorebird species recorded for the shorebird year (from Table 2) and
(c) an average rank for each site based upon individual site rankings using total birds counted throughout the shorebird year for each of the 12 important species (Appendix A).

For each site, the average of these three rankings was used as a measure of the status of the site for a particular year as shown for the past three years in Table 3. The lower the ranking the higher the status of the site as shorebird habitat on the basis of a combination of the three criteria noted above.

Table 3. Derived rank of relative importance of the ten sampling sites currently in use at the PoB based upon data from Tables 2 & Appendix A. The rankings are for each of the past three "shorebird years". The data used for other than the latest year, can be found in previous reports. The site rankings within years are colour graduated from light green (high rank or low numeric value) to dark green (low rank or high numeric value). The last column indicates the extent of change in ranking from the last (2019) to the first year (2017). If the value is negative, then the ranking has improved.

Site	Site code	Rank 2017	Rank 2018	Rank 2019	Lastest-First
Area D - R3	PBR3	1.70	1.40	1.80	0.1
Area D - C3	PBC3	3.20	3.00	2.30	-0.9
Claypan	FICP	3.30	6.10	4.00	0.7
Area D - FPE	PFPE	3.80	4.10	4.90	1.1
Area D - BS4	PBS4	5.50	4.30	5.00	-0.5
Area D - BS3	PBS3	6.20	7.70	6.70	0.5
Area D - BS2	PBS2	6.80	6.60	4.90	-1.9
Artificial roost	PBAR	6.90	3.90	6.90	0.0
Area D - C2	PBC2	8.60	9.40	9.70	1.1
Area D - BS1	PBS1	9.00	8.50	8.80	-0.2
Area D - C4	PBC4			n/a	

Generally, the site rankings have not changed appreciably over the three years. The most noticeable exception being the better ranking of the artificial roost (PBAR) in 2018, which reverted to a poorer ranking in 2019. In contrast, the claypan site (FICP) was ranked poorly in 2018 compared with 2017 and 2019. The best two subsites have consistently been PBR3 and the adjacent PBC3. Apart from the anomaly in 2018 for FICP, the next two subsites (FICP and PFPE) have also maintained the same status or relative rankings between 2017 and 2019. Similarly, the two worst ranked subsites (PBC2 and PBS1) have consistently held the two worst rankings with the purpose-built artificial roost (PBAR) being the next worst ranked subsite, except in 2018 as noted above.

Migratory shorebirds are still concentrating their roosting activities just behind the front line of reclamation running from the north in PBR3, through PBC3 and into PBS4 and PFPE. The claypan (FICP) is fairly consistently suited to use by shorebirds whereas the other permanent site, PBAR, appears less suited.

A more detailed appraisal of the subsites requires a breakdown of their importance for particular species, which could be done using data presented in this and previous reports.

E. COMPARISON OF SHOREBIRD NUMBERS BETWEEN THE POB AND MORETON BAY AS A WHOLE

This section presents a comparison of migratory shorebird numbers between the PoB reclamation area (including the claypan) and Moreton Bay as a whole. An Index of Relative Importance (IRI) of the PoB was developed, which is applied to each of the twelve "important" species (see Table 1). Temporal changes in the index for each species are tabulated in Table 4 for the shorebird years 2016 to 2019.

The IRI is calculated for each month between September to April each year (Eq. 1). It is the ratio of counts for the PoB compared with averaged (where more than 1 count a month) and summed counts across most of Moreton Bay, (refer to Appendix for a list of sites used). Usually there is a single count each month at the Port (no average) and sometimes a count is missed. In the latter case, the relevant month is omitted from calculations. For each year, the relevant IRI measures are averaged across months and tabulated for the relevant shorebird years (Table 4). Changes in the IRI reflect local changes in the relative importance to the species of the PoB lands compared with Moreton Bay as a whole.

$$IRI = \frac{Port\ of\ Brisbane\ count}{Moreton\ Bay\ count} \qquad (1)$$

The IRI can vary between zero and one, with a value of one meaning all birds of that species were counted within the PoB (11 sites together). The results are colour graduated in Table 4 as green for highest, yellow for lowest where the grading applies between years not from one species to another.

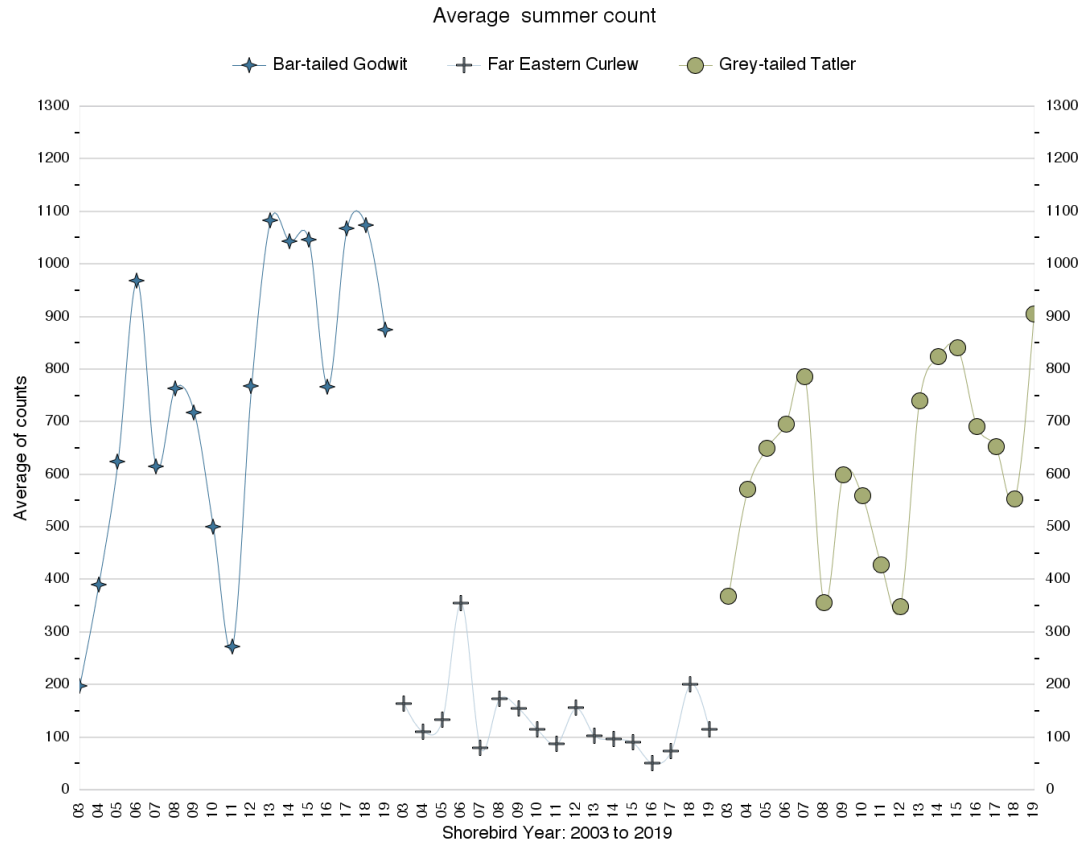
The IRI was highest in 2016 for six of the twelve species, whereas it was highest for two others in 2017, one species (Sharp-tailed Sandpiper) in 2018, and highest for three species in 2019. Mention has already been made of the high counts at the Port of one of these latter three species, the Pacific Golder Plover in section B. The index as an average for all twelve species was highest (0.52) in 2016 and consistently lower for the subsequent three years (0.44 to 0.46). Whereas the results from the last shorebird year (2018) suggested the IRI may be rebounding somewhat from the 2017 figures, these latest results confirm another set (2019) of low IRI values, especially compared with 2016.

Seven of the twelve species showed their lowest recorded IRI for the shorebird year of 2019, perhaps another indication of recent low numbers of migratory shorebirds reported at the Port (see Section C & Section F). In this instance, the low numbers may not necessary be a reflection of a more general trend throughout Moreton Bay. There may be a local effect of fewer birds at the PoB.

The transitory and ever-changing condition of shorebird habitat on the reclamation area at the Port may be influencing these results. As has been stated previously, in the long-term shorebirds may suffer population declines in Moreton Bay generally due to a lack of suitable roosting habitat as land reclamation at the Port proceeds to conclusion. Continued use of this index of relative importance will help to monitor the changes in shorebird numbers at the PoB compared to elsewhere throughout Moreton Bay.

Table 4. Index of Relative Importance (IRI) for the PoB, for each of the last four shorebird years for each of the twelve "important" species (Table 1). Colour coding for the four years is green: highest; yellow: lowest and graded green to yellow in between. The colour grading is for between years, not between species.

Mean propotion of the Moreton Bay Population (IRI) in succeeding shorebird years (Sept to August)				
Species	2016	2017	2018	2019
Bar-tailed Godwit	0.21	0.16	0.15	0.12
Curlew Sandpiper	0.68	0.84	0.71	0.56
Far Eastern Curlew	0.16	0.07	0.12	0.07
Great Knot	0.36	0.35	0.31	0.39
Greater Sand Plover	0.72	0.63	0.61	0.53
Grey Plover	0.85	0.70	0.79	0.90
Grey-tailed Tattler	0.43	0.31	0.36	0.34
Lesser Sand Plover	0.71	0.76	0.67	0.67
Pacific Golden Plover	0.57	0.44	0.49	0.63
Red-necked Stint	0.51	0.51	0.40	0.37
Ruddy Turnstone	0.66	0.36	0.54	0.37
Sharp-tailed Sandpiper	0.40	0.25	0.42	0.39
Aver. across the species	0.52	0.45	0.46	0.44



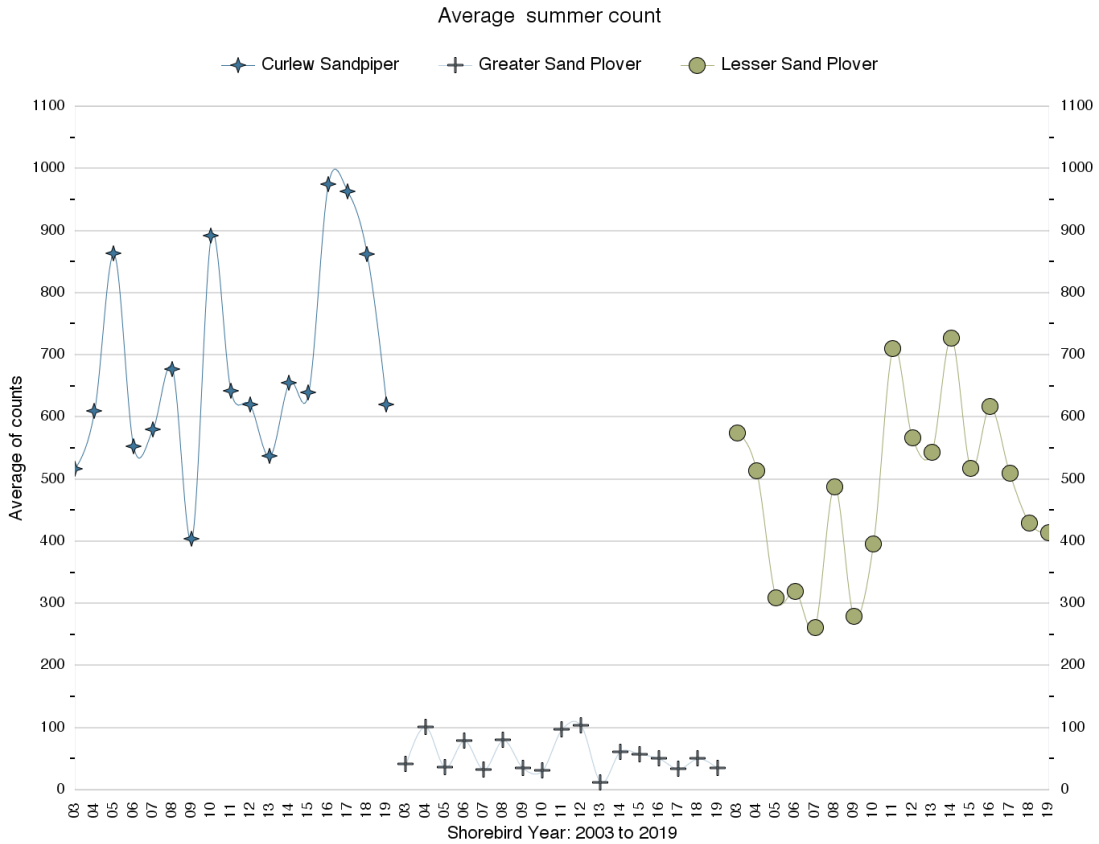
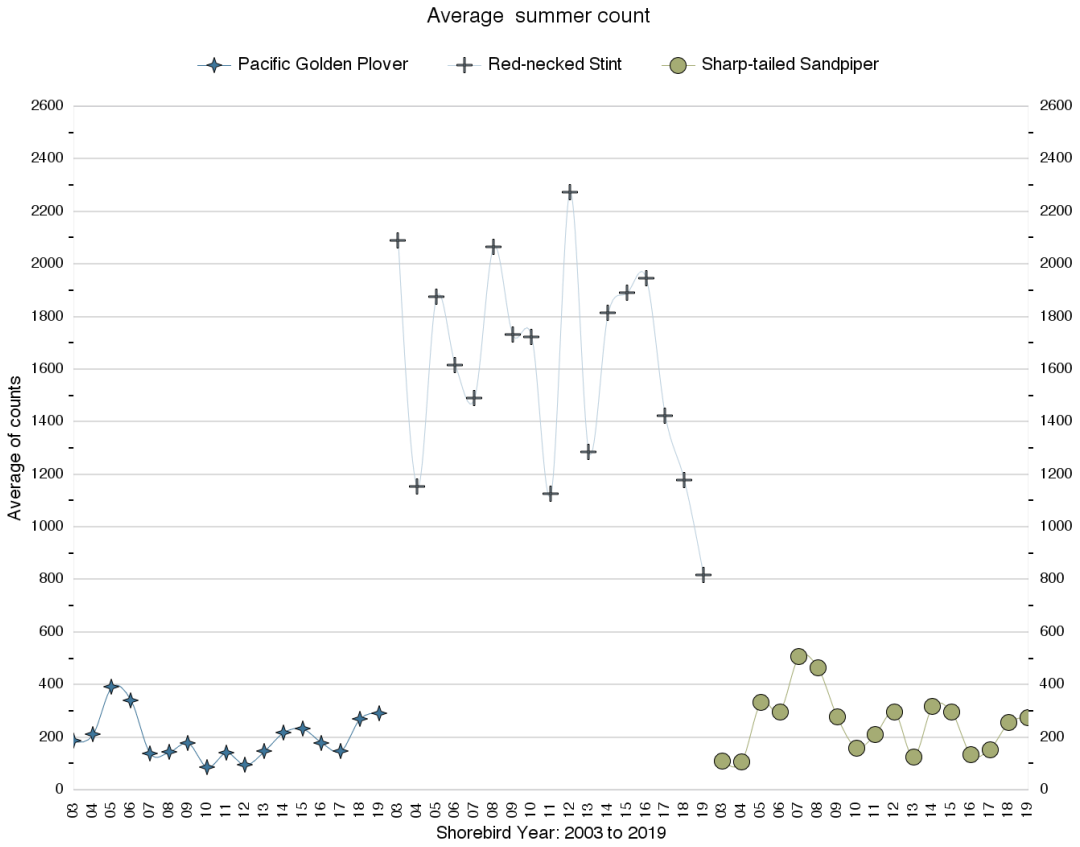


Figure 4a. Temporal variation in PoB average non-breeding (summer) counts (mid Nov-mid Mar) for six "important" species. These and maximum counts together with average breeding (winter) and migration period counts are tabulated in Appendix A for each shorebird year between 2003 and 2019.



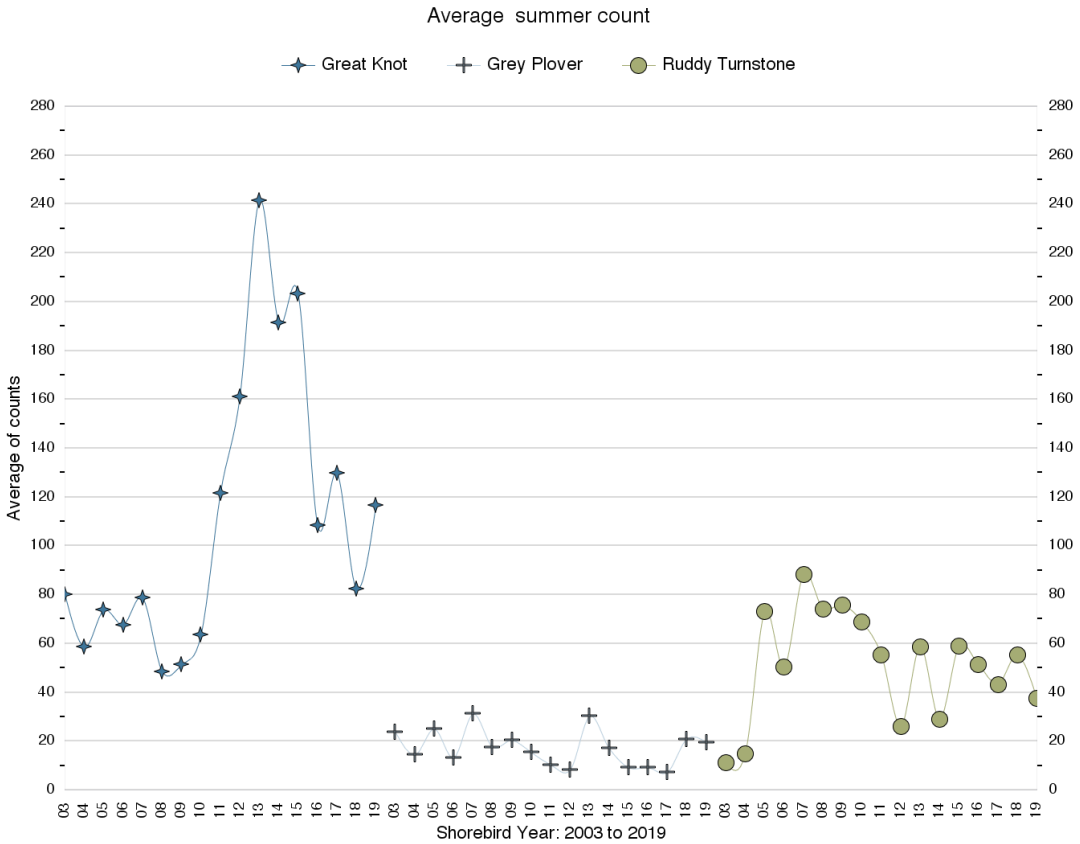


Figure 4b. Temporal variation in PoB average non-breeding (summer)counts (mid Nov-mid Mar) for the other six "important" species. These and maximum counts together with breeding (winter) counts and migration period counts are tabulated in Appendix A for each shorebird year between 2003 and 2019.

F. LONG TERM TRENDS IN SHOREBIRD NUMBERS

Data are available since 1991, however consistency in sampling procedures has been best since 2003. The data presented in Figure 3 are mean and maximum values for non-breeding (summer), and mean values for other seasons for migratory shorebirds for different seasons across the PoB, including the claypan (FICP) (11 subsites) from 2003 until mid-2020. The concept of the shorebird year and definition of the shorebird seasons are given in Section C. The corresponding values for resident shorebirds are given on a separate graph in Figure 3, however for resident shorebirds, the maxima are for any time of year. Yearly, mean non-breeding (summer) counts for each of the twelve "important" migratory species are plotted in Figure 4a and 4b

The average summer numbers of Grey-tailed Tattler that were reported as declining over recent years have rebounded with a peak value in 2019, which is not the case for Lesser Sand Plover, Red-necked Stint and Curlew Sandpiper, which all show continuing declines in recent years. A long-term decline in Great Knot numbers may have stabilised, which is not the case for Ruddy Turnstone. Numbers of Pacific Golden Plover, Sharp-tailed Sandpiper, Grey Plover, Greater Sand Plover, Far Eastern Curlew and Bar-tailed Godwit continue to fluctuate around a median value (Figures 4a, 4b & Appendix C).

G. CRITICAL COUNT VALUES OF EACH IMPORTANT SPECIES

The critical low count value (threshold) for summer counts of each of the "important" species at the PoB have been calculated based upon data for shorebird years between 2003 and 2010, and separately for 2011 to 2018 (refer to Table 5 and Appendix D for a full definition). The values are the lower 90% confidence limit of the samples of all summer counts of each species within the timeframes as stated (see Appendix D). The chosen threshold value for each species is taken from either of the two timeframes. The most conservative (highest) of the two threshold values was chosen and is listed for each species in Table 5.

Table 5. "Important" species summer counts are tabulated with the lower 90% confidence limits (in red, threshold values derived from either of two successive 8-year sampling blocks between 2003 and 2018; see Appendix D). The coloured cells indicate the occasions where low threshold counts have been breached, suggesting the relevant species may be exhibiting a real decline in numbers at the PoB.

		Summer counts 2019					
Species	**Threshold**	Nov 2019	Dec 2019	Jan 2020	Feb 2020	**2019 Mean**	**Long-term Mean**
Bar-tailed Godwit	*469*	199	1106	1572	621	875	818
Curlew Sandpiper	*505*	1455	633	432	141	665	954
Far Eastern Curlew	*61*	98	69	207	83	114	129
Great Knot	*64*	322	389	191	113	254	182
Greater Sand Plover	*13*	0	147	25	140	78	53
Grey Plover	*15*	34	40	41	29	36	33
Grey-tailed Tattler	*291*	924	1434	781	480	905	507
Lesser Sand Plover	*673*	163	1672	803	577	804	1033
Pacific Golden Plover	*202*	1219	487	402	354	616	367
Red-necked Stint	*1373*	2218	1332	523	808	1220	2457
Ruddy Turnstone	*27*	0	190	41	163	99	61
Sharp-tailed Sandpiper	*137*	549	808	511	212	520	260

The 90% lower confidence limit represents a threshold value, below which only 1 in 20 sample means will occur. Hence a single count below this value is likely to be an indication of a real change in the population mean, that is, an actual change in the numbers of birds. The prevalence (four species) of low counts recorded in November may be an artifact of overlap with southward migration. That is, counts in the December, January and February are likely to be a better indication of summer population numbers (Table 5). That being the case, there are two species, Curlew Sandpiper and Lesser Sand Plover that exhibit counts that may indicate a real drop in summer numbers at the Port. Both species were noted in the discussion of species trends (refer to Section F and Figure 4).

H. RECOMMENDATIONS

Overall numbers of migratory shorebirds, coupled with results for several species separately, suggests that a decline in numbers of shorebirds that began in 2017 has continued for the subsequent two years. This is not the case for all species, but it is a dominant trend at present. Overall, numbers of migratory shorebirds for 2019 are as low as they have ever been. Results for the upcoming year might be decisive in determining whether the decline in numbers continues or rebounds, as it has done previously.

It is highly likely the Port area has attracted birds that previously roosted elsewhere in Moreton Bay, that is, it contains a higher proportion of the shorebirds than before the reclamation got into full swing and before the possible degradation of other roost sites. Although this hypothesis is not addressed in this report, the results do suggest that any such trend may have stabilised.

Nevertheless, it remains a high priority that consideration be given to the calamity that could arise once the Port lands are fully reclaimed and are largely unsuitable as shorebird habitat. The existing purpose-built artificial roost does not function as well as subsites within the reclamation area and until this is addressed the future adequacy of shorebird habitat within the Port remains even more questionable, both in terms of its extent and quality.

A list of recommendations is given below, much of which is a reaffirmation of previous recommendations. It is recommended that:

- The monitoring of shorebirds within the Port continues with the same intensity. From month to month, low counts should be scrutinised to be sure no values are falling below the tabulated critical thresholds.
- There should be analysis of patterns of habitat type use by shorebirds based on more specific habitat parameters. Such an analysis would help indicate the appropriate proportion and extent of each habitat that is required to support the existing shorebird populations as reclamation continues. It would help identify those species with less flexibility in habitat choice. It would potentially identify habitat construction/maintenance priorities and options. Possible relevant habitat features might include wet margins of ponds, dry rubble/broken ground and shallow pools up to 5 cm deep and bund wall design and features. Other considerations are substrate wetting and drying cycles through seasonal effects but also as a response to the mechanics of reclamation.
- Serious consideration be given to the long-term outcome for shorebirds on and in close proximity to PoB lands once the extensive reclamation project draws to a close when much of the current habitat will inevitably disappear. All shorebird habitat types must remain available in sufficient quantity over the long term to sustain the numbers, balance and diversity of shorebird species that currently use the Port lands.
- The PoB must continue to recognise that its environment is a major component of shorebird habitat in Moreton Bay and encourage and/or participate in more thorough analysis of the shorebird distribution and numbers throughout the Bay in order to better understand the monitoring results that are being collected from within the Port.
- The PoB work with other stake holders, including researchers and managers of shorebirds and other relevant organisations and government agencies that operate within Moreton Bay, to develop Bay wide strategies to sustain Moreton Bay as a premier shorebird site in Australia.

Appendix A (4 pages): Shorebird counts for each important species at each site within the Port lands during the 2018-19 "shorebird year". Seasons are winter (breeding), summer (non-breeding) and migration (south and north migrations).

Species group 1 (App A: 1st of 4 pages). *Counts of Grey-tailed Tattler, Red-necked Stint and Sharp-tailed Sandpiper.*

Season->B4	Sth Migr.			Non Br.				Nth Migr.	Breeding			
Month of Survey -->	*Sep 2019*	*Sep 2019*	*Oct 2019*	*Nov 2019*	*Dec 2019*	*Jan 2020*	*Feb 2020*	*Mar 2020*	*Jun 2020*	*Jul 2020*	*Aug 2020*	**Total**
Grey-Tailed Tattler												
FICP												
PBAR				1								1
PBC2												
PBC3					1							1
PBC4									102			102
PBR3							24					24
PBS1												
PBS2												
PBS3							456					456
PBS4				923	1433							2356
PFPE						781					2	783
Total				**924**	**1434**	**781**	**480**		**102**		**2**	**3723**
LYN1*												
Red-necked Stint												
FICP	15	57	430	117	121	110	389		91		14	1344
PBAR		4		11	6	1						22
PBC2			24		211	3	5			4		247
PBC3	2	248	455	1768	894	173	26	29		275	19	3889
PBC4								1				1
PBR3	583	1025	26		16		4	37	44		41	1776
PBS1				248	31	38	4					321
PBS2			137		8	60	374		97	160	75	911
PBS3	10		6		25	84	3		14	55		197
PBS4	4	3	11	74	19	16	2	2	11		4	146
PFPE	7	52			1	38	1		47			146
Total	**621**	**1389**	**1089**	**2218**	**1332**	**523**	**808**	**69**	**304**	**494**	**153**	**9000**
LYN1*				28	264	16	226	52		11		597
Sharp-tailed Sandpiper												
FICP	4	41	59	89	9	47	60				6	315
PBAR	4	38	31	63	52	11					5	204
PBC2					18							18
PBC3				321	179	40	19	2				561
PBC4												
PBR3	2	2	620	41	450	362	111	99				1687
PBS1				16	8	1	3					28
PBS2			5	12	38	7	2					64
PBS3				3	4	7	12					26
PBS4		4	4	4	50	36	2				6	106
PFPE			3								1	4
Total	**10**	**85**	**722**	**549**	**808**	**511**	**209**	**101**			**18**	**3013**
LYN1*	17	24	240	88	472	6	34				41	922

Species group 2 (App A: 2nd of 4 pages). *Counts of Curlew Sandpiper, Great Knot and Bar-tailed Godwit.*

Season->	Sth Migr.			Non Br.				Nth Migr.	Breeding			
Month of Survey -->	*Sep 2019*	*Sep 2019*	*Oct 2019*	*Nov 2019*	*Dec 2019*	*Jan 2020*	*Feb 2020*	*Mar 2020*	*Jun 2020*	*Jul 2020*	*Aug 2020*	**Total**
Curlew Sandpiper												
FICP	5	54	176	1	10	161	51				7	465
PBAR		18	166	137	40	2						363
PBC2					7							7
PBC3		94	125	1301	551	194				81		2346
PBC4											6	6
PBR3	960	1495	224		12			118	2		437	3248
PBS1				13		20	3					36
PBS2			90			54	71					215
PBS3							15			26		41
PBS4		1	12	3	13	1	1			1	1	33
PFPE		1	63								1	65
Total	**965**	**1663**	**856**	**1455**	**633**	**432**	**141**	**118**	**2**	**108**	**452**	**6825**
LYN1*	96		35	8	74	32	135	18				398
Great Knot												
FICP					43							43
PBAR				12	2							14
PBC2												
PBC3						35						35
PBC4												
PBR3		116	38	310	344							808
PBS1												
PBS2						156						156
PBS3							113					113
PBS4			1					3				4
PFPE	18		87					4				109
Total	**18**	**116**	**126**	**322**	**389**	**191**	**113**	**7**				**1282**
LYN1*			23	27	94							144
Bar-tailed Godwit												
FICP			336		14	2	321					673
PBAR		88		167	17	3		21				296
PBC2												
PBC3						637						637
PBC4								62	64			126
PBR3		324	380		1074	2	38					1818
PBS1												
PBS2						650	1					651
PBS3						7	252					259
PBS4				1	1	1	5	102				110
PFPE	15	90	113	31		270	4	114				637
Total	**15**	**502**	**829**	**199**	**1106**	**1572**	**621**	**299**	**64**			**5207**
LYN1*	1	3	964	1062	668	462	444	102		59		3765

Species group 3 (App A: 3rd of 4 pages). *Counts of Far Eastern Curlew, Pacific Golden Plover and Ruddy Turnstone.*

Season->	Sth Migr.			Non Br.				Nth Migr.	Breeding			
Month of Survey -->	*Sep 2019*	*Sep 2019*	*Oct 2019*	*Nov 2019*	*Dec 2019*	*Jan 2020*	*Feb 2020*	*Mar 2020*	*Jun 2020*	*Jul 2020*	*Aug 2020*	**Total**
Eastern Curlew												
FICP	63					207	77				69	416
PBAR		2		1	1							4
PBC2												
PBC3												
PBC4												
PBR3		35		97	60		1					193
PBS1												
PBS2							3					3
PBS3					8							8
PBS4												
PFPE												
Total	**63**	**37**		**98**	**69**	**207**	**81**				**69**	**624**
LYN1*	45	31	240	82	311	295	138		62	49	112	1365
Pacific Golden Plover												
FICP	4	22	1	15	26	20	10					98
PBAR		1				3						4
PBC2												
PBC3		8	58	1200	458	378	7			9		2118
PBC4									6			6
PBR3		180	74	1	1							256
PBS1												
PBS2			341	3			305					649
PBS3							32					32
PBS4	2		9					1	3	3	4	22
PFPE	1	4	11		2	1						19
Total	**7**	**215**	**494**	**1219**	**487**	**402**	**354**	**1**	**9**	**12**	**4**	**3204**
LYN1*												
Ruddy Turnstone												
FICP												
PBAR												
PBC2												
PBC3					8	6	63					77
PBC4												
PBR3					18		18					36
PBS1												
PBS2			9			3	45					57
PBS3						2	6					8
PBS4					126		2			7		135
PFPE		1	1		38	30	29				2	101
Total		**1**	**10**		**190**	**41**	**163**			**7**	**2**	**414**
LYN1*												

Species group 4 (App A: 4th of 4 pages). *Counts of Lesser Sand Plover, Greater Sand Plover and Grey Plover*.

Season->	Sth Migr.		Non Br.				Nth Migr.		Breeding		
Month of Survey –>	*Sep 2018*	*Nov 2018*	*Dec 2018*	*Jan 2019*	*Feb 2019*	*Mar 2019*	*Apr 2018*	*May 2019*	*Jun 2019*	*Aug 2019*	**Total**
Lesser Sandplover											
FICP											
PBAR											
PBC2			27								27
PBC3		68		20	381	1103	716	11		10	2309
PBR3		4	485	18	156	35					698
PBS1											
PBS2	3		386		4		20				413
PBS3					2						2
PBS4				4	2	2	4				12
PFPE	7	52		622			1	1	61	95	839
Total	**10**	**124**	**898**	**664**	**545**	**1140**	**741**	**12**	**61**	**105**	**4300**
LYN1*											
Greater Sandplover											
FICP											
PBAR											
PBC2			3								3
PBC3		10		1	12	195	38	2		1	259
PBR3			40	5	2						47
PBS1											
PBS2	2		180								182
PBS3											
PBS4											
PFPE		2		5			1			3	11
Total	**2**	**12**	**223**	**11**	**14**	**195**	**39**	**2**		**4**	**502**
LYN1*											
Grey Plover											
FICP											
PBAR											
PBC2											
PBC3						3					3
PBR3	13	44	44		34	33					168
PBS1											
PBS2											
PBS3											
PBS4									8		8
PFPE				22			2	4		2	30
Total	**13**	**44**	**44**	**22**	**34**	**36**	**2**	**4**	**8**	**2**	**209**
LYN1*											

Appendix B (1 page): Shorebird counts (all species) for each month on the Port Lands - Sep 2019 to Aug 2020

(2019 "shorebird year" and no counts for April or May 2020 and the March 2020 count incomplete)

Date	Sep 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Jun 2020	Jul 2020	Aug 2020	
Migratory wader count (#spp)	10	14	14	16	18	16	16	8	10	7	8	
Resid. wader count (#spp)	6	6	4	6	7	6	5	4	4	4	4	
Total waders	2098	4908	5577	7597	9029	6082	4133	763	1021	906	782	**Total**
Bar-tailed Godwit	15	502	829	199	1106	1572	621	299	64			5207
Black-fronted Dotterel	1	1		1	2							5
Black-tailed Godwit			1		2	3						6
Broad-billed Sandpiper			10	4	38	2	6					60
Common Greenshank		3		6	6		1		1			17
Curlew Sandpiper	965	1663	856	1455	633	432	141	118	2	108	452	6825
Double-banded Plover	2								17	37	6	62
Eurasian Whimbrel		20	32	25	68	50	113	17				325
Far Eastern Curlew	63	37		98	69	207	83				69	626
Great Knot	18	116	126	322	389	191	113	7				1282
Greater Sand Plover		43	2		147	25	140		10	19		386
Grey Plover		54	13	34	40	41	29	3				214
Grey-tailed Tattler				924	1434	781	480		102		2	3723
Lesser Sand Plover	44	427	565	163	1672	803	577		228	75		4554
Marsh Sandpiper				1								1
Masked Lapwing	4				4	6	5	3	7	6	4	39
Pacific Golden Plover	7	215	494	1219	487	402	354	1	9	12	4	3204
Pied Oystercatcher	23	24	9	30	80	145	126	108	40	62	2	649
Pied Stilt	266	184	281	202	257	213	35	18	88	10	21	1575
Red Knot	4	49	20	35	8	5						121
Red-capped Plover	53	93	28	38	194	106	56	19	132	67	49	835
Red-kneed Dotterel		1		2	2							5
Red-necked Avocet	2	1	490	71	55	20	69					708
Red-necked Stint	621	1389	1089	2218	1332	523	808	69	304	494	153	9000
Ruddy Turnstone		1	10		190	41	163			7	2	414
Sharp-tailed Sandpiper	10	85	722	549	808	511	212	101			18	3016
Sooty Oystercatcher						3						3
Terek Sandpiper					5		1		17			23
Wandering Tattler				1								1
unident. mig. Wader					1					9		

Appendix C (1 page): "Important species" average and maximum summer counts, and average winter and migration period counts (north and south) - Sept 2003 to Aug 2020 (shorebird years 2003-2019)

Species	ShBdYear-->	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bar-tailed Godwit	Sum	198	391	623	968	615	764	718	500	272	768	1084	1042	1047	766	1067	1074	875
	Max (Sum)	461	401	874	1235	657	913	942	577	344	1283	1481	1185	1356	1066	1529	1499	1572
	Mig	518	260	464	669	547	597	384	511	130	499	742	594	801	581	425	344	411
	Win	435	397	557	395	342	326	573	88	37	53	292	146	28	132	32	47	21
Curlew Sandpiper	Sum	1062	865	1612	1037	899	1387	667	1784	1218	691	956	1078	553	1599	1914	1045	665
	Max (Sum)	1418	2298	2289	1813	1855	2007	768	2086	1746	697	2040	1671	849	2443	2607	2192	1455
	Mig	184	676	530	481	527	620	324	1043	660	880	462	477	937	806	712	1082	901
	Win	50	160	58	28	244	63	185	96	62	50	101	188	70	477	32	58	187
Far Eastern Curlew	Sum	163	111	133	355	80	173	155	114	87	156	102	97	90	51	74	201	114
	Max (Sum)	244	186	280	670	164	212	227	128	105	259	119	165	122	133	117	291	207
	Mig	38	88	83	63	69	105	83	74	100	153	140	106	91	62	17	79	25
	Win	134	32	34	67	43	56	59	41	67	107	29	49	34	35	14	169	23
Great Knot	Sum	71	95	117	117	133	84	74	89	166	277	439	246	363	177	283	153	254
	Max (Sum)	123	221	210	185	183	111	112	160	180	515	708	534	596	379	580	186	389
	Mig	304	104	99	115	87	53	103	98	358	203	261	449	156	175	148	71	67
	Win	1		1		20	10	5	1	3	2	33	86			1	0	0
Greater Sand Plover	Sum	99	240	71	215	28	121	102	74	207	173	31	109	82	120	56	111	78
	Max (Sum)	404	415	158	441	42	185	216	146	432	336	80	226	133	287	103	223	147
	Mig	1	40	37	19	83	129	26	27	82	129	5	64	61	43	48	14	11
	Win	1	61	1		1		6	50	23	4		1				2	10
Grey Plover	Sum	43	30	51	30	52	29	37	40	14	20	32	34	16	21	16	34	36
	Max (Sum)	55	51	59	45	145	32	45	45	23	33	40	38	52	38	33	44	41
	Mig	21	17	11	13	35	27	23	19	30	10	19	21	12	11	16	16	18
	Win	5	1	7		9		5					3		4		5	0
Grey-tailed Tattler	Sum	368	572	649	696	786	356	599	560	428	349	740	824	841	692	653	553	905
	Max (Sum)	496	890	801	960	1288	584	1105	568	478	413	803	1230	1175	1296	1259	710	1434
	Mig	288	476	415	488	509	527	491	455	271	441	532	577	550	250	89	629	0
	Win	232	419	360	149	197	362	22	15	33	254	375	357	265	55	11	5	35
Lesser Sand Plover	Sum	1164	1216	549	493	353	989	461	625	1438	1173	1036	1303	1013	1275	986	812	804
	Max (Sum)	2433	1664	823	605	954	1256	643	833	1458	1856	1424	1929	1409	1804	1138	1140	1672
	Mig	294	277	212	345	390	479	276	485	550	640	462	543	322	577	553	222	259
	Win	101	65	37	49	85	12	46	123	19	15	21	41	28	36	3	83	101
Pacific Golden Plover	Sum	363	367	711	682	242	327	381	175	223	233	233	419	379	384	289	458	616
	Max (Sum)	455	755	902	1090	303	372	546	201	298	418	301	664	575	464	399	836	1219
	Mig	118	183	276	265	167	117	113	137	148	112	159	175	208	157	117	191	179
	Win	18	46	20	11	18	9	15	3	6	2	22			4		52	8
Red-necked Stint	Sum	3841	1294	3153	2043	1882	4525	2914	3451	1602	2463	2151	3145	2033	3040	2369	1103	1220
	Max (Sum)	6803	2383	5239	2978	2623	5586	3547	4791	2015	3323	3143	6669	4111	4666	3902	1505	2218
	Mig	1072	1292	1236	1964	1366	1513	1401	1887	1112	2381	1270	1183	2207	2022	1246	1576	792
	Win	525	735	591	460	1176	527	709	349	441	1933	153	432	817	332	393	525	317
Ruddy Turnstone	Sum	23	10	80	68	84	70	118	118	69	56	100	49	91	128	31	99	99
	Max (Sum)	46	22	207	134	113	104	166	136	104	91	131	75	127	213	37	156	190
	Mig	5	12	63	47	80	112	55	76	80	28	55	33	56	27	14	32	3
	Win		31	75	31	108	15	55	28	27	6	11	2	4	19	6	14	3
Sharp-tailed Sandpiper	Sum	193	97	658	622	641	1208	485	286	421	469	211	367	235	209	228	460	519
	Max (Sum)	454	226	2078	1082	1201	1680	774	446	610	476	258	832	504	304	434	569	808
	Mig	90	227	175	217	868	283	279	218	167	388	129	606	465	184	196	181	230
	Win	4		1	4	14	64	3	1	8	3	7	78	5	1	1	1	6

Appendix D (1 page): "Important" species summer means and lower 90% confidence limits.

The results (derived from log transformed counts) are for successive 8-year sampling blocks since 2003. Colour coding indicates for each species the higher (green) and lower (yellow) means for the different time periods. Red font indicates the critical count that can serve as a trigger to suggest the relevant species may be exhibiting a real decline in numbers at the PoB.

The table uses two periods of sampling, that is, 2010 and earlier, and after 2010 ("shorebird" years). Both sets of data incorporate eight years of sampling. For some species the sample mean for the earlier sampling is higher and for some it is lower than for sampling after 2010. Colour coding is used to indicate whether the mean is higher (green) or lower (yellow) than the alternative mean for each species. Each mean has an associated threshold value that can serve as a trigger for response if any future count is lower than this figure. For each species there are two choices of threshold value, one for each of the sampling periods. A conservative approach would be to use the higher of these two values for each species. These are the choices of threshold values that have been highlighted in red lettering. Future counts of each species can be evaluated.

The 90% lower confidence limit represents a threshold value, below which only 1 in 10 sample means will occur. Hence a single count below this value is likely to be an indication of a real change in the population mean, that is, an actual change in the numbers of birds (refer to the 2020 report for details of derivation of this table).

Period (shorebird yrs)->	**2003-2010**		**2011-2018**	
Species	Mean	Threshold	Mean	Threshold
Bar-tailed Godwit	418	*114*	818	*469*
Curlew Sandpiper	954	*505*	911	*439*
Far Eastern Curlew	129	*61*	75	*27*
Great Knot	64	*18*	182	*64*
Greater Sand Plover	35	*4*	53	*13*
Grey Plover	33	*15*	10	*2*
Grey-tailed Tattler	507	*291*	558	*259*
Lesser Sand Plover	524	*163*	1033	*673*
Pacific Golden Plover	367	*202*	295	*164*
Red-necked Stint	2457	*1373*	1853	*936*
Ruddy Turnstone	44	*14*	61	*27*
Sharp-tailed Sandpiper	307	*100*	260	*137*

Appendix E (1 page): Sites, other than the 11 Port subsites that are used to access the Index of Relative Importance of counts from Port sites with those from all of Moreton Bay. All of these sites are included in the regular monthly count program run by QWSG.

Site code	Site name	Latitude	Longitude	Site code	Site name	Latitude	Longitude
BSVP	Base Street, Victoria Point	-27.59	153.31	DTMI	Dead Tree Beach, Moreton Is	-27.34	153.43
PTHR	Pt Halloran reserve	-27.57	153.29	MIPO	Mirapool Moreton Island	-27.34	153.44
KSMF	King Street Mudflat - Thornlands	-27.56	153.28	MIPB	Mirapool beach, Moreton Is	-27.32	153.44
THLD	Thornlands Rd Thornlands	-27.56	153.28	PRNS	Pine Rivers north	-27.29	153.03
OYPO	Oyster Point	-27.54	153.28	PRWR	Pine Rivers Wetland Res	-27.29	153.04
SBTH	Sandy Bank, Toondah Harbour	-27.53	153.31	DOHL	Dohle's vic. Pine River nth side	-27.28	153.04
NAPK	Nandeebie Park Cleveland	-27.53	153.28	GRHI	Gregory Rd, Hays Inlet	-27.25	153.06
GOSE	Goat Is SE	-27.52	153.38	NARD	Nathan Rd Redcliffe	-27.21	153.07
DUNW	Dunwich Nth Straddie (One Mile)	-27.49	153.40	RANS	Redcliffe airport north side	-27.20	153.06
EAGS	East Geoff Skinner Reserve	-27.49	153.25	DBMN	Deception Bay south	-27.20	153.04
WEGS	West Geoff Skinner Reserve	-27.49	153.24	DBBA	Deception Bay claypan	-27.17	153.02
THQE	Thornside Queens Esp.	-27.48	153.21	CABO	Caboolture River mouth	-27.15	153.04
ACAC	Acacia St Wellington Pt	-27.48	153.23	BHBI	Buckleys Hole sandbar Bribie Is	-27.10	153.16
MAHA	Manly Harbour	-27.46	153.19	GOBC	Godwin Beach	-27.09	153.11
KIAN	Kianawah Road Wetland	-27.45	153.14	KKBC	Kakadu Beach Bribie Is	-27.05	153.14
LYTT	Lytton	-27.42	153.16	TOOR	Toorbul	-27.05	153.11
SHIS	St Helena Is south east	-27.40	153.24	TRSF	Toorbul sandfly	-27.04	153.11
AMSB	Amity Point sandbank	-27.39	153.43	TRNT	Toorbul north	-27.04	153.11
SHIP	St Helena Is pier	-27.39	153.22	BHMS	Bishop's Marsh	-27.04	153.06
SHIH	St Helena Is homestead	-27.39	153.23	TGBC	Toorbul George Bishop causeway	-27.04	153.09
SHIN	St Helena Is north	-27.38	153.23	TRSS	Toorbul sandspit	-27.03	153.09
LUPO	Luggage Point	-27.38	153.15	BECK	Bell's Creek Caloundra	-26.85	153.11
DAYS	Day's Gutter Moreton Island	-27.37	153.41	PEWA	Pelican Waters Lamerough Ck	-26.83	153.12
REPO	Reeders Point Moreton Is	-27.36	153.42	SBN2	Sandbank No 2 Caloundra	-26.82	153.12
KBWL	Kedron Brook Wetlands	-27.36	153.08	SBN1	Sandbank No 1 Caloundra	-26.81	153.13