



BHP Billiton Iron Ore

Port Hedland Migratory Shorebird Survey Report and Impact Assessment

Final Report

Prepared for BHP Billiton
Iron Ore
by Bennelongia Pty Ltd

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Report 2011/124.



Port Hedland Migratory Shorebird Survey Report and Impact Assessment

Cover photo: Terek Sandpiper (*Tringia cinereus*)

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EXECUTIVE SUMMARY

This report describes the occurrence of migratory shorebirds in the vicinity of BHP Billiton Iron Ore's proposed Outer Harbour Development, approximately 1.5 kilometres (km) west of the Pilbara coastal town of Port Hedland. The shorebird significance of the area around the Outer Harbour Development is documented, counts are compared with those at other coastal sites in north-western Australia, and the potential impacts to migratory shorebirds as a result of the proposed development are evaluated. The framework for assessment of migratory shorebird significance is the *Environment Protection and Biodiversity Conservation Act 1999* Policy Statement 3.21.

Migratory shorebird data were collected by literature review and during field survey in April 2011 at nine survey sites within the Study Area, which was a 27 km length of coast stretching from approximately 18 km east to 9 km west of Port Hedland. In addition, a map of areas with moderate or high value for shorebird foraging or roosting (open shoreline habitat only) was prepared from aerial photography and by extrapolating the results of the field survey.

Altogether, 23 migratory shorebird species have been recorded within the Study Area since 2002. A total of 4248 migratory shorebirds of 18 species were observed during the field survey in April 2011. Three of the species seen in April 2011 (Little curlew, Sanderling, Broad-billed sandpiper) had not been recorded during previous surveys of the Study Area. The more abundant species in April 2011 were Grey-tailed Tattler (588 birds), Bar-tailed Godwit (448) and Red-necked Stint (455). Counts are likely to have under-estimated actual abundance.

On the basis of the field survey, the observed abundance and species richness of migratory shorebirds within Study Area triggered all three types of criteria for determining a site to be either nationally or internationally significant for shorebirds under Policy Statement 3.21:

- More than 1% of the species population of Grey-tailed tattler occurred at the site in April 2001, indicating the site is of international significance for this species;
- More than 0.1% of the flyway population of 5 species occurred in April 2001, making the site nationally significant because of these species (Greater sand plover, Bar-tailed godwit, Terek sandpiper, Ruddy turnstone, Red-necked stint). Both Grey-tailed tattler and Ruddy turnstone were also recorded above the 0.1% threshold in earlier surveys;
- More than 2000 shorebirds were recorded in April 2011 (4248), indicating the site is nationally significant in terms of overall shorebird abundance; and
- More than 15 shorebird species were recorded (23 overall and 18 in April 2011), making the site nationally significant in terms of richness of shorebird species.
- Although far higher numbers of migratory shorebirds occur at other sites along the Pilbara and southern Kimberley coasts, e.g. 262,485 birds at Eighty Mile Beach 250 km from Port Hedland, the Study Area remains a regionally significant site for migratory shorebirds and is likely to contribute to shorebird conservation at the regional level.

Mapping showed that the Study Area encompasses approximately 5026 ha of intertidal flat on open shoreline and 2196 ha of intertidal flats on tidal creeks. Sediment (sand and mud) flats on open shorelines provide the most valuable shorebird foraging habitat. The majority of open shoreline intertidal sediment within the Study Area is located east of Cooke Point where an extensive intertidal flat was assessed as high value shorebird foraging habitat. Intertidal habitats to the west

of Cooke Point, and in tidal creeks, are considered to be only of moderate value for migratory shorebird foraging.

Fewer than 10% of shorebirds counted in the Study Area in April 2011 occurred on Finucane Island; 74% of shorebirds occurred from Cooke Point eastwards where there is a wide intertidal flat and the birds are away from any Harbour and townsite-related disturbances.

In terms of assessing the likely impacts of the proposed Outer Harbour Development on migratory shorebirds, it appears that most of the potential impacts will be restricted to the western portion of the Study Area. The only shorebird habitat that will be lost in open shoreline areas are 3 ha of intertidal sediment and 1.7 ha of intertidal hard substrate around the proposed jetty on Finucane Island. These areas constitute less than 0.1% and 1%, respectively, of each habitat type within the shorebird site. In addition, 5 ha of intertidal creek and 27 ha of mangrove will be lost on the southern side of Finucane Island. These areas constitute 1% and less than 0.1%, respectively, of each habitat type.

The main cause of physical habitat degradation will be sedimentation from dredging activities. It is predicted that patches of high sedimentation will occur across all the Study Area, including the extensive sediment flats east of Cooke Point that have high value foraging value. While large changes in shorebird use of the Study Area as a result of sedimentation are unlikely, full assessment of impacts cannot be undertaken in advance of the Outer Harbour Development proceeding.

The main disturbances likely to affect shorebirds as a result of the Outer Harbour Development are light, noise and human activity. It is considered possible that localised reduction in the value of shorebird roosting and foraging habitats will occur in the vicinity of the proposed jetty and conveyors and ship loaders at Finucane Island as a result of light emissions. Light is unlikely to have any further effect on shorebird use of the Study Area east of Spoil Bank where 82% of birds occur. It is also unlikely that light from the Outer Harbour Development will cause disorientation of shorebirds during their migration or affect the overall shorebird conservation values of the Study Area.

Noise from construction and operation of the Outer Harbour Development will not affect the conservation value of the Study Area however it may cause a local reduction in shorebird use of part of Finucane Island where noise resulting from pile driving and, later, port operations will be considerable (70-100 dB(A)). Shorebirds are tolerant of regular noise in many industrial and transport-related situations.

Human activity is a major cause of shorebird disturbance world-wide, with dogs and beach-walkers implicated in much disturbance. The level of human disturbance is expected to increase in the Study Area as the population of Port Hedland grows but the increase will not be related to Port activity.

Discharges and spills of oils and toxic material occasionally cause direct mortality to wildlife. Port Hedland is already one of the largest ports in Australia and there exists a risk of spills and unplanned discharges that may potentially affect shorebirds. The risk will be minimized through adherence to best practice and maintaining a rapid response capability to protect migratory shorebirds and other wildlife from any effects of unplanned discharges and spills.

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1. INTRODUCTION

BHP Billiton Iron Ore proposes to expand existing iron ore export facilities at Port Hedland. The proposed Outer Harbour Development is located adjacent to existing port facilities and consists of new iron ore handling, stockpiling and ship loading facilities including a 4 kilometre (km) jetty, 2 km wharf, and 34 km dredged shipping channel (Figure 1).

Migratory shorebirds are one of the significant conservation values of many northern Australian coastlines (see section 1.1). Bennelongia Environmental Consultants were commissioned by BHP Billiton Iron Ore to undertake a field survey in April 2011 of the areas most likely to support migratory shorebirds and to compile a desktop assessment of the likely impact on migratory shorebird conservation values from potential disturbance associated with the proposed Outer Harbour Development. The field survey was intended to supplement existing information, rather than being a comprehensive count of shorebirds in the Port Hedland area. Results of the survey and desktop are provided in this report.

As a group, shorebirds are highly mobile species and may use an extensive network of sites in a local area for foraging and roosting, depending on tidal and weather conditions. In recognition of the way shorebirds may use multiple areas and habitats, the critical habitat for persistence of migratory shorebirds in a local area may be larger than what is usually recognized as a survey site. For the purposes of assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), a shorebird site is defined in EPBC Act policy statement 3.21 as:

the entire (discreet) area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roost and feeding areas.

It is considered likely that shorebirds found at Port Hedland will forage and roost over an area extending approximately 30 km through coastal habitat from 118° 30' E to 118° 49' E (Figure 1). Thus, to meet EPBC Act requirements, this area is recognised as the Port Hedland shorebird site and constitutes the Study Area for field survey reported here (Figure 1).

The objectives of the migratory shorebird survey and desktop assessment were to:

- Investigate the occurrence of migratory shorebirds around the proposed Outer Harbour Development (effectively the Study Area);
- Determine the significance of the Study Area (and the parts of it that will be directly affected by development) for migratory shorebirds compared with other Pilbara coastal sites; and
- Assess the potential impacts to migratory shorebirds as a result of the proposed Port Hedland Outer Harbour Development.

1.1. Migratory Shore Birds

Australia is located within the East-Asian Australasian Flyway for migratory shorebirds (sometimes referred to as migratory waders). These species breed as far north as Siberia and Alaska during the northern hemisphere summer and migrate to non-breeding grounds in Australia and New Zealand to avoid the northern winter and take advantage of energy rich food sources in the southern hemisphere (Lane 1987). Migrating shorebirds arrive in northern Australia between late August and early November. Many birds remain in the north but others disperse southwards for the austral

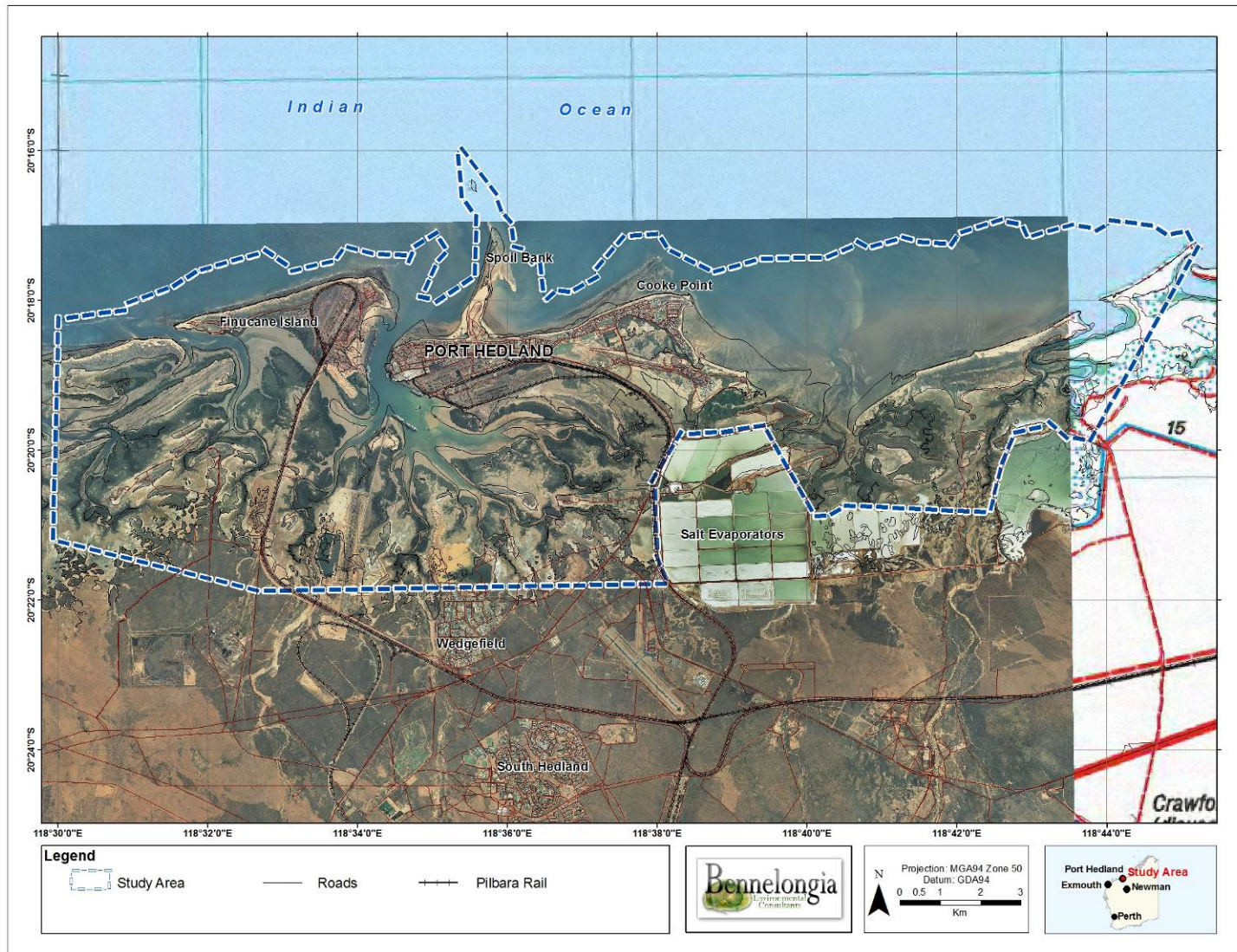


Figure 1. The boundary of the Study Area, which represents the Port Hedland shorebird site (see text).

summer. Migratory shorebird numbers on northern Australian beaches peak in November and again in March as the majority of birds begin their return to the northern hemisphere.

Australia is signatory to three international treaties with China, Japan and the Republic of Korea, respectively, to safeguard migratory species. These are predominantly shorebirds. To facilitate observance of the three agreements, 36 species of migratory shorebirds have been listed as specially protected under both the Commonwealth EPBC Act and the Western Australian *Wildlife Conservation Act 1950* (WC Act), and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) has drafted EPBC Act policy statement 3.21 that sets out criteria for determining the significance of sites based on these migratory shorebirds (Australian Government 2009). One species, the Eastern curlew (scientific names are provided in Appendix B and Table 3), is also a Priority 4 species in Western Australia, which indicates that it is not currently threatened or in need of special protection but should be monitored.

For the purposes of meeting obligations and under international treaties and ensuring shorebird conservation, five criteria are used to identify important sites (as defined in the Introduction) for shorebirds.

A shorebird site is regarded as being internationally important if, within the last five years, there have been counts of at least:

- 1% of the population of a shorebird species or sub-species;
- 20,000 waterbirds, including shorebirds.

A site is regarded as being nationally important if, within the last five years, there have been counts of at least:

- 0.1% of the flyway population of a shorebird species;
- 2000 migratory shorebirds;
- 15 shorebird species.

2. METHODS

2.1. Desktop Survey

A desktop study was undertaken to consolidate existing information on shorebirds occurring in the Study Area and immediate surrounds. This desktop study included:

- fauna database searches to identify listed migratory shorebird species that potentially occur in the Study Area (Table 1);
- a literature review of previous shorebird surveys in the Port Hedland area; and
- compilation of a shorebird habitat map based on aerial photography and the results of the migratory shorebird field survey by Bennelongia.

2.1.1. Database Review

The EPBC Act Protected Matters database is compiled from a range of data sources, including information held by the Department of Environment and Conservation (DEC), Western Australian Museum, Birds Australia, Australian National Wildlife Collection and Australian Museum. The EPBC

Table 1. Database searches conducted.

Database name	Search area	Search date
EPBC Act Protected Matters Search Tool	Polygon 20 18' 17" S 118 29' 10" E 20 22' 11" S 118 30' 20" E 20 20' 08" S 118 46' 25" E 20 16 07" S 118 44' 10" E	8/06/2011
NatureMap	Rectangle 20 18'16" S 118 29' 09" E 20 20'08" S 118 46' 24" E	8/06/2011

Act Protected Matters Search Tool (<http://www.environment.gov.au/epbc/pmst>), OZCAM (Online Zoological Collections of Australian Museums - <http://www.ozcam.org.au>) and NatureMap (<http://naturemap.dec.wa.gov.au>) are three of the tools providing this information (Table 1).

2.1.2. Literature Review

Results of previous migratory shorebird surveys around Port Hedland and on the north-west Australian coast were reviewed. These included (Figure 2):

Port Hedland (including Leslie Saltfields)

- Port Hedland Outer Harbour Development surveys (ENV 2009);
- Shorebirds 2020 Program surveys of Finucane Island, Cooke Point and Leslie Saltfields (Birds Australia 2009); and
- Rio Tinto Birdwatch surveys of Leslie Saltfields (Rio Tinto 2006);

North-western Australia

- Various surveys of Eighty Mile Beach 250 km north-east of Port Hedland (Rogers *et al.* 2006c; Birds Australia 2009; Kingsford *et al.* 2011);
- National Waterbird Count surveys of the De Grey River mouth 70 km north-east of Port Hedland (Kingsford *et al.* 2011);
- Shorebird surveys of Anketell Point and Dixon Island 160 km south-west of Port Hedland (AECOM 2010);
- Rio Tinto Birdwatch surveys of Dampier Salt Fields (Rio Tinto 2006)
- Monitoring surveys at Cape Preston, 250 km south-west of Port Hedland (Bennelongia 2010);
- Waterbird surveys at Lake McLeod 650 km south-west of Port Hedland (Jaensch and Vervest 1990; Rio Tinto 2006; Kingsford *et al.* 2011); and
- Sites described in a paper dealing with the history of wader studies in north-west Australia (Minton 2006).

Two additional reports of surveys in the vicinity of Port Hedland (Mattiske 1994 and Biota 2008) were referenced in the ENV (2009) report prepared for the Port Hedland Outer Harbour. Bird counts and survey locations were not presented, but the identification of migratory shorebirds recorded were summarised in the ENV (2009) report and are included in this review.

2.2. Field Survey

This report presents the results of a field survey of nine sites within the Study Area between 3 and 5 April 2011 (Table 2, Figure 3). This was a period of spring tides, the wind was not unusually strong, and there was no rain.

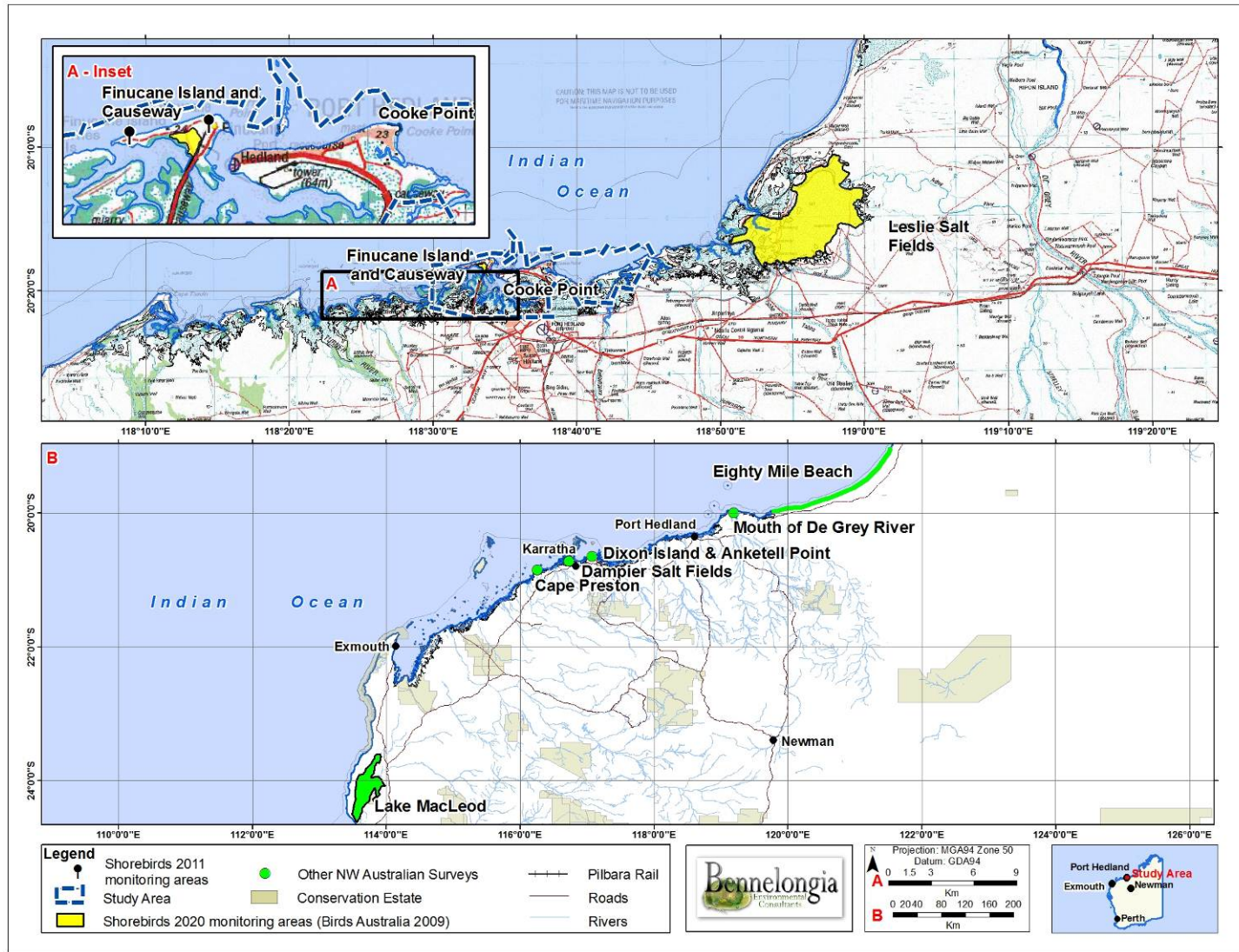


Figure 2. Previous surveys in the Study Area and elsewhere in north-western Australia.

Where possible, all shorebirds at each survey site were counted, identified to species and their foraging and roosting behaviours noted by using a spotting scope from a vantage point (see Figure 2 for locations). If species identification could not be achieved, birds were identified as either medium or small waders. While total shorebird numbers within each study site were calculated from the counts made at vantage points, in some cases additional information on species composition was collected by walking along the shoreline within each survey area.

Three of the sites (site 1 -Finucane Island Boat Ramp, site 4- North Beach, and site 9- Burgess Point Boat Ramp) were counted twice at different states of the tide and shorebird use of these sites was characterised using the higher of the two counts for each species. The value of all nine sites for migratory shorebirds was evaluated as high or moderate, based on the number of shorebirds counted, shorebird behaviour and the types of habitats within the site.

Field surveys were conducted by Grant Pearson, who has over 30 years of experience in wetland and waterbird research and management. Jim Cocking (both Bennelongia) and Natasha Bevan (BHP Billiton Iron Ore) provided assistance.

2.3. Habitat Mapping

A habitat map identifying the locations and values of foraging and roosting habitats was prepared by interpreting a 1:35,000 orthophotograph taken in June 2010. Habitats were mapped as having either high or moderate value for shorebirds based on:

- The inferred characteristics of the site, especially width of intertidal area;
- Known habitat information from field surveys in April 2011; and
- Information collected on shorebird use of different areas and habitat types during field surveys in April 2011.

2.4. Limitations of Field and Desktop Surveys

Some species of shorebirds using the Port Hedland area, including Greater sandplover, Great knot and Bar-tailed godwit, are likely to have departed north-western Australia prior to field survey in early April. This may have caused some under-estimation of the significance of the Survey Area.

The Dampier Salt Beach could not be accessed by foot and was surveyed by telescope from the western shore of the adjacent creek. No boat transport was available to any site, which limited access to tidal creek habitats throughout the Study Area. Both these logistical constraints are likely to have resulted in shorebird use of the Study Area being underestimated.

Potential roosting habitats in the tidal creek systems were not mapped because aerial photography is an unreliable method of identifying shorebird roosts in mangrove and supra-tidal salt flats. As a result, the extent of roosting areas within the Study Area may have been underestimated.

3. RESULTS

3.1. Database Searches

All 36 species listed in EPBC Act policy statement 3:21 as migratory shorebirds are included on the EPBC Act list of migratory birds, the EPBC Act list of marine species, and the WC Act schedule of migratory species.

Table 2. Sites surveyed for shorebirds in April 2011.

Number of surveys and length of shoreline surveyed are shown, together with brief site description.

Survey site	1	2	3	4	5	6	7	8	9
Location	Finucane Is Boat Ramp	Harbour west	Spoil Bank	North Beach	Cooke Point south	Pretty Pool Beach	Six Mile	Dampier Salt Point	Burgess Point Boat Ramp
Coordinates (dd mm ss)	20 18 25 S 118 31 55 E	20 18 00 S 118 34 24 E	20 17 47 S 118 35 43 E	20 18 12 S 118 37 05 E	20 18 00 S 118 38 28 E	20 18 44 S 118 38 37 E	20 19 31 S 118 40 03 E	20 19 37 S 118 40 38 E	20 19 44 S 118 35 38 E
Shoreline length (km)	1.1	2.2	3.2	5.8	0.8	1.6	1.8	0.7	0.3
No. of surveys	2	1	1	2	1	1	1	1	2
Description	Sand and reef intertidal zone, extensive mangroves in some areas, rocky shoreline	Sandy beach with some reef around deep water harbour	Sandy intertidal zone around artificial sandbar with some mangroves and remnant tidal pools	Sand and reef intertidal zone, rocky shore with dune behind	Mud and sand intertidal zone, sandy beach behind	Extensive mud and sand intertidal zone, sandy beach, tidal creek	Extensive mud and sand intertidal zone with rocky shoreline and sparse mangroves, tidal creek	Extensive mud and sand intertidal zone, sandy beach with some rocks, sparse mangroves	Boat landing surrounded by mangroves and samphire

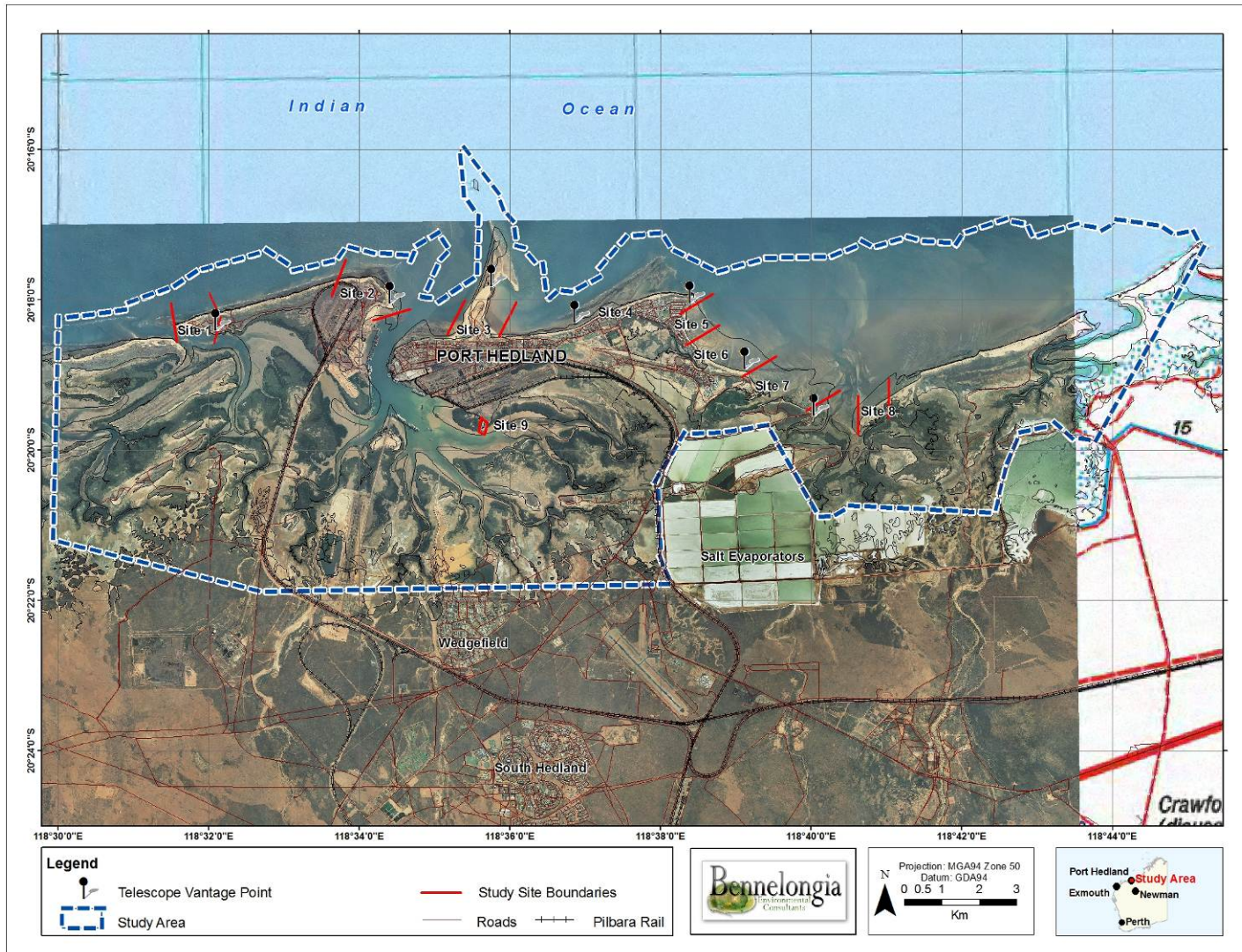


Figure 3. Survey sites surveyed in April 2011.

Table 3. Migratory shorebird species likely to occur within or near the Study Area, as identified from database searches.

Common name	Scientific name	Birds Australia surveys	ENV survey	April 2011 survey
Bar-tailed godwit	<i>Limosa lapponica</i>	✓	✓	
Little curlew	<i>Numenius minutus</i>			✓
Whimbrel	<i>Numenius phaeopus</i>	✓	✓	✓
Eastern curlew	<i>Numenius madagascariensis</i>	✓	✓	✓
Common redshank	<i>Tringa totanus</i>		✓	
Marsh sandpiper	<i>Tringa stagnatilis</i>	✓	✓	
Common greenshank	<i>Tringa nebularia</i>	✓		
Terek sandpiper	<i>Xenus cinereus</i>	✓	✓	✓
Common sandpiper	<i>Actitis hypoleucos</i>	✓	✓	
Grey-tailed tattler	<i>Heteroscelus brevipes</i>	✓	✓	✓
Ruddy turnstone	<i>Arenaria interpres</i>	✓	✓	✓
Great knot	<i>Calidris tenuirostris</i>	✓	✓	✓
Red knot	<i>Calidris canutus</i>	✓	✓	✓
Sanderling	<i>Calidris alba</i>			✓
Red-necked stint	<i>Calidris ruficollis</i>	✓	✓	✓
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	✓		
Curlew sandpiper	<i>Calidris ferruginea</i>	✓	✓	
Broad-billed sandpiper	<i>Limicola falcinellus</i>			✓
(Pacific) Golden plover	<i>Pluvialis fulva</i>	✓		
Grey plover	<i>Pluvialis squatarola</i>	✓	✓	✓
Lesser sand plover	<i>Charadrius mongolus</i>		✓	✓
Greater sand plover	<i>Charadrius leschenaultii</i>	✓	✓	✓
Oriental plover	<i>Charadrius veredus</i>	✓	✓	

Fauna

database searches identified that 27 of the 36 migratory species listed in EPBC Act policy statement 3:21 are likely to occur in the Study Area; 24 species were found in an EPBC Act Protected Matters search and 25 species in a NatureMap search (Table 3).

3.2. Literature Review

A brief summary of recent surveys conducted in, or near, the Study Area is provided below. Information about surveys elsewhere in north-western Australia is provided in Appendix A.

Port Hedland Outer Harbour Development Surveys (ENV 2009)

These surveys were conducted from October to November 2007 and in May 2008 within the Study Area but exact location are not available. Observations were opportunistic and shorebirds were recorded only as present or absent. A total of 17 migratory shorebirds species were recorded during the combined winter and summer survey. Six migratory shorebird species were recorded in winter (Whimbrel, Marsh sandpiper, Terek sandpiper, Grey-tailed tattler, Ruddy turnstone and Greater sand plover) (Appendix B), demonstrating that that small numbers of shorebirds use the Study Area year-round.

Shorebirds 2020 Program Surveys (Birds Australia data in ENV 2009)

Despite a significant number of shorebird surveys within the Port Hedland area, only two locations within the Study Area had previous area-based counts. These were the open shoreline habitat at Cooke Point, and sheltered supra-tidal habitat at Finucane Island (Figure 2), which are part of the

Birds Australia Shorebirds 2020 network of 235 monitoring sites throughout Australia (Birds Australia 2009). This program also surveyed the less saline ponds in the Leslie Saltfields (Figure 2). Surveys were conducted by volunteers during the summer months.

In counts prior to 2009, 18 species were recorded (Appendix B). Finucane Island was characterised by moderate species richness but low shorebird abundance (a total of 14 species were recorded across all surveys but shorebird numbers averaged only 135 shorebirds). Abundance was higher (205 shorebirds) at Cooke Point, although only 12 species were recorded. However, in some years combined counts of Grey-tailed tattler and Ruddy turnstone exceeded the respective 0.1% estimates of their flyway populations (57 Grey-tailed tattler counted vs 0.1% threshold of 50; 93 Ruddy turnstone vs 35), thus showing the Study Area to be nationally important.

Counts at Leslie Salt Fields were not significantly different to those of the Rio Tinto Birdwatch surveys described below.

Rio Tinto Birdwatch Surveys of Leslie Salt Fields (Rio Tinto 2006)

Between 2002 and 2006, Rio Tinto funded shorebird surveys at Leslie Salt Fields, most of which lies about 12 km north-east of the Study Area (Figure 2), although the final evaporation ponds lie south of the Study Area. Systematic surveys were conducted of ponds 0-8 and the mudflats adjacent to pond 0 in September and October 2002, and November of 2004, 2005 and 2006. A total of 26 shorebird species were recorded, with shorebird abundance varying between 2027 and 11,301. Three migratory shorebird species were recorded in greater numbers than 1% of their species populations, making the Salt Fields internationally important. These were Red-necked stint (maximum count of 5152 vs 1% trigger of 3250), Sharp-tailed sandpiper (2625 vs 1600) and Broad-billed sandpiper (267 vs 250). A further three species were recorded in greater numbers than 0.1% of their flyway populations, adding further national importance to the site. These were Bar-tailed godwit (1273 vs 325), Curlew sandpiper (818 vs 180) and Oriental plover (85 vs 70).

Other Pilbara surveys

North-western Australia is a globally important area for shorebirds, and contains the largest numbers of shorebirds recorded in Australia (Minton 2006). Shorebird sites in the north-west can be divided into three broad categories: sites with outstanding shorebird values, those with significant values (including possible national or international importance), and sites with low shorebird values. Comparison of counts at the Study Area with those from other sites on the Pilbara coast, or in adjacent areas, during the period from 2002 to 2009 suggests that with only 340 shorebirds counted the Study Area was at the low end of the range of sites with significant shorebird values (Table 4). This at least partly reflects that only small portions of the Study Area were surveyed but other sites may also contain better habitat.

The most important sites for shorebirds in north-western Australia are the southern Kimberley sites of Eighty-mile Beach and Roebuck Bay, where 262,485 and 149,131 listed migratory shorebirds were recorded, respectively, in December 2004 and October 2008 (Table 4). Lake McLeod in the northern Gascoyne region also has outstanding shorebird value, with 54,851 listed migratory shorebirds counted in November 2004. Sites with significant values include the artificial Leslie Salt Fields (see section 3.2) to the east of the Study Area and Dampier Salt Works, where 17,745 listed migratory shorebirds were counted in November 2005 (Table 4). Natural sites on the coast with significant values include Balla Balla Creek (8522 listed migratory shorebirds), mouth of the De Grey River (7305), Cape Preston (3562) and Exmouth Gulf (1780) (Table 4).

Table 4. Recent counts of listed shorebirds at other sites on the Pilbara coast and beyond.

See Appendix A for details.

Site	Distance & direction from Port Hedland	Survey date & source	Shorebird count ¹
Leslie Salt Fields	30 km W	November 2006 (Rio Tinto 2006)	9815
De Grey River mouth	70 km NW	October 2008 (Kingsford <i>et al.</i> 2011)	7305
Coastal mud flats at Balla Balla Creek	90 km W SW	October 2008 (Kingsford <i>et al.</i> 2011)	8522
Dampier Salt Works	200 km W SW	November 2005 (Rio Tinto 2006)	17,745
Cape Preston	250 km W SW	November 2010 (Bennelongia 2010)	3562
Eighty Mile Beach	250 km E NE	December 2004 (Rogers <i>et al.</i> 2006b)	262,485
Exmouth Gulf	470 km W SW	October 2008 (Kingsford <i>et al.</i> 2011)	1780
Roebuck Bay	470 km NE	October 2008 (Kingsford <i>et al.</i> 2011)	149,131
Lake McLeod	650 km SW	November 2004 (Rio Tinto 2006)	54,851

¹ Migratory species listed in EPBC Act policy statement 3.21)

3.3. Field survey

3.3.1. Migratory shorebird counts

An estimated 4248 shorebirds of 18 species occurred in the Study Area in April 2011, based on summing the maximum counts for each species at each survey site (Table 5, Appendix B). Both site 7 (Six Mile Beach) and site 1 (Finucane Island Boat Ramp) had 12 species, with the highest number of shorebirds (1858) occurring at site 7. Only 31 birds were recorded at site 9 (Burgess Point Boat Ramp).

Three species recorded during the April 2011 survey, Little curlew, Sanderling and Broad-billed sandpiper, were not seen during previous surveys of the Study Area, although the fauna database searches had suggested they were likely to be present (Appendix B). Of the 4248 shorebirds counted, 1845 were too distant to identify other than as shorebirds (Table 5), meaning that counts recorded for individual species were under-estimates. Grey-tailed tattler (588), Red-necked stint (455) and Bar-tailed godwit (448) appeared to be the most numerous species. Little curlew, Eastern curlew and Broad-billed sandpiper were each represented by single birds.

Table 5. Shorebird counts in April 2011.

Higher count presented when two surveys of a site undertaken (see Appendix C).

Shorebird species	1	2	3	4	5	6	7	8	9	All
Grey Plover		3		1			1			5
Lesser Sand Plover	23						25			48
Greater Sand Plover	166	15		9		8	105			303
Bar-tailed Godwit	21	34	19	63		29	177	105		448
Little Curlew									1	1
Whimbrel	1	6	4			1	4	1	20	37
Eastern Curlew							1			1
Terek Sandpiper	58			2			2			62
Common Sandpiper				2						2
Grey-tailed Tattler	50	140	3	167	69	31	118		10	588
Common Greenshank	1			1		2				4
Ruddy Turnstone	8	14	11	18			64			115
Great Knot	35	36	42	5		13	120	30		281
Red Knot							42			42
Sanderling			1		4					5
Red-necked Stint	38	3	23	66		66	259			455
Curlew Sandpiper	5									5
Broad-billed Sandpiper	1									1
Unidentified wader						625	940	280		1845
No. of species	12	8	7	10	2	8	13	4	3	18
No. of birds	407	251	103	334	73	775	1858	416	31	4248

3.3.2. Significance of counts

In total, 23 species of shorebird have been recorded within the Study Area (or Port Hedland shorebird site, Tables 3 and 5). The count of 4248 listed migratory shorebird species in April 2011 showed that the relatively low shorebird counts made between 2002 and 2009 within the Study Area were largely an artefact of surveys covering only a small portion of the site where shorebirds were less dense. The Study Area appears to have relatively high significance for shorebirds compared with most of the Pilbara coastline and is nationally important in terms of both shorebird abundance and species richness (23 species with maximum count of 4242 vs thresholds of 15 species and 2000 birds).

The April 2011 survey also showed the Study Area is internationally important for Grey-tailed tattler. The count for this species exceeded 1% of the flyway population (588 vs 1% estimate of 500) (Table 5). The recorded abundance of five other species exceeded 0.1% of their flyway estimates: Greater sand plover (303 vs 110), Bar-tailed Godwit (448 vs 325), Terek Sandpiper (62 vs 60), Ruddy Turnstone (115 vs 35), and Red-necked Stint (455 vs 325). Grey-tailed Tattler were recorded at all survey locations except site 8 (Dampier Salt Point), and their abundance equalled or exceeded 50 birds (0.1% estimate) at site 7 (Six Mile Beach), site 5 (Cooke Point south), site 4 (North Beach), site 2 (Harbour West) and site 1 (Finucane Island Boat Ramp).

The only study site within the Study Area counted in both April 2011 and previous Shorebirds 2020 surveys was part of site 4 (North Beach). This is referred to as Cooke Point in Shorebird 2020 counts (Figure 2). The average Shorebirds 2020 count of 205 birds is of similar magnitude to the count of 334 for all of site 4 in April 2011.

3.3.3. Comparisons with Leslie Salt Fields

Historically, the Leslie Salt Fields were regarded as much more important for shorebirds than the Study Area, with counts of up to 65,000 recorded in these artificial wetlands during the 1980s (Minton 2006). However, counts declined to between 5,000 and 10,000 shorebirds after the system was modified in the 1990s and results from the April 2011 survey suggest that the Salt Fields and Study Area now have similar overall shorebird values.

Despite their close proximity, species composition at the two sites differs substantially, reflecting habitat differences between the sites and suggesting that birds use the areas independently. This was illustrated by the most abundant species at the Salt Fields being in low abundance or not observed at all in the Study Area (e.g. Broad-billed sandpiper, and Lesser sand plover), while two of the more commonly recorded species in the Study Area (Ruddy turnstone, Grey-tailed tattler) were not well represented at the Salt Fields.

3.3.4. Shorebird densities

Shorebird numbers per kilometre of shoreline were higher at the eastern part of the Study Area (sites 8 - Port Hedland Salt Beach, site 7 - Six Mile Beach, site 6 - Pretty Pool Beach) than at the centrally located and more westerly survey sites (Figure 4). However, the density of shorebirds at site 1 (Finucane Island Boat Ramp) was high relative to other western survey areas.

Shorebird activity followed a consistent pattern of roosting during periods of high tide and foraging during periods of low tide.

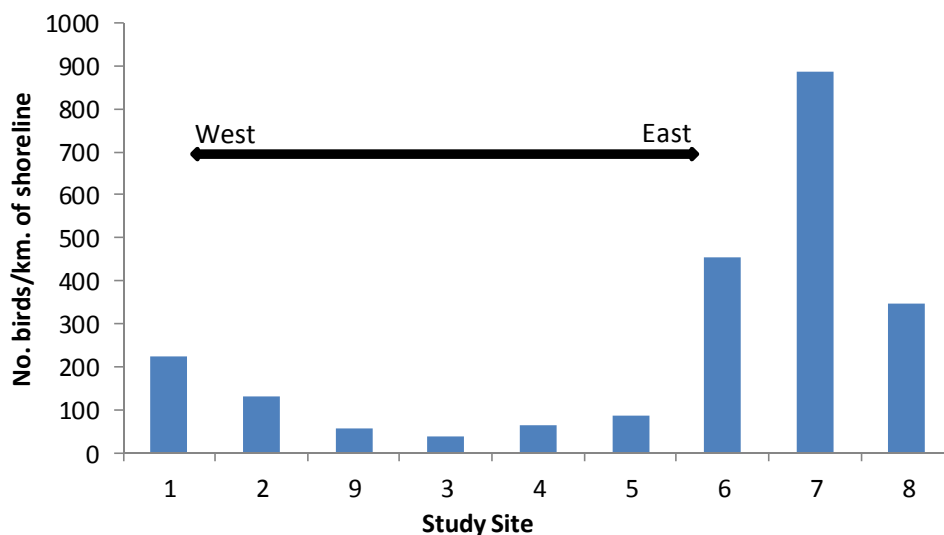


Figure 4. Density of shorebirds at the different study sites.

3.3.5. Migratory Shorebird Habitats

Habitat descriptions of the Study Area were made in April 2011 and assessments of the foraging and roosting values of individual survey sites are provided in Tables 6. Using the information gathered during the April 2011 field survey of individual sites, together with habitat mapping for the whole Study Area (based on interpretation of aerial photography), the assessed and inferred foraging and roosting values within the Study Area were mapped (Figures 5 and 6).

Foraging habitat

Most shorebirds are tactile feeders and probe for prey. Thus, the most important potential foraging habitat for shorebirds is intertidal sediment. Species such as Whimbrel and Grey-tailed tattler often use muddy areas associated with mangroves and species that are visual predators, such as Ruddy turnstone and plovers, will feed on rocky substrates, including reefs.

The largest area of high value foraging habitat was east of site 5 (Cooke Point) where there was an extensive intertidal sediment (sand and mud) flat, measuring about 11 km long by 4 km wide at its widest point, which contained only 0.5% rocky substrate (Figure 5). There was less intertidal habitat between the Harbour entrance and site 5 and the proportion of rocky substrate was much higher (19%), resulting in only moderate foraging value. Similarly, the area of intertidal sediment was not extensive west of the Harbour entrance and, although there was relatively little rocky substrate (1.5%), the area had only moderate foraging value (Figure 5).

In addition to open shoreline habitat, aerial mapping indicated there was a substantial area of moderate value foraging habitat in the network of tidal creeks (Figure 5). Because the network of tidal creeks is more extensive inland from the harbour entrance, there are more tidal creek foraging habitats to the west than to the east of Cooke Point.

Roosting habitat

Potential roosting habitats for migratory shorebirds include sandy beaches, some rocky shorelines, mangroves and, occasionally during high tides or storms, areas of marsh behind the mangroves. Most of the Study Area does not consist of shorebird roosting habitat, with only 4 km of the 37 km of the open shoreline habitat (11%) assessed as being high value for roosting (Figure 6). High value roosting habitat was associated primarily with sandy shores located east of site 5 (Cooke Point), adjacent to the large intertidal area, and also at the western point of Finucane Island in the western section of the Study Area.

Rocky shorelines mostly provided poorer roosting habitat, though the patchy rocky habitat on the far western point of Finucane Island appeared to provide valuable roosting habitat for shorebirds (Figure 6). The shoreline roosting habitat in the central portion of the Study Area was assessed as having moderate value. The mangrove community at Burgess Point was also considered to be of moderate value.

4. IMPACT ASSESSMENT

According to EPBC Act policy statement 3.21, the principal threats to migratory shorebirds are habitat loss, habitat degradation, disturbance and direct mortality from chemicals, bird strike and other hazards. Guidelines for assessing whether threats at a site significantly affect shorebird conservation values are provided. In summary, it is important to consider the extent and quality of

Table 6. Assessments of value of each survey site for migratory shorebirds.

See Table 2 for site names and descriptions.

Site	Foraging value	Roosting value
1	Moderate value intertidal feeding zone for visual feeding species such as Ruddy Turnstone and plovers	High value shorebird roost above the sandy beach amidst rocky headland habitat
2	Tide too high to assess intertidal habitat in the field. Moderate value inferred from aerial photography	Moderate value shorebird roost on the elevated beach
3	Tide too high to assess intertidal habitat. Moderate value inferred from aerial photography	Moderate value high tide roost for shorebirds and seabirds
4	Moderate value intertidal feeding area for some visual feeding species such as Ruddy Turstone and plovers	Moderate value roost for species such as Ruddy turnstone on the rocky shore.
5	High value intertidal foraging habitat	Moderate value shorebird roost on the sandy beach
6	High value intertidal feeding area. Small tidal creek provides moderate feeding habitat for Whimbrel, Eastern curlew, Bar-tailed Godwit and knots	Sandy beach provides moderate value shorebird roost. Small tidal creek provides moderate roosting habitat for Whimbrel and Eastern curlew
7	High value intertidal feeding area. Tidal creek likely to provide additional feeding sites for species such as Grey-tailed tattler and Whimbrel	High value shorebird roost on the sandy beach. Tidal creek likely to provide additional roost sites for Grey-tailed tattler and Whimbrel
8	High value intertidal feeding area. Tidal creek likely to provide additional feeding sites for Grey-tailed tattler and Whimbrel	High value shorebird roost on the sandy beach. Tidal creek to the south likely to provide additional roost sites for Grey-tailed tattler and Whimbrel
9	Moderate value shorebird foraging habitat	Low value shorebird roost site

habitat in and near the shorebird site and then assess the likely impact of the threat on overall shorebird values of the site and surrounding areas.

The unit of assessment considered here is the Study Area, representing the Study Area. The Outer Harbour Development will principally affect the western part of the Study Area (Section 4.1). The effect of habitat loss, habitat degradation, disturbance and direct mortality in the Study Area on shorebird conservation values are considered below. It was considered that the potential threats were:

- Loss of habitat (Section 4.2);
- Habitat degradation through sedimentation (Section 4.3);
- Disturbance through light spill, noise and human activity (Section 4.4); ; and
- Direct mortality through chemical discharges or spills (Section 4.5).

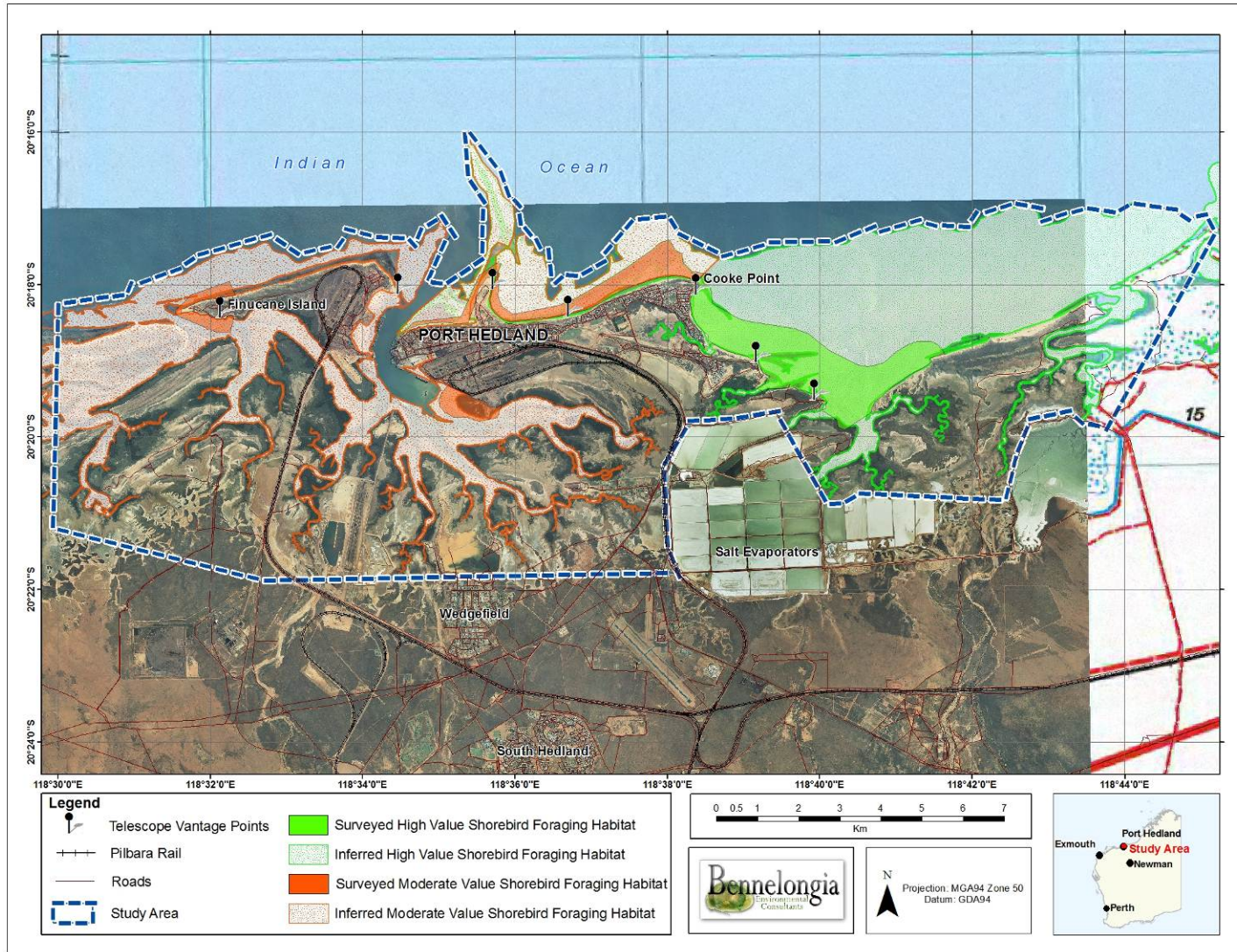


Figure 5. Habitat value of intertidal foraging areas in the Study Area.

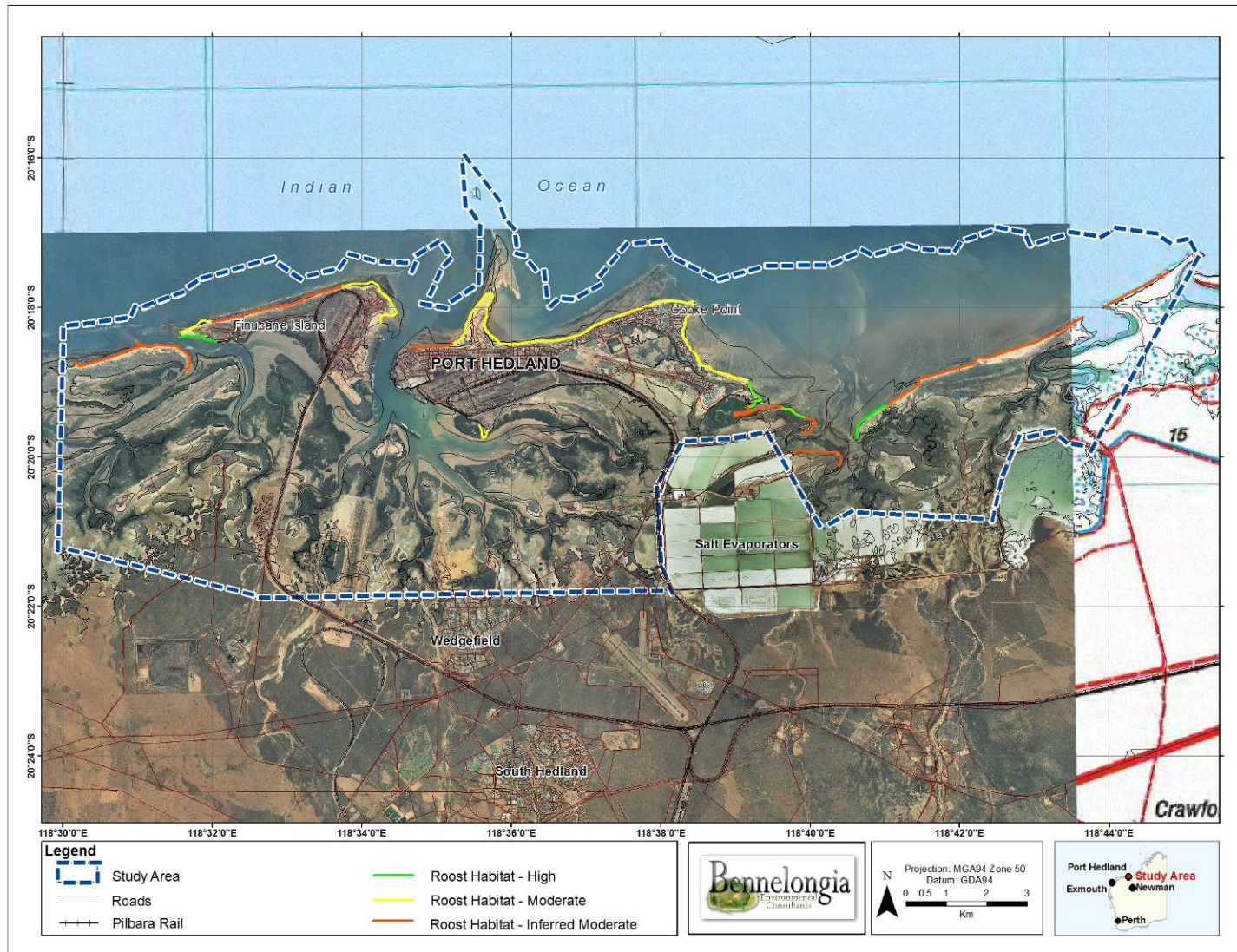


Figure 6. Open shoreline roosting habitat value in the Study Area.

4.1. Project description

The Outer Harbour Development project involves the construction and operation of iron ore handling and export facilities (Figure 7) with an estimated throughput of 240 million tonnes per annum. The main landside components of the project consist of:

- rail connections and a spur from the existing BHP Billiton Iron Ore Newman rail line to new stockyards at Boodarie;
- stockyard infrastructure consisting of car dumpers, stackers and reclaimers; and
- an infrastructure corridor between Boodarie stockyards and the proposed marine jetty offshore from Finucane Island to accommodate an access roadway and tracks, five conveyors; and power, water and communication utilities.

The main marine components of the project consist of an eight berth, 2 km wharf at the end of a 4 km jetty and 34 km shipping channel requiring a six year dredging program to remove 54 million cubic metres of sediment to offshore spoil grounds.

4.2. Habitat Loss

Clearing of potential shorebird habitat as a result of Outer Harbour Development will be restricted to the area around Finucane Island, with an estimated habitat loss of:

- 1.7 ha of hard intertidal hard substrate on open shorelines;
- 3 ha of intertidal sediments on open shorelines;
- 27 ha of mangroves; and
- 5 ha of intertidal sediments on tidal creeks.

The loss of open shoreline habitat will occur where the proposed jetty extends north from Finucane Island at the narrowest point of the intertidal flats (Figure 7). Less than 1% of intertidal hard substrates (1.7 ha) and only 0.1% of the intertidal soft sediments (3 ha) within the Study Area will be lost from an section assessed as only of moderate foraging value (Figure 5). The area lost has little roosting value and represents a very small portion of potential roosting area on Finucane Island.

Most migratory shorebirds make little use of mangrove areas in Australia (Rogers *et al.* 2006a). However, a small number of species sometimes use mangroves as roost sites, including Grey-tailed tattler, for which the Study Area (i.e. Port Hedland shorebird site) is internationally significant. However, the 27 ha area proposed to be cleared represents only 1% of existing mangrove habitat within the Study Area.

The area of tidal creek intertidal mud flat that will be lost is less than 0.3% of the total area of tidal creek mudflat in the Study Area. However, this loss will impinge on the Shorebirds 2020 Finucane Island monitoring area (Figure 2), where 13 shorebird species have been recorded with an annual average abundance of 135. The most abundantly recorded species at this location was the Great knot with an annual average maximum count of 47 birds. In 2011, 35 Great Knot were counted at Finucane Island, representing only 12% of the 281 Great knot recorded across seven survey sites within the Study Area. Although the Shorebirds 2020 monitoring area at Finucane Island is of scientific value, it is unlikely to represent critical habitat for shorebirds within the Study Area.

It is considered that loss of shorebird habitat at Finucane Island will have negligible effect on the conservation values of the Study Area or on shorebird conservation values at a regional or international level.

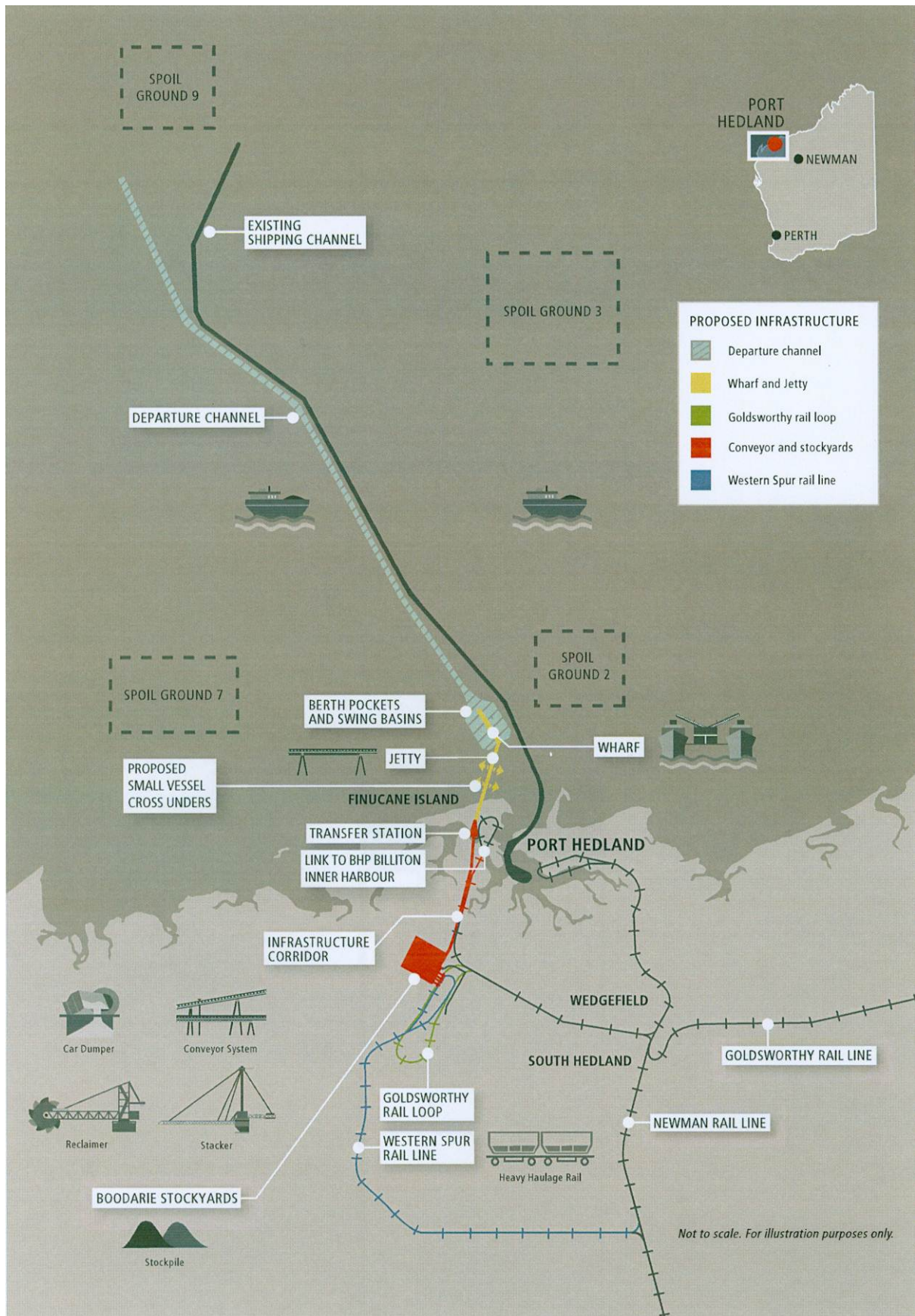


Figure 7. The major components and arrangement of the Outer Harbour Development.

Sourced from the Outer Harbour Development environmental assessment documentation, BHPBIO 2011).

4.3. Sedimentation

Dust will be a minor source of sediment during both construction and operational phases of the Outer Harbour Development and will be confined to a relatively small area of the moderate value roosting and foraging habitats around Finucane Island, adjacent to conveyors on the jetty (Figure 7). The main source of sedimentation will be dredging activities. During construction, 54 million cubic metres of sediments will be removed by dredging over a period of five to six years, and maintenance dredging will be conducted periodically during operation of the Outer Harbour.

Suspended and settling sediments from dredging operations have the potential to impact the invertebrate food sources of migratory shorebirds through direct smothering and by clogging gills and filter-feeding mechanisms. In addition, increased turbidity may reduce light and primary production in intertidal areas, with consequent reduction in food availability for invertebrate fauna. However, an assessment of dredging impacts on intertidal benthic primary producers (SKM 2011) has concluded that the levels of suspended sediment will not be high enough in any section of the intertidal zone to cause the complete loss of benthic primary producers. Based on this assessment, it is unlikely that there will be any large areas where total loss of the food sources of benthic invertebrates will occur, although plume modelling indicates that tidal regimes will cause sediment plumes to move inshore throughout the Study Area and the local geomorphological features may result in some trapping and greater elevation of sediment levels in isolated patches (APASA 2009).

Given current uncertainties about the pattern of sedimentation and the response of benthic invertebrate species, it is not known whether sedimentation will affect shorebirds. Invertebrate communities of intertidal sediments along the Pilbara coastline are naturally dynamic because strong tidal currents, periodic cyclones and river discharge events maintain a natural cycle of sedimentation and re-suspension. Accordingly, shorebirds are likely to have adaptable foraging strategies that enable them to persist through periods of localised sedimentation and invertebrate decline (see Rogers *et al.* 2006c). However, even the high value foraging habitat on the extensive intertidal sediment flats east of Cooke Point may be affected by sedimentation and, while large changes in shorebird use of the Study Area are considered to be unlikely, full assessment of impacts cannot be undertaken in advance of the Outer Harbour Development proceeding.

4.3. Disturbance

4.3.1. Light

The majority of studies into the effects of light on migratory birds have been conducted on species that are not shorebirds, but light is known to disrupt the navigation of many migratory birds and there are reports of mass mortality of some species in association with bright beams of light, especially from illuminated offshore oil platforms (Evans Ogden 1996; Wiese *et al.* 2001; Longcore *et al.* 2008; Poot *et al.* 2008).

There are no reports of mass mortalities, or chronic low level mortalities, of migratory shorebirds associated with illuminated developments along the north-west coast of Australia, including the past operation of Port Hedland port and township developments. Therefore, the risk of significant disorientation of migratory shorebirds as a result of the Outer Harbour Development is considered to be low.

In relation to other potential impacts of night-time lighting from the Outer Harbour Development, it has been suggested that artificial lighting may alter the pattern of daytime and night-time foraging

(Rohweder and Bavershock 1996, Burton and Armitage 2005). The levels of light initiating such behavioural changes are unknown. Elevated light levels can also increase the vulnerability of shorebirds to visual predators at night.

Major sources of night-time light spill from the Outer Harbour Development will be lighting on the 4 km jetty and 2 km wharf and associated conveyors and ship loaders in the offshore environment, and stacking and sorting infrastructure at the Boodarie stockpile area on land (Figure 7). Light spill modelling indicates that light spill is likely to be greatest from stockyard stackers and reclaimers. This modelling predicted that:

- Lights from shipping and the new jetty will be visible at North Beach (site 4) but their contribution to cumulative light levels will be minimal (Bassett 2009); and
- Existing light spill from local street lights and a sports complex in the Port Hedland townsite will continue to dominate at Cooke Point (site 5), Pretty Pool (site 6) and Six Mile (site 7) beaches, while Dampier Salt Point (site 8) will receive almost no additional light.

Light spill modelling did not include Spoil Bank (site 3), Harbour West (site 2) or the western end of Finucane Island (site 1). Spoil Bank and Harbour West are near the illuminated town site and industrial developments but light levels at both locations may increase as a result of the Outer Harbour Development. The high value roosting habitat identified on the far western end of Finucane Island currently receives little spill and the Outer Harbour Development may cause substantial increases in light at this site. However, given that the roosting site is about 3 km from the proposed conveyors and jetty, light is unlikely to exceed levels already experienced at sites adjacent to existing industrial and town site developments in Port Hedland.

Roosting and foraging habitats in tidal creek and open shoreline areas adjacent to the conveyors and jetty will be subject to an increase in illumination and to an altered outlook onto the illuminated infrastructure. The potential for disturbance by altered light regimes is greatest in these areas. Birds might choose not to roost adjacent to the jetty, and increased vulnerability to visual predators may occur. However, habitats in this area are not considered to be of high value and if birds are alienated by lights in close proximity to illuminated infrastructure, the area of lost night time habitat is likely to be small when compared with the availability of alternative roosting and foraging habitats elsewhere in the Study Area.

In conclusion, it is unlikely there will be disorientation of migratory shorebirds as a result of the Outer Harbour Development. The risk that light spill from the Outer Harbour Development will influence bird use of the high value roosting and foraging habitats east of Cooke Point (site 5) is also very low. Light levels at the western end of Finucane Island (site 1) will not exceed those currently experienced nearer to the Port Hedland townsite but the probable effect of the light increase on roosting value of the site is unknown. Any light induced disturbance of shorebird activities in tidal creek and open shoreline areas of Finucane Island close to the proposed conveyors and jetty is likely to be limited to local scale adjustments to night time usage patterns and not of conservation significance.

4.3.2. Noise

Shorebirds appear to be mostly tolerant of industrial developments (e.g. Conoco Phillips 2005) and often occur in high abundance at airports, where they require ongoing management to reduce numbers (Godin 1994). Other studies of specific disturbances have, however, shown that shorebirds

respond to noise and also that they may be more sensitive to other disturbance after exposure to loud noise (Koolhaas *et al.* 1992). There is also evidence that long-lasting construction may adversely affect shorebirds (Burton *et al.* 2002).

Most areas in the western portion of the Study Area already have high noise levels from transport and industrial developments and the continued use of these areas by migratory shorebirds demonstrates a tolerance to some noise, although the trigger levels likely to cause birds to vacate an area are unknown. Additional acoustic emissions from fixed plant (car dumpers, stackers and reclaimers, conveyors and ship loaders) and rail operations during Outer Harbour Development operations, and pile driving during the construction phase, will add to the current noise levels, which are likely to exceed 70 dB(A) along the length of the conveyors, jetty and wharf (SVT 2009). The only section of coast where noise levels are predicted to reach 70 dB(A) is where the conveyors and jetty infrastructure cross the tidal creek and northern shoreline of Finucane Island.

Pile driving, which is percussive and may produce noise levels in excess of 100 dB(A) at source, will be conducted over a period of 24 months during construction. A ramp up procedure will be used to warn wildlife of an impending piling sequence and enable them to move away prior to the emission of dangerous noise levels. Modelled noise emissions from pile driving indicate that a 1-2 km stretch of coastline may experience more than 70 dB(A) (SVT 2010). Pile driving may, therefore, temporarily increase the area subject to some reduction in habitat value. However, the narrowness of the intertidal flats around the jetty means that the surrounding 2 km of coastline represents only about 2% of available open coastline intertidal habitats and 6% of intertidal creek habitats in the Study Area.

Given that shorebirds have some tolerance to noise, and with noticeable increases in noise levels confined to relatively small areas off Finucane Island that have been assessed as having only moderate value for shorebirds, it is unlikely that noise will cause significant impacts to migratory shorebirds beyond a local adjustment in usage patterns within the western section of the Study Area.

4.3.3. Human Activity

Shorebirds may be disturbed by people, pets and vehicles. Work carried out elsewhere has identified dogs as a significant source of disturbance (Davidson and Rothwell 1993; Shorebird Conservation Project 2005) and a study of shorebird disturbance at Roebuck Bay determined that 20-30% of alarm flights were in response to recreational beach walkers (Rogers *et al.* 2006b)

The requirement for vehicle or personnel access along shoreline roosting sites during Outer Port operations will be minimal. Disturbance in the vicinity of the jetty will occur during construction. This disturbance will be temporary and by limiting access beyond the construction area, will be confined to a narrow stretch of shoreline that is not considered to provide high value shorebirds roosting and foraging habitats.

The Outer Harbour and other developments in the Port Hedland area are attracting more residents to the town. It is the recreational activities of the development workforce, their families and pets that perhaps have the greatest potential to cause significant ongoing shorebird disturbance in the Study Area.

4.4. Discharges and Spills

With the planned avoidance of discharge of most wastes to the coastal and marine environments, stormwater discharge does not appear to pose a significant threat to migratory shorebirds. The expected reduction in water quality within a 250 m buffer surrounding the jetty is not likely to have direct effect on shorebird health.

Port Hedland is already one of the largest ports in Australia and there is an existing risk of spills and unplanned discharges. The proposed management framework to minimise risk through the implementation of best management practices, monitoring and the maintenance of a rapid response capability provides the most effective approach to protecting migratory shorebirds from the effects of unplanned discharges and spills.

5. CONCLUSION

Altogether, 23 species of migratory shorebirds have been recorded at Study Area in surveys since 2002. During surveys in April 2011, a total of 4248 migratory shorebirds of 18 species were counted. Three species seen in April 2011 (Little curlew, Sanderling, Broad-billed sandpiper) had not been recorded during previous surveys. However, fauna database searches had suggested these species were likely to occur. Six Mile Beach (site 7) and Finucane Island Boat Ramp (site 1) were the survey sites supporting most species (12 each). The more numerous species were Grey-tailed tattler (588 birds), Red-necked stint (455) and Bar-tailed godwit (448), although species counts are likely to have under-estimated actual abundance.

The Study Area represents a shorebird site as outlined in EPBC Policy statement 3.21. The observed abundance and species richness of migratory shorebirds within the Study Area (i.e. the Port Hedland shorebird site) triggered all three types of criteria for determining a site to be either nationally or internationally significant for shorebirds (EPBC Policy Statement 3.21):

- More than 1% of the species population of Grey-tailed tattler occurred at the site in April 2001, indicating the site is of international significance for this species;
- More than 0.1% of the flyway population of 5 species occurred in April 2001, making the site nationally significant because of these species (Greater sand plover, Bar-tailed godwit, Terek sandpiper, Ruddy turnstone, Red-necked stint). Both Grey-tailed tattler and Ruddy turnstone were recorded above the 0.1% threshold in surveys by Birds Australia (ENV 2009);
- More than 2000 shorebirds were recorded in April 2011 (4248), indicating the site is nationally significant in terms of overall shorebird abundance; and
- More than 15 shorebird species were recorded (23 overall and 18 in April 2011), making the site nationally significant in terms of richness of shorebird species.

Although far higher numbers of migratory shorebirds occur at other sites along the Pilbara and southern Kimberley coasts, e.g. 262,485 birds at Eighty Mile Beach 250 km from Port Hedland, the Study Area remains a regionally significant site for migratory shorebirds and is likely to contribute to shorebird conservation at the regional level.

The Study Area encompasses approximately 5026 ha of intertidal flat on open shoreline and 2196 ha of intertidal flats on tidal creeks. Sediment (sand and mud) flats on open shorelines provide the most valuable shorebird foraging habitat. The majority of open shoreline intertidal sediment within the Study Area is located east of Cooke Point where an extensive intertidal flat was assessed as high

value shorebird foraging habitat. Intertidal habitats to the west of Site 5 - Cooke Point, and in tidal creeks, are considered to be only of moderate value for migratory shorebird foraging.

Fewer than 10% of shorebirds counted in the Study Area in April 2011 occurred on Finucane Island; 74% of shorebirds occurred from Cooke Point eastwards where there is a wide intertidal flat and the birds are away from any Harbour and townsite-related disturbances.

Most of the potential impacts of the proposed Outer Harbour Development will be restricted to the western portion of the Study Area or Study Area. The only shorebird habitats of open shoreline areas that will be lost are 3 ha of intertidal sediment and 1.7 ha of intertidal hard substrate around the proposed jetty on Finucane Island. These areas constitute less than 0.1% and 1%, respectively, of each habitat type within the Study Area. In addition, 5 ha of intertidal creek and 27 ha of mangrove will be lost on the southern side of Finucane Island. These areas constitute 1% and less than 0.1%, respectively, of each habitat type.

The main cause of physical habitat degradation is likely to be sedimentation from dredging activities. It is predicted that patches of high sedimentation will occur across all the Study Area, including the extensive sediment flats east of Cooke Point (site 5) that have high value foraging value. While large changes in shorebird use of the Study Area as a result of sedimentation are unlikely, full assessment of impacts cannot be undertaken in advance of the Outer Harbour Development proceeding.

The main disturbances likely to affect shorebirds as a result of the Outer Harbour Development are light, noise and human activity. It is considered possible that localised reduction in the value of shorebird roosting and foraging habitats will occur in the vicinity of the proposed jetty and conveyors on Finucane Island as a result of light emissions. Light is unlikely to have any further effect on shorebird use of the Study Area east of Spoil Bank (site 3) where 82% of birds occur. It is also unlikely that light from the Outer Harbour Development will cause disorientation of shorebirds during their migration or affect the overall shorebird conservation values within the Study Area.

Noise from construction and operation of the Outer Harbour Development will not affect the conservation value of the Study Area other than causing a local reduction in shorebird use of part of Finucane Island where noise resulting from pile driving and, later, port operations will be considerable (70-100 dB(A)). Shorebirds are tolerant of regular noise in many industrial and transport-related situations.

Human activity is a major cause of shorebird disturbance world-wide, with dogs and beach-walkers implicated as a major cause of the disturbance. The level of human disturbance is expected to increase in the Study Area as the population of Port Hedland grows but the increase will not be directly related to Port activity.

Discharges and spills of oils and toxic material occasionally cause direct mortality to wildlife. Port Hedland is already one of the largest ports in Australia and there exists a risk of spills and unplanned discharges that may potentially affect shorebirds. The risk will be minimized through adherence to best practice and maintaining a rapid response capability to protect migratory shorebirds and other wildlife from any effects of unplanned discharges and spills.

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7. APPENDICES

Appendix A. Summary of shorebird surveys in north-western Australia.

Project name – Rio Tinto Birdwatch (Rio Tinto 2006) Survey dates - September 2002, October 2002, November 2004, 2005, 2006.	
METHODS	RESULTS
<p>Surveys of evaporation ponds at Dampier Salt, Karratha, and Lake MacLeod, north of Carnarvon, were conducted by professional ornithologists.</p> <p>Monitoring at Lake MacLeod included 9 survey locations covering much of the lake.</p>	<p>Dampier Salt Peak number of migratory shorebird species was 17,744 in November 2005. During at least one survey since 1999, 21 species of migratory waders have been recorded and counts of the following species exceeded 1% of flyway estimates:</p> <ul style="list-style-type: none"> • Red-necked Stint; • Curlew Sandpiper <p>During at least one survey since 1999, counts of the following species exceeded 0.1% of flyway estimates:</p> <p>Lake MacLeod Peaks numbers of migratory shorebird species was 65,617 in November 2004. During at least one survey since 1999, 24 species of migratory waders have been recorded and counts of the following species exceeded 1% of flyway estimates:</p> <ul style="list-style-type: none"> • Red-necked Stint • Sharp-tailed Sandpiper • <p>During at least one survey since 1999, counts of the following species exceeded 0.1% of flyway estimates:</p> <ul style="list-style-type: none"> • Bar –tailed Godwit • March Sandpiper • Grey-tailed Tattler • Curlew Sandpiper • Broad-billed Sandpiper • Oriental Plover
Project name - National Waterbird Count of the De Grey River mouth, Eighty Mile Beach and Lake MacLeod (Kingsford <i>et al.</i> 2011)	
METHODS	RESULTS
<p>Aerial surveys using fixed wing plane with two experienced observers, one either side of the plane.</p>	<p>Mouth of the De Grey River Medium sized waders – 1527 Small waders – 5677 Bar-tailed Godwit – 100 Greenshank – 1 TOTAL of 7305 migratory shorebirds at the mouth of the De Grey River</p> <p>Eighty Mile Beach Medium sized waders – 139,308 Small waders – 121,489 Bar-tailed Godwit – 630 TOTAL of 261,427 migratory shorebirds recorded</p> <p>Lake MacLeod TOTAL of 15,174 migratory shorebirds recorded</p>

Project name - Anketell Point and Dixon Island surveys (AECOM 2010) Survey dates – March and October 2008, February, March and July 2009, October 2010.	
METHODS	RESULTS
Systematic survey of the Anketell Point and Dixon Island site which is about 160 km south-east of Port Hedland.	20 migratory wader species recorded Maximum southern migration counts of Grey-tailed Tattlers (662) exceeded the site significance criterion of 1% of their flyway population estimates making this an internationally significant site for this species. Maximum counts of Greater Sand Plovers and Red-necked Stints exceeded the site significance criterion of 0.1% of their flyway estimate. Bird counts in excess of 2000 birds.
Project name – Shorebird monitoring at Cape Preston (Bennelongia 2010) Survey dates - Oct. 2002 (Hassell 2002), Oct, Nov 2009 and Nov 2008, and Nov. 2010	
METHODS	RESULTS
8 survey locations at Cape Preston were surveyed by a professional ornithologist using high quality telescopes and binoculars	Maximum shorebird count of migratory and non-migratory waders of 3562 birds. 23 species were recorded The following species occurred in numbers above 1% of their flyway population: <ul style="list-style-type: none"> • Grey-tailed Tattler The following species occurred in numbers above 0.1% of their flyway population: <ul style="list-style-type: none"> • Red-necked Stint • Bar-tailed Godwit • Greater Sand Plover
Project name – Waterbirds at remote wetlands in Western Australia (Jaensch and Vervest 1990) Survey dates September and October 1987	
METHODS	RESULTS
Comprehensive survey by professional ornithologists and volunteers of Lake MacLeod using vehicles, walking, a boat and a reconnaissance flight	53,660 migratory shorebirds 19 species of migratory shorebirds The following species occurred in numbers above 1% of their flyway population: <ul style="list-style-type: none"> • Red Knot (<i>Calidris canutus</i>) • Re-necked Stint • Curlew Sandpiper The following species occurred in numbers above 0.1% of their flyway population: <ul style="list-style-type: none"> • Common Greenshank • Sharp-tailed Sandpiper

Appendix B. Migratory shorebird species likely to occur in, or near to, the Study Area, as identified from database searches.

Scientific name	Common name	Protected Matters search tool	NatureMap
Swinhoe's snipe	<i>Gallinago megala</i>		✓
Black-tailed godwit	<i>Limosa limosa</i>	✓	✓
Bar-tailed godwit	<i>Limosa lapponica</i>	✓	✓
Little curlew	<i>Numenius minutus</i>	✓	✓
Whimbrel	<i>Numenius phaeopus</i>	✓	✓
Eastern curlew	<i>Numenius madagascariensis</i>	✓	✓
Marsh sandpiper	<i>Tringa stagnatilis</i>	✓	✓
Common greenshank	<i>Tringa nebularia</i>		✓
Wood sandpiper	<i>Tringa glareola</i>	✓	✓
Terek sandpiper	<i>Xenus cinereus</i>	✓	✓
Common sandpiper	<i>Actitis hypoleucos</i>	✓	✓
Grey-tailed tattler	<i>Heteroscelus brevipes</i>	✓	
Ruddy turnstone	<i>Arenaria interpres</i>	✓	✓
Asian dowitcher	<i>Limnodromus semipalmatus</i>		✓
Great knot	<i>Calidris tenuirostris</i>	✓	✓
Red knot	<i>Calidris canutus</i>	✓	✓
Sanderling	<i>Calidris alba</i>	✓	✓
Red-necked stint	<i>Calidris ruficollis</i>	✓	✓
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	✓	✓
Curlew sandpiper	<i>Calidris ferruginea</i>	✓	✓
Broad-billed sandpiper	<i>Limicola falcinellus</i>	✓	✓
(Pacific) Golden plover	<i>Pluvialis fulva</i>	✓	✓
Grey plover	<i>Pluvialis squatarola</i>	✓	✓
Lesser sand plover	<i>Charadrius mongolus</i>	✓	✓
Greater sand plover	<i>Charadrius leschenaultii</i>	✓	✓
Oriental plover	<i>Charadrius veredus</i>	✓	
Oriental pratincole	<i>Glareola maldivarum</i>	✓	✓

Appendix C. Shorebird identifications and counts at each study site in April 2011.

States of the tide are abbreviated as follows: RT - receding tide, LT – low tide, IT – incoming tide, HT – high tide.

For sites that were visited on two occasions, only the higher count is used for species totals. The lower counts are in grey font.

Site	1	1	2	3	4	4	5	6	8	7	9	9	
April date	4	5	4	4	4	4	5	3	3	3	4	5	
Start time	7:55	14:50	10:00	12:50	6:30	14:00	14:00	15:00	12:30	13:15	15:45	12:10	
Coverage	walk	walk	walk	walk	scope	walk	walk	walk	scope	walk	walk	walk	
State of tide	IT	RT	HT	HT	IT	LT	HT	LT	RT	RT	RT	HT	
Grey plover			3			1				1			5
Lesser sand plover	23	16								25			48
Greater sand plover	40	166	15		4	9		8		105			303
Bar-tailed godwit	1	21	34	19	36	63		29	105	177			448
Little curlew												1	1
Whimbrel	1	1	6	4				1	1	4		20	37
Eastern curlew										1			1
Terek sandpiper	58	53				2				2			62
Common sandpiper						2							2
Grey-tailed tattler	10	50	140	3	19	167	69	31		118	1	10	588
Common greenshank	1					1		2					4
Ruddy turnstone	5	8	14	11		18				64			115
Great knot	2	35	36	42	5			13	30	120			281
Red knot										42			42
Sanderling				1			4						5
Red-necked stint	36	38	3	23	66			66		259			455
Curlew sandpiper	4	5											5
Broad-billed sandpiper		1											1
Unidentified wader								625	280	940			1845
Sub total	118	394	251	103	126	253	73	775	416	1858	1	31	4248

Appendix D. Photographic images of April 2011 survey sites.

Survey site 1



Survey site 2



Survey Site 3



Survey site 4



Survey site 5



Survey site 6



Survey site 7



Survey site 8

