

## 19. TERRESTRIAL ECOLOGY - SHOREBIRDS

This chapter presents the findings of the supplementary shorebirds assessment prepared by Ecosure Pty Ltd (Appendix 12, Shorebirds Supplementary EIS Study) to further investigate the impacts of the project on shorebirds in Port Curtis, and to validate the relevant mitigation measures proposed in the Arrow LNG Plant EIS (Coffey Environments, 2011).

Findings of the supplementary shorebirds assessment pertaining to species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) are also discussed in Attachment 2, Matters of National Environmental Significance Update.

### 19.1 Studies and Assessments Completed for the EIS

Ecosure was engaged to conduct the terrestrial ecology assessment for the EIS.

This section provides an overview of elements of the terrestrial ecology impact assessment of relevance to shorebirds and the main conclusions from that assessment. This information was provided in Chapter 18, Terrestrial Ecology of the Arrow LNG Plant EIS. Furthermore, detailed information relating to shorebirds and matters of national environmental significance (MNES) was provided in Attachment 4, Matters of National Environmental Significance, to the EIS.

Ecosure found that 11 migratory species of shorebird had been recorded within Port Curtis either during surveys for the Arrow LNG Plant or surveys for other LNG proponents (Section 3 of Appendix 9, Terrestrial Ecology Impact Assessment to the EIS). The identified species are:

- Bar-tailed godwit (*Limosa lapponica*).
- Common greenshank (*Tringa totanus*).
- Eastern curlew (*Numenius madagascariensis*).
- Great knot (*Calidris tenuirostris*).
- Grey-tailed tattler (*Heteroscelus brevipes*).
- Lesser sand plover (*Charadrius mongolus*).
- Pacific golden plover (*Pluvialis fulva*).
- Red-necked stint (*Calidris ruficollis*).
- Sharp-tailed sandpiper (*Calidris acuminata*).
- Terek sandpiper (*Xenus cinereus*).
- Whimbrel (*Numenius phaeopus*).

An additional 17 migratory shorebird species were identified during the course of the EPBC Protected Matters search, and were found by Ecosure to have the potential to occur within the study area based on habitat preferences and distribution.

All of the identified species migrate to Australia during the southern hemisphere summer, having bred in Siberia and high Arctic regions, with the exception of the double-banded plover, which is a trans-Tasman migrant to Australia during the winter months.

Considering the data reviewed and the guidelines in the draft Background Paper to EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species (DEWHA, 2009d), Ecosure found that it is unlikely for the salt pans on Curtis Island adjacent to the project area to be classified as important habitat for migratory shorebirds. Significant numbers (over 0.1% of a flyway population or at least 2,000 migratory shorebirds) are not likely to use this location, and the location is unlikely to support at least 15 migratory species.

The mudflats at the mainland tunnel launch site and tunnel spoil disposal area have the potential to be classified as important habitat for migratory shorebirds. Although significant numbers (over 0.1% of a flyway population or at least 2,000 migratory shorebirds) are not likely to use this location, Ecosure identified that the location may support at least 15 migratory species.

Although the area of mudflats at the mainland tunnel launch site and tunnel spoil disposal area is relatively intact, four-wheel driving, kite flying and illegal dumping cause some disturbance to this location. Any shorebirds foraging at this location are already likely to be subjected to low to moderate disturbance.

An area of key shorebird foraging habitat identified in the Curtis Coast Regional Coastal Management Plan (EPA, 2003) is located on the eastern, or seaward, side of the mangroves adjacent to the mainland tunnel launch site. The mudflats on which the mainland tunnel launch site will be located are not designated as part of this area, and greater numbers of shorebirds are likely to be present in the area on the eastern side of the mangroves than at the mainland tunnel launch site itself.

The mangroves will act as a visual buffer between the area of key shorebird foraging habitat and construction and operational works at the mainland tunnel launch site. There may be temporary displacement of less tolerant shorebird species from the area of mudflat closest to the works, as a result of construction noise. Areas to the north and southeast of these mudflats will be relatively undisturbed and will still provide foraging habitat for species disturbed and temporarily displaced from the area closest to the works.

A shorebird roost site approximately 1 km southeast of the mainland tunnel launch site and tunnel spoil disposal area, at Flying Fox Creek, was also identified in the Curtis Coast Regional Coastal Management Plan. This site is unlikely to be disturbed by project construction and operation activities, because of its distance from these activities. A key roost site at Clinton ash ponds is located on the eastern bank of the Calliope River south of launch site 1.

During construction of the feed gas pipeline, project activities may result in displacement of birds from the area immediately adjacent to the construction site. During operation, shorebird species are likely to return to use the intertidal areas for foraging as habituation takes place. Some birds may be displaced from a small area immediately adjacent to project infrastructure due to personnel and vehicle movements and construction noise.

Significant flora and fauna values of the study area pertaining to shorebirds were found to be characterised by:

- Curtis Island:
  - Mangrove and saltpan habitat (regional ecosystems 12.1.3 and 12.1.2) support marine plants and provide shorebird feeding habitat for at least six observed EPBC Act listed migratory species, around the margins of Boatshed Point and North China Bay.
  - A threatened fauna species under the *Nature Conservation Act 1992* (Qld), the beach stone-curlew (*Esacus magirostris*), was found at, or within 5 km of the site.
- Mainland tunnel launch shaft and tunnel spoil disposal site:
  - The salt pans (regional ecosystem 12.1.2) along the mainland coastal strip form part of a shorebird feeding and roosting area. The area is likely to support more than 15 species of migratory shorebird and is therefore considered a significant shorebird habitat.

- Ten migratory bird species were observed in and around this location, along with an additional shorebird species listed as threatened under the *Nature Conservation Act*, the beach stone-curlew.
- Launch sites:
  - Migratory shorebirds may utilise launch site 1 at the mouth of the Calliope River.
  - No shorebird habitat at launch site 4N.

Potential impacts from the project on migratory shorebirds are likely to be primarily associated with clearance and habitat loss, degradation and fragmentation of remaining habitat, direct disturbance of fauna through noise and lighting and construction activities, and the introduction or spread of invasive weeds or pests.

The loss of shorebird habitat will be small: an area to the north of Hamilton Point on the margins of North China Bay and an area of mudflat at the mainland tunnel launch site and tunnel spoil disposal area. These areas comprise less than 0.5% of the regional ecosystems in the Gladstone region.

The saltpan between Boatshed Point and Hamilton Point also has the potential to provide habitat for foraging shorebirds, and may be disturbed by the Arrow LNG Plant. It is unlikely that this area is used by significant numbers of shorebirds, as the saltpan is not optimal habitat.

There is a network of shorebird sites around Port Curtis. Areas of key shorebird foraging habitat and shorebird roosts within Port Curtis are identified in the Curtis Coast Regional Coastal Management Plan and do not include the salt pans on Curtis Island adjacent to the project area, or the mainland tunnel launch site and tunnel spoil disposal area.

Table 19.1 lists the commitments Arrow Energy made in the EIS to manage the project impacts on terrestrial ecology that are of relevance to shorebirds.

**Table 19.1 Terrestrial ecology EIS commitments of relevance to shorebirds**

No.	Commitment
C12.17	Develop an acid sulfate soils (ASS) management plan prior to construction work. In the plan, specify how onsite ASS disturbances should be managed in accordance with SPP2/02 and the methods set out in Queensland acid sulfate soil technical manual soil management guidelines.
C13.12	Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site.
C16.04	Test and treat all discharges to Port Curtis to meet water quality criteria, as required, prior to discharge.
C17.01	Prepare construction and operations environmental management plans. These documents are to include detailed information about significant flora and fauna species and their management and ongoing conservation. Include site-specific mitigation and details of monitoring and inspection to be undertaken, in the environmental management plans consistent with advice provided by government.
C17.02	Determine areas (if any) requiring to be offset in consultation with DERM and DSEWPC and other government stakeholders prior to commencement of construction.
C17.09	Develop weed management measures prior to initiation of construction activities in accordance with local and regional management guidelines and best practice advice prescribed in DERM's pest control factsheet series.
C17.13	Include measures in the pest management plan to control invasive plant species that may colonise the mudflats and degrade remaining habitat.

**Table 19.1 Terrestrial ecology EIS commitments of relevance to shorebirds (cont'd)**

No.	Commitment
C17.14	Prior to initiation of works, clearly mark access tracks to prevent secondary tracks becoming established. Use existing access tracks where practical. Where practical, the location and design of access tracks should avoid sites of high ecological value.
	Implement measures to reduce the impacts of light from the LNG plant and ancillary facilities including:
C17.16	<ul style="list-style-type: none"> <li>• Shield/direct the light source onto work areas where practical.</li> </ul> Common with Chapter 19, Marine and Estuarine Ecology, and Chapter 23, Landscape and Visual.
C17.17	<ul style="list-style-type: none"> <li>• Use long-wavelength lights, where practicable, including use of red, orange or yellow lights.</li> </ul> Common with Chapter 19, Marine and Estuarine Ecology.
C17.18	<ul style="list-style-type: none"> <li>• Lower the height of the light sources as far as practical.</li> </ul> Common with Chapter 19, Marine and Estuarine Ecology.
C17.19	<ul style="list-style-type: none"> <li>• Avoid planned routine maintenance flaring at night during sensitive turtle reproductive periods (where practicable).</li> </ul> Common with Chapter 19, Marine and Estuarine Ecology.
C17.20	Design lighting around the perimeter of the LNG plant to minimise impacts on roosting shorebirds, where practical. Lowest possible luminescent globes should be used in sensitive areas, particularly around intertidal zones, where practical.
C17.21	Design construction lighting on the causeway at the mainland tunnel entry shaft and tunnel spoil disposal area to minimise impacts on roosting shorebirds. The lowest possible luminescent globes should be used in sensitive areas, particularly around intertidal areas, where practical.
C17.22	Induct all personnel prior to entering a project site, including on measures for managing the impacts on flora and fauna likely to be present.
C17.24	Prohibit access to the salt pans and fringing mangroves (RE 12.1.2 and 12.1.3) outside the planned area of disturbance of the mainland tunnel entry shaft and tunnel spoil disposal area.
C17.31	Prohibit pets of staff and contractors from entering the project area (unless assistance animals).
C17.32	Adopt waste control measures to avoid introducing new external seed sources for exotic flora.
C17.38	Identify areas to be rehabilitated and develop procedures for restoration and maintenance.
C22.04	Regularly maintain all machinery and equipment and check for excessive noise generation.

Note: Commitment number C17.19 was developed for the marine technical study for the EIS assessing the impact on turtles from the Arrow LNG Plant. Aspects of the commitment are also of benefit to minimising impacts of lighting on shorebirds.

## 19.2 Study Purpose

The supplementary shorebirds assessment addresses changes to the project description that have arisen as a result of the front end engineering design and further refinement of project options that were completed after finalisation and exhibition of the EIS and responds to specific issues raised in the submissions on the EIS. These aspects are identified below.

### 19.2.1 Project Description Changes

Changes to the project description that relate to the shorebirds study are primarily related to amendments to the area of disturbance. The project area encompasses the area that will be disturbed or potentially disturbed by the proposed project, including all potential options (see Chapter 4, Project Description: LNG Plant).

Figure 1.1 illustrates the revised project area and key project features. The main changes to the area of disturbance are at the mainland tunnel launch site and around the LNG plant site on Curtis Island, as well as the addition of the site at Red Rover Road. The footprint of the mainland tunnel launch site has been reduced by approximately 30% from the figure presented in the EIS

to approximately 33 ha. A summary of the amended area of disturbance in relation to regulated vegetation is presented in Section 18.6.

### **19.2.2 Additional Information**

The EIS identified the need for further assessment of the impacts of the Arrow LNG Plant on species of conservation significance and MNES, including shorebirds. Ecosure was commissioned to undertake a desktop review of shorebird information in Port Curtis, as well as a shorebirds field surveys program to support this assessment.

This field surveys program will conclude in March 2013, and the findings of these additional surveys will be prepared as an addendum to the SREIS.

### **19.2.3 Submissions**

Several submissions on the EIS raised issues relating to terrestrial ecology, including shorebirds. The full details of these submissions can be seen in the issue register table in Part B of the SREIS, together with responses to specific issues raised.

## **19.3 Legislative Update**

The primary legislation relevant to the protection of migratory shorebirds in Australia is the EPBC Act, which lists migratory shorebirds as MNES. Migratory shorebird species are listed under Section 209 of the EPBC Act and consist of:

- Migratory species that are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II).
- Migratory species that are included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).
- Native, migratory species that are identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

A number of the 36 migratory species identified are also listed under the Commonwealth EPBC Act or the state *Nature Conservation Act* as endangered, vulnerable or near threatened (EVNT) species.

Habitat for shorebirds is protected under the *Nature Conservation Act, Vegetation Management Act 1999* (Qld) or the *Coastal Protection and Management Act 1995* (Qld).

EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species (DEWHA, 2009b), provides the framework for the assessment of potential impacts on migratory shorebird species from the Arrow LNG Plant. The policy statement builds on the information and explanations in EPBC Act Policy Statement 1.1, Significant Impact Guidelines: Matters of National Environmental Significance (DEWHA, 2009d).

Policy Statement 3.21 is designed to help determine the impacts of proposed actions on migratory shorebird species and to provide mitigation strategies to reduce the level or extent of those impacts. The policy aim is to promote ecologically sustainable development that allows for the continued ecological functioning of important habitat for migratory shorebirds.

Using these guidelines, a site is considered to provide important habitat for migratory shorebirds if:

- The site is identified as internationally important.
- The site supports at least 0.1% of the flyway population of a single species.
- The site supports at least 2,000 migratory shorebirds.
- The site supports at least 15 shorebird species.

## 19.4 Study Method

This section describes the supplementary shorebirds assessment study method. The work undertaken for the SREIS is largely based on a review of previous ecological work undertaken for the Arrow LNG Plant EIS (Appendix 9, Terrestrial Ecology Impact Assessment; Chapter 17, Terrestrial Ecology; and Attachment 4, Matters of National Environmental Significance), cross-referenced against the Terms of Reference for the Arrow LNG Plant and submissions made on the Arrow LNG Plant EIS.

Desktop and database searches encompassed a wider extent than the project area so as to include all legislatively significant species possibly present within the project area and to remain consistent with the technical study undertaken for the EIS. Broadly, the area focused on Port Curtis from the northern point of Kangaroo Island in the Narrows to the southern point of Facing Island to obtain a wide area of regional context. Counts from nearby areas, such as the Fitzroy Estuary and Rodds Bay, were also obtained to place Port Curtis into regional context.

The following sites were the focus for desktop study and fieldwork due to their proximity to project infrastructure:

- Mudflats at the mainland tunnel launch site and tunnel spoil disposal area.
- North China Bay/Hamilton Point.
- Salt pans around Boatshed Point (Curtis Island).
- The Calliope River mouth including Clinton ash ponds and the oxbow upstream of the launch site.

Thirty-six species of migratory shorebirds (listed in EPBC Act Policy Statement 3.21) were covered by the study, as well as resident shorebird species. Of the resident species, particular attention was paid to EVNT species listed in the EPBC Act or the *Nature Conservation Act*.

### 19.4.1 Review of EIS Data

A review of the EIS chapter, MNES attachment, and terrestrial ecology technical study was undertaken to identify the need for additional desktop study and field work.

### 19.4.2 Literature Review

The assessment of impacts on shorebirds was consistent with the guidelines in EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species (DEWHA, 2009b), and the associated background paper, Significant Impact Guidelines for 36 Migratory Shorebird Species: Background paper to EPBC Policy Statement 3.21 (DEWHA 2009b).

Publicly available literature was reviewed to supplement, refine and update the desktop assessment undertaken for the EIS. The review considered a full range of information sources on shorebirds, with a focus on literature or databases that had been updated or added since the EIS was finalised.

Information reviewed included database searches (including the Shorebird 2020 database and Queensland Wader Study Group data), information held by agencies, impact assessment reports from other infrastructure projects in the Gladstone region (including other LNG proponents and the Western Basin Dredging and Disposal Project study), and shorebird monitoring reports for infrastructure projects in Port Curtis (especially the Western Basin Ecosystem Research and Monitoring Program) (Gladstone Ports Corporation, 2011, 2012).

### **19.4.3 Field Survey**

Fieldwork is based on the method identified in the draft Background Paper to EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species (DEWHA, 2009b).

The initial desktop study identified roosts present within or adjacent to the project area, as well as potentially important foraging habitat. The study included use of aerial imagery, as well as data from other shorebird monitoring programs undertaken in Port Curtis. From this review, areas were identified for shorebird field survey program.

The survey program includes four survey campaigns between September 2012 and March 2013. The program incorporates both low-tide and high-tide surveys. High-tide surveys will be conducted as close to the high tide as possible and no more than two hours either side of the high tide. Surveys for foraging shorebirds at low tide will also be no more than two hours either side of the low water. Two of the surveys at low tide will be on spring low tide and two on neap low tide.

One of the four survey campaigns has been completed, the September 2012 southbound migration survey. Three further survey campaigns are scheduled as follows:

- December 2012 and January 2013 (peak period for over-summering shorebirds).
- March 2013 (northbound migration).


A survey was also undertaken during the northern hemisphere breeding season in August 2012 for overwintering species and the double-banded plover. This survey was characterised by low diversity of shorebirds (numbers of species and individuals) and served as a reconnaissance visit, during which survey sites were assessed for the main program of fieldwork.

Assessments carried out at the different sites involved surveys to establish the presence of shorebirds as well as to obtain information on the habitat characteristics of the site and its context within the local region. The characteristics of each site were assessed to identify potential habitat, taking a precautionary approach. Landform, hydrology, flood levels and substrate were all noted. From these assessments, the survey sites for the main program of fieldwork were identified (Figure 19.1).




The survey sites coverage includes areas of contiguous habitat where shorebirds may occur and may be impacted by the Arrow LNG Plant.





  
 0 km 1  
 Scale 1:60,000  
 Page size: A4  
 Projection: GDA 94 MGA Zone 56

**LEGEND**

-  Major road
-  Shorebird survey site location
-  Project area

Source:  
 Project area from Coffey Environments.  
 Shorebird survey site locations from Ecosure.  
 Place names and roads from DME.  
 Imagery from Nearmap (captured 7 August 2012).



Surveys are timed to correspond with medium-level tide heights to facilitate access to sites. High tides during the August and September survey times were around 3.5 m, and low tides ranged from approximately 0.5 m to 1.2 m. Spring and neap tides will occur during the December and January surveys, providing the best chance of sampling the shorebird population at its peak.

Surveys are conducted by a field team of two experienced observers, two hours either side of both low and high tide, with most sites accessed by boat. Surveys during low tide generally focus upon foraging habitat, while surveys around high tide focus on roosting birds.

Foraging habitat is surveyed by boat only, due to the difficulty of accessing these sites from land. Access on foot would likely result in birds being disturbed and flushed. Potential roosting sites are primarily accessed by foot, although potential mangrove roost sites are surveyed by boat.

Most potential roosting habitat is surveyed by foot at high tide by approaching birds quietly and with the use of a spotting scope (20 to 60 mm zoom) to count roosting individuals. Care is taken to avoid flushing birds, and where this occurs, observers stop moving and allow birds to resetttle. If birds move away from the site, they are tracked to prevent double counting of birds at subsequent roosting sites.

For surveys at non-tidal sites, appropriate methods as per the survey guidelines are utilised, broadly similar to those at tidal sites.

Data is collected using a standardised field sheet based on the requirements of the Shorebird 2020 data collection process, and in keeping with information collected for similar surveys in the area. Data collected is detailed in the supplementary shorebirds assessment study, and is summarised as follows:

- Shorebird statistics relating to roosting sites.
- Shorebird behaviour.
- Survey conditions.
- Number of observers and experience level.
- Habitat characteristics.
- Method used to conduct the survey.

#### **19.4.4 Survey Limitations**

Access to North China Bay was not possible during the fieldwork due to construction activity at this location from other LNG project proponents. Survey data from other shorebird monitoring programs was used to provide information to characterise the shorebird populations of this particular site. This area has been extensively covered by shorebird monitoring in recent years for other LNG proponents and the Western Basin Dredging and Disposal Project.

#### **19.4.5 Assessment Method**

The significance of impacts on shorebird habitat was determined by assessing sensitivity of shorebird habitat and the magnitude of impacts on these habitats.

##### **Sensitivity of Shorebird Habitat**

Sensitivity of shorebird habitat within and adjacent to the project area was assessed based on five criteria. These were:

- Conservation status.
- Intactness.
- Uniqueness (or rarity).

- Degree of non-resilience to change.
- Degree of difficulty in replacing.

Each shorebird habitat type within the project area was given a sensitivity rating (very low, low, medium, high and very high) for each of the five criteria to determine the overall sensitivity of the habitat. Attributes for intactness were assessed in determining the conservation status of the habitat.

### **Conservation Status (including intactness)**

Conservation status was based on designation of habitat under EPBC guidelines.

The assessment of impacts to shorebirds under the EPBC Act Policy Statement 3.21 requires a determination of important habitat for migratory shorebirds in Australia. Important habitat consists of both nationally and internationally important sites as defined by DEWHA (2009d) but also sites of state and regional significance (Clemens *et al.*, 2008). Criteria for determining important shorebird habitat and sites are outlined in Table 19.2.

**Table 19.2 Criteria for determining important shorebird habitat as defined by DEWHA (2009d) and Clemens *et al.*, (2008)**

<b>Geographic Scale</b>	<b>Source</b>	<b>Criteria</b>
International	Ramsar Convention on Wetlands (2005)	Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds. Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
National	DEWHA (2009d)	Does the site support: <ul style="list-style-type: none"> <li>• At least 0.1% of the flyway population of a single species; or</li> <li>• At least 2,000 migratory shorebirds; or</li> <li>• At least 15 shorebird species.</li> </ul>
State	Clemens <i>et al.</i> , (2008)	A shorebird area is of state significance if it: <ul style="list-style-type: none"> <li>• Is significant at the national level;</li> <li>• Exhibits significant decline in: a) the total number of shorebirds; or b) populations of any species, not known to be experiencing declines more broadly; or</li> <li>• Supports threatened or endangered shorebird species; or</li> <li>• Supports greater than 1% of the population of any resident Australian shorebird species.</li> </ul>
Regional	Clemens <i>et al.</i> , (2008)	A shorebird area is of regional significance if it: <ul style="list-style-type: none"> <li>• Has associated records of 15 or more species of migratory shorebird;</li> <li>• Has associated records of 20 or more migratory and resident shorebirds; or</li> <li>• Forms one of three most abundant shorebird areas, within each Natural Resource Management boundary, for any of the following species: Latham's Snipe, little curlew, oriental plover, oriental pratincole and Australian pratincole;</li> <li>• Areas that support threatened species or endangered shorebirds; or</li> <li>• Areas that support greater than 1% of the Australian population of any resident shorebird species.</li> </ul>

Appendix 12, Shorebirds Supplementary EIS Study provides detail on how these criteria are defined, particularly relating to site and support and the DEWHA (2009d) criteria.

Fieldwork and desktop studies identified important habitat for shorebirds as defined under EPBC guidelines (DEWHA, 2009d) as well as secondary shorebird habitat and potential shorebird habitat. Secondary habitat is utilised by shorebirds but not in the numbers required to constitute important habitat. Potential habitat has characteristics suggesting it could be important and further information from peak season surveys in December 2012 and January 2013 will be required to confirm this.

Areas of internationally important shorebird habitat would have a very high conservation status value, areas of nationally important habitat a high conservation status value, areas of potential shorebird habitat a medium conservation status value, areas of secondary habitat a low conservation status value, and other areas a very low conservation status value.

### ***Uniqueness (or Rarity)***

Uniqueness can be defined as, the occurrence, abundance and distribution of the habitat within and beyond its reference area (e.g., bioregion or biosphere). A habitat would be considered to have a very high uniqueness if it is the only known example of that value within the Gladstone region. A habitat would have a very low uniqueness if it is considered common within the Gladstone region.

### ***Non-resilience to Change***

An ecological value is less sensitive the higher its resilience to change is. This criterion is a measure of how an area of habitat can adapt to change without adversely affecting its conservation status or uniqueness or rarity. A very high score for this criterion would be an area of habitat extremely sensitive to change that may require 25 years or more to naturally return to a state comparable to the original. A habitat with a low score may be able to naturally return to original state within less than one year. A habitat with a very low score for this criterion would be insensitive to change and any impact would be minimal.

### ***Difficulty in Replacing***

The more difficult it is to find a representative or equivalent area of habitat to replace any losses, the higher the sensitivity of that value. An area of habitat with a very high score would be one that was almost impossible to offset. A value with a very low score would have readily available areas which could be used as an area for habitat offsets within the Gladstone region.

### ***Duration and Severity of the Impact***

Assessments of shorebird habitats to determine whether an activity will have a 'significant' impact are also outlined in EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species. Four factors need to be considered for this assessment: habitat loss, habitat degradation, disturbance and direct mortality.

Each shorebird habitat type within the project area was scored a magnitude of impact rating (very low, low, medium, high and very high) for each of the four criteria, to determine the overall magnitude of the impact on the habitat.

### ***Habitat Loss***

The loss or degradation of sites that support large numbers of migratory shorebirds can cause disproportionate declines in shorebird populations, as displaced birds are unable to find suitable replacement habitat. Similarly, the incremental loss of smaller sites affects the broader conservation of habitat availability. In Australia, the loss of important habitat reduces the availability of foraging and roosting sites, affecting the ability of birds to build up the energy stores necessary for successful migration and breeding. Some sites are also important year-round for

juvenile birds, with loss of these habitats affecting the future breeding populations of these species.

Habitat may be lost due to a variety of activities that make the habitat unavailable to shorebirds. These may include direct loss through clearing, inundation, infilling or draining (for example, for buildings or marine services, such as harbours, marinas, ports or oil terminals) or indirect loss through changes to hydrology, water quality or structural changes near some roosting sites (for example, increased cover or encroachment of buildings).

### ***Habitat Degradation***

Migratory shorebirds are sensitive to subtle changes to their habitat. In particular, many have specialised feeding techniques that make them susceptible to slight changes to prey sources and their foraging environments. Any activity that reduces the ability of shorebirds to use an area for roosting or foraging, or that reduces the availability of food, degrades habitat. These activities include (among others):

- Substantial loss of marine or estuarine vegetation, which is likely to alter the dynamic equilibrium of sediment banks and mudflats, as well as to reduce the amount of organic matter that supports the invertebrates on which migratory shorebirds feed.
- Invasion of intertidal mudflats by weeds, such as cord grass (*Spartina* species).
- Water pollution and changes to the water regime.
- Artificial changes to hydrological regimes that affect the productivity of the feeding environment (for example, changes in water depth).
- Exposure of acid sulfate soils changing the chemical balance of the site.

### ***Disturbance***

Disturbance is emerging as a major conservation issue for migratory shorebirds (DEWHA, 2009d). Certain activities may interrupt migratory shorebirds during their limited foraging periods, such as during low tide, and prevent them from foraging effectively. Disturbance can also affect roosting birds and cause them to waste energy stored for migration.

Disturbance can result from residential and recreational activities, such as four-wheel-drive vehicles, jet- and water-skiing, power boating, fishing, walking, wind-surfing, kite-surfing, walking dogs, noise and night-lighting. While some activities may result in only low-levels of disturbance, it is important to consider the combined effects of disturbance with other threats when determining the level of potential impact of an action. Roosting and foraging birds are most sensitive to discrete, unpredictable disturbances, such as sudden loud noises (for example, from demolition activities) and from objects that approach them from the water (for example, boats). High and sustained levels of disturbance can prevent shorebirds from using all or parts of the habitat.

### ***Direct Mortality***

Direct mortality of birds may occur due to a variety of reasons. Activities that may result in direct mortality include development of wind farms in migration or movement pathways, bird strike caused by aeroplanes, and chemical or oil spills.

### **Significance of Impacts**

The sensitivity of shorebird habitat and the magnitude of the impacts of habitat loss, degradation, disturbance and direct mortality were assessed to determine the significance of the project's

impact on the shorebird habitat of the survey area. There were five levels of significance that could be applied for each habitat: major, high, moderate, minor and negligible.

### ***Major Impact Significance***

Major impact significance occurs when an impact on important shorebird habitat is long term, irreversible or widespread. This level of impact is likely to be a key factor in the decision-making process or to raise considerable stakeholder concern. Avoidance is the only effective mitigation.

### ***High Impact Significance***

High impact significance occurs when the proposed activities are likely to exacerbate existing threatening processes, affecting the intrinsic characteristics and structural elements of important shorebird habitat. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve intactness or conservation status.

### ***Moderate Impact Significance***

Moderate impact significance occurs where, important shorebird habitat would be degraded or further degraded due to the scale and nature of the works or due to its susceptibility to further change. The abundance of the ecological value ensures it is adequately represented in the region and that replacement, if required, is achievable.

### ***Minor Impact Significance***

Minor impact significance occurs on shorebird habitat that is not considered to meet the criteria for important habitat under EPBC guidelines (DEWHA, 2009d). Impacts are not considered to adversely affect its viability, provided standard environmental controls are implemented.

### ***Negligible Impact Significance***

Negligible impact significance is assigned to an impact that will not result in any noticeable change in shorebird habitat. It typically occurs when the activities take place in industrial or highly disturbed areas.

## **19.5 Desktop Study Findings**

The findings of the supplementary shorebirds assessment desktop study undertaken by Ecosure are summarised below.

### **19.5.1 Shorebird Ecology**

Of the 36 species of migratory shorebird listed as MNES under the EPBC Act, all but one breed in the northern hemisphere and migrate to non-breeding grounds in Australia along the East Asian-Australasian (EAA) flyway, which stretches from breeding grounds in Siberia and Alaska to non-breeding grounds in Australia and New Zealand. The exception to this migration is the double-banded plover which migrates between Australia and its breeding grounds in New Zealand.

Over 75% of the flyway populations of eight species and between 20% and 75% of the flyway populations of another 13 species reside in Australia during the non breeding season. Large proportions of the populations of some species that migrate to New Zealand (e.g., red knot) use Australia as a stepping stone on their migration.

Australia has the highest number of recognised internationally important sites (118) (87%) of any country within the EAA flyway. Birds typically begin arriving back in Australia in late August, first on the extensive tidal flats of northern Australia or Papua New Guinea. Most birds are commonly present between October and March each year. Return migration to northern breeding grounds



occurs from March onwards, although smaller numbers of non-breeding birds (often juveniles or first summer birds) remain in Australia during the austral winter.

Many species have a migration of up to 25,000 km (round trip) each year, and the ability to complete this migration depends on suitable sites being present along the EAA flyway. Migratory shorebirds in Australia have two basic habitat requirements: foraging habitats and roosting habitats where they can rest at high tide when foraging areas are limited (Plate 19.1). Preference is given to foraging and roosting sites that are in close proximity, to reduce travelling distance between the two (and so the energy expended). Shorebirds show a high degree of fidelity to specific roosting and foraging sites from year to year.

Birds that arrive in these northern staging grounds may remain there or move further south along the east coast or through central Australia. Those species that travel along the coast require foraging and roosting sites all along their journey. New groups from the north will occupy appropriate roosting sites as they are vacated by birds in front of them. It is therefore important that a network of appropriate habitat is available along the east coast and into central Australia.

### **19.5.2 Shorebirds in Port Curtis and Surrounding Region**

The regional and local (Port Curtis) context for shorebirds is described below.

#### **Regional Context**

A network of nationally important shorebird sites occurs within the Curtis Coast region, from the Fitzroy Estuary in the north to Rodds Peninsula in the south. Shorebirds have been studied sporadically in recent years in this area, first by Queensland Wader Study Group counts and also by Driscoll (1997) but more recently by shorebird studies commissioned for other LNG projects and for the Western Basin Dredging and Disposal Project.

Driscoll (1997) found that the Curtis Coast supported internationally significant populations of Australian pied oystercatcher, eastern curlew and grey-tailed tattler. Further study by Sandpiper Ecological Surveys (for Gladstone Ports Corporation) on the Western Basin Dredging Project Shorebirds Monitoring Program in 2011, 2012 (Gladstone Ports Corporation, 2011 and 2012) found the Curtis Coast as a whole supported internationally significant populations (greater than 1% of the flyway population) of seven species. These species were lesser sandplover, eastern curlew, whimbrel, terek sandpiper, grey-tailed tattler, red-necked stint and Australian pied oystercatcher.

Within the Curtis Coast, the extensive sandflats of both the Fitzroy Estuary and North Curtis Island were identified as being sites of particular importance with the largest numbers of shorebirds recorded in these areas consistently on the surveys.

Sites qualifying as being internationally and nationally significant shorebird sites in the 2011 and 2012 Gladstone Ports Corporation surveys within the overall region of the Curtis Coast are outlined in Table 19.3.



**Plate 19.1**  
Roosting bar-tailed godwits  
(library image)

**Table 19.3 Internationally and nationally significant shorebird counts for Curtis Coast from Western Basin Dredging Project Shorebirds Monitoring Program 2011 and 2012**

Site	Species
Cheetham Saltworks (Port Alma)	<b>Nationally important numbers (0.1% of flyway population):</b> Sharp-tailed sandpiper, curlew sandpiper.
North Curtis/Fitzroy Estuary	<b>Internationally important numbers (1% of flyway population):</b> Lesser sand plover, eastern curlew, whimbrel and red-necked stint. <b>Nationally important numbers (0.1% of flyway population):</b> Greater sand plover, bar-tailed godwit, terek sandpiper, grey-tailed tattler, great knot, sanderling and Australian pied oystercatcher. Exceeded threshold for national importance (at least 2,000 migratory shorebirds and at least 15 shorebird species).
Port Curtis	<b>Internationally important numbers (1% of flyway population):</b> Eastern curlew. <b>Nationally important numbers (0.1% of flyway population):</b> Lesser sand plover, bar-tailed godwit, whimbrel, terek sandpiper, grey-tailed tattler and Australian pied oystercatcher. Exceeded threshold for national importance (at least 2,000 migratory shorebirds and at least 15 shorebird species).
Rodds Peninsula, Mundoolin and Colosseum Inlets	<b>Internationally important numbers (1% of flyway population):</b> Eastern curlew and Australian Pied Oystercatcher. <b>Nationally important numbers (0.1% of flyway population):</b> Bar-tailed godwit, whimbrel, terek sandpiper, grey-tailed tattler, ruddy turnstone and red-necked stint. Exceeded threshold for national importance (at least 2,000 migratory shorebirds and at least 15 shorebird species).

Sources: Gladstone Ports Corporation (2011, 2012).

### Port Curtis

Within Port Curtis, there is a large degree of variability in the quality of shorebird habitat. Large areas support extensive important foraging habitat and corresponding important roosting sites. Areas of key shorebird foraging and roosting habitat were identified in the Curtis Coast Regional Coastal Management Plan (EPA, 2003). Key roosting habitat was identified at Clinton ash ponds and at Flying Fox creek (1 km southeast of the mainland tunnel launch site), and key foraging habitat was identified at Targinie wetlands adjacent to the mainland tunnel launch site, as discussed within the EIS (shown on Figure 3, Attachment 4 Matters of National Environmental Significance).

Further shorebird studies undertaken for the Western Basin Shorebirds Monitoring Program and for other LNG proponents indicate that the area of Port Curtis known as the lower port (east and south of the mouth of the Calliope River) typically hosts larger numbers of shorebirds than the upper port. Generally shorebird populations within Port Curtis are dominated by large shorebirds and species that forage primarily on crustaceans. Smaller wader species, such as the *Calidris* sandpipers that forage for prey in soft sediments are present in much smaller numbers.

The spring and neep tide surveys for the QCLNG pipeline crossing (Sandpiper Ecological Surveys, 2011) found that over 75% of the shorebirds present in Port Curtis were in the area around the Southend flats and Facing Island. The lower port contains larger areas of intertidal

habitat, a greater substrate diversity and a higher tidal range, which results in increased foraging resources for shorebirds in this area.

The most significant roosting sites were identified at Southend claypan with smaller roosts on Facing Island. At low tide, birds disperse onto the Pelican Banks, and intertidal areas along the western shoreline of Facing Island.

Other significant roosts are present on Facing Island and on Kangaroo Island at the southern end of the Narrows. At low tide, birds disperse from the latter roost and move onto the Passage Island mudflats up the Narrows or onto the Fishermans Landing mudflats and the mudflats adjacent to the mainland tunnel launch site.

A significant roost site at ash ponds adjacent to the access road to launch site 1 appears to have declined in its importance, with lower numbers of shorebirds now using this site, perhaps due to a decline in prey availability and an increase in anthropogenic disturbance at this site. Some of the ponds at this site have also been or are in the process of being reclaimed.

Key shorebird sites within Port Curtis identified in the desktop review are shown on Figure 19.2.

A number of shorebirds listed as EVNT species under either the *EPBC Act* or the *Nature Conservation Act* have the potential to be present in Port Curtis. Port Curtis has international significance for eastern curlew (listed as 'near threatened' under the *Nature Conservation Act*). Surveys for other proponents and for the Western Basin Shorebirds Monitoring Program indicate that the area around Southend is of particular importance for this species (Gladstone Ports Corporation, 2011).

The sooty oystercatcher (listed as 'near threatened' under the *Nature Conservation Act*) favours rocky shorelines, and an individual was identified on the GLNG site during surveys. One was also noted on Tide Island, off the south coast of Curtis Island adjacent to the Arrow Energy LNG plant site (Ecosure, 2011), and this species is likely to be present in small numbers ranging widely around rocky shoreline habitat within Port Curtis.

Suitable habitat for the beach stone-curlew (Plate 19.2) (listed as 'vulnerable' under the *Nature Conservation Act*) occurs throughout the study area, along the mainland coastline and along the coast of Curtis Island. This species has been observed on tidal mudflats on the mainland coastline and at the mouth of Graham Creek, Curtis Island. It has also been recorded in the study area on Curtis Island and on the mainland north of Fishermans Landing. Recent population estimates suggest that a very small population (approximately six individuals) occurs within the Port Curtis area and ranges widely around the area (Ecosure, 2011).

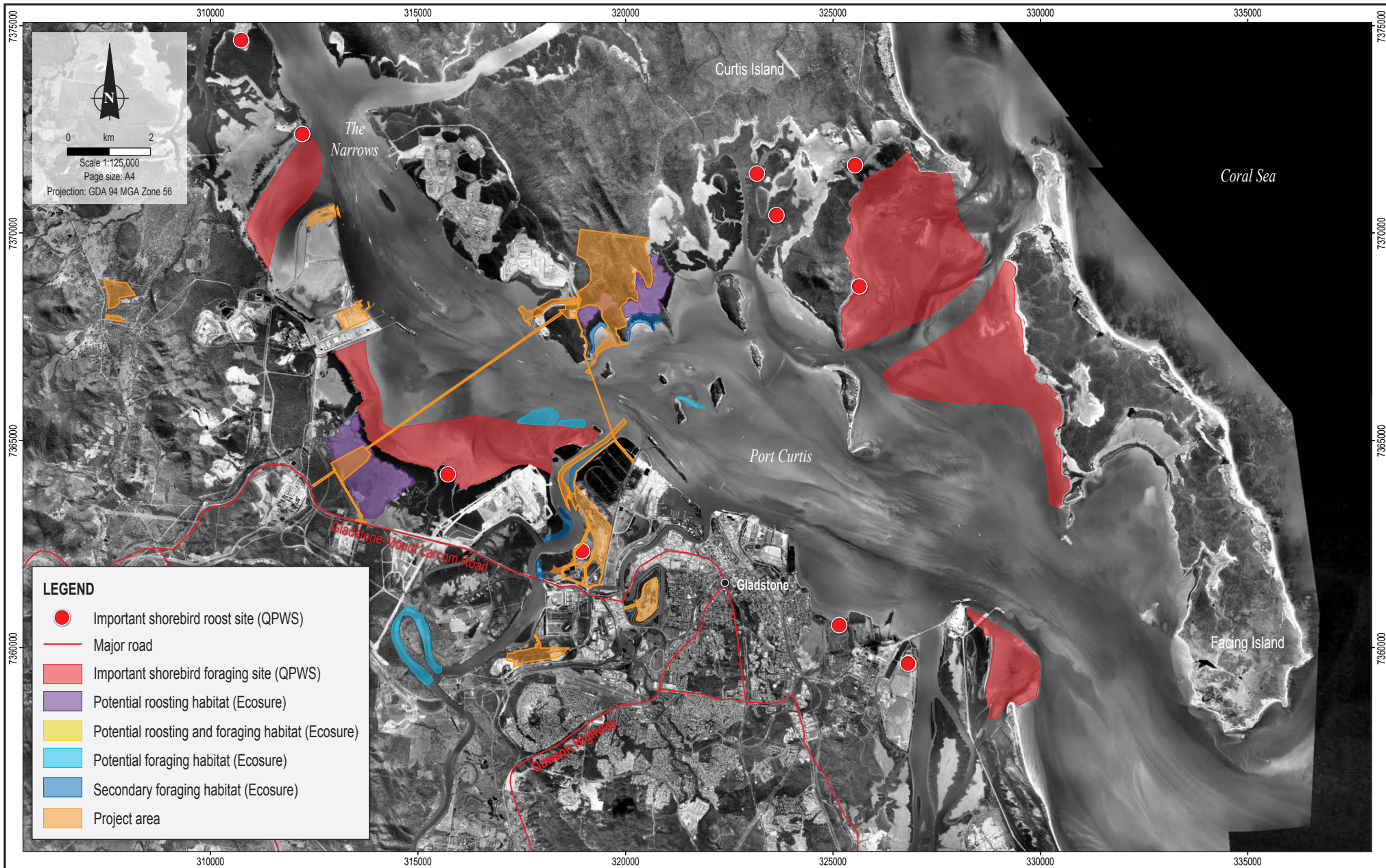
No Australian painted snipe (listed as 'vulnerable' under both the *EPBC Act* and *Nature Conservation Act*) were recorded in desktop searches of other shorebird studies or databases within the Port Curtis area. The species favours freshwater wetland habitat and low lying grasslands and is generally found in inland areas on ephemeral wetlands. It is not likely to be a frequent visitor to the Gladstone region.

Within Port Curtis, no key areas of habitat for Latham's snipe (*Gallinago hardwickii*) were identified, and the species is generally present in freshwater wetland habitat. The habitat in Port Curtis, and in particular around project infrastructure, is unsuitable for this species.

## 19.6 Arrow LNG Plant Field Survey Findings

Interim findings of the shorebird surveys undertaken by Ecosure are presented below. Findings will be validated upon the conclusion of the shorebird monitoring program in March 2013.





Source:  
 Place names and roads from DME.  
 Important shorebird areas in Port Curtis from Curtis Coast Regional Coastal Management Plan, QPWS.  
 Supplementary shorebird habitat from Ecosure.  
 Project area from Coffey Environments  
 Imagery from Nearmap (captured 7 August 2012).



Date:  
 13.12.2012  
 MXD:  
 7033CC\_16\_GIS075\_v1\_1  
 File Name:  
 7033\_16\_F19.02\_GIS\_VS

Arrow Energy  
 Arrow LNG Plant



Important shorebird habitats  
 in and near Port Curtis

Figure No:  
 19.2





**Plate 19.2**  
Beach stone-curlew  
(library image)

## 19.6.1 Habitat Descriptions

Table 19.4 shows sites surveyed for shorebirds during the Arrow LNG Plant shorebird field survey program. Survey sites were selected to provide adequate coverage of potential shorebird foraging and roosting habitat that has the potential to be affected by project activities. These sites are also shown on Figure 19.1.

**Table 19.4 Habitat descriptions for shorebird sites surveyed for the Arrow LNG Plant shorebird field survey program**

Site Number and Location	Shorebird Habitat (Roosting or Foraging)	Description and Proximity to Project Infrastructure
1	Potential roosting	Claypan (little vegetation), dry but potential roosting habitat after rain or spring tides. Adjacent to Arrow Energy LNG plant site west of Boatshed Point.
2	Foraging	Rocky headland with mudflats at low tide. Tip of Boatshed Point and eastern margin. Adjacent to Arrow Energy LNG plant site.
3	Foraging	Rocky headland with mudflats at low tide. Tip of Boatshed Point and western margin. Adjacent to Arrow Energy LNG plant site.
4	Foraging (limited)	Rocky margin to the east of Hamilton Point. Away from project infrastructure.
5	Foraging and potentially important roosting	Steep rocky habitat on riverside of this area. Mangrove that has been cleared and disturbed. Muddy flat adjacent to river with some samphire vegetation. Adjacent to launch site 1 and Clinton ash ponds.
6	Foraging and potentially important roosting	Narrow fringe of mudflat on Calliope river at low tide, artificial ponds at rear. Clinton ash ponds, adjacent to potential access road to launch site 1.
7	Foraging and roosting	Mudflat with sparse mangroves, adjacent to potential access road to launch site 1.
8	Foraging (limited)	Rocky shoreline north of launch site 1 on bank of Calliope River.
9	Potential roosting	Claypan with mangrove surrounding. Very dry with many piles of dumped household waste and other disturbance. Site of mainland tunnel launch site.
10	Foraging	Narrow band of rocky shoreline and intertidal area next to claypan west of Boatshed Point. Adjacent to Arrow Energy LNG plant site.
11	Potentially important foraging	Extensive intertidal mudflats at Targinie wetlands, with mangroves at rear. Mangroves separate this area from mainland tunnel launch site.
12	Foraging (limited)	Narrow band of rocky beach and mudflat at low tide, at mouth of Calliope River near Wiggins Island and Mud Island. Adjacent to launch site 1, southeast of Targinie wetlands.
13	Potential roosting	Claypan (little vegetation), dry but potential roosting habitat after rain or spring tides. Adjacent to Arrow Energy LNG plant site east of Boatshed Point.
14	Potential foraging	Mangrove island, shallow potential foraging habitat surrounding the island. Upstream along Calliope River away from project infrastructure.
15	Foraging	Area of mudflat and fringing mangrove east of Boatshed Point. Away from project infrastructure.
16	Foraging (limited)	Narrow band of mudflat and fringing mangrove on opposite side of Calliope River to launch site 1.
17	Foraging (limited)	Narrow band of mudflat and fringing mangrove on opposite side of Calliope River to launch site 1.

**Table 19.4 Habitat descriptions for shorebird sites surveyed for the Arrow LNG Plant shorebird field survey program (cont'd)**

Site Number and Location	Shorebird Habitat (Roosting or Foraging)	Description and Proximity to Project Infrastructure
18	Foraging (limited)	Some mudflat and mangrove upstream on the Calliope River west bank from launch site 1 away from area of disturbance.
19	Foraging (limited)	Some mudflat and mangrove upstream on the Calliope River east bank from launch site 1 away from area of disturbance.
20	Foraging	Small area of sandy beach on island in Port Curtis. Away from area of disturbance.
21	Foraging (limited)	Mangrove shrubland on island in Port Curtis. Away from area of disturbance.

Potentially important habitat was identified within the survey area at Targinie wetlands (Plate 19.3) (foraging habitat on intertidal mudflats, on the seaward side of the mainland tunnel launch site) and at Clinton ash ponds south of launch site 1 (Plate 19.4 and Plate 19.5) on the Calliope River (roosting habitat on artificial ponds). These results validated the findings presented in the EIS and MNES attachment of potentially important shorebird sites, as identified in the Curtis Coast Regional Coastal Management Plan.

Targinie wetlands is separated from the mainland tunnel launch site by an extensive belt of mangroves fringing Port Curtis, which screens this extensive area of intertidal wetlands from construction activities. Clinton ash ponds is a significantly disturbed site, and counts at this site have been in decline in recent years. Plates 19.4 and 19.5 show mulch that has been added for dust suppression at this site by an unknown source, and Plate 19.5 shows vehicular movement and construction activities taking place on the ash ponds.

Further investigation is required of the areas of potential foraging and roosting habitat identified during the initial surveys on the dry claypans east (Plate 19.6) and west (Plate 19.7) of Boatshed Point, and at the mainland tunnel launch site (Plate 19.8). These counts will encompass 'after rain' or spring tides conditions and will assist to confirm the significance of these sites for shorebirds.

### **19.6.2 Shorebird Counts**

Two shorebird counts have been completed.

#### **August 2012 (Winter Count)**

Three migratory shorebird species were present during the winter count: eastern curlew, bar-tailed godwit and whimbrel. Resident species consisted of masked lapwing, Australian pied oystercatcher, red-capped plover, black-fronted dotterel and beach stone-curlew. Counts are summarised in Table 19.5.

**Plate 19.3**  
Targinie wetlands at high tide  
looking towards mangroves  
adjacent to mainland tunnel  
launch site



**Plate 19.4**  
Clinton ash ponds  
(northern pond)



**Plate 19.5**  
Clinton ash ponds  
(southern pond)







**Plate 19.6**  
Claypan to the east  
of Boatshed Point



**Plate 19.7**  
Claypan to the west  
of Boatshed Point



**Plate 19.8**  
Claypan at the mainland  
tunnel launch site



**Table 19.5 Shorebird species present during August 2012 counts**

Species	Number	Sites
<b>Migratory Species</b>		
Eastern curlew	24	1, 4, 5, 6, 10, 11, 12 and 15
Bar-tailed godwit	36	5, 6, 9 and 11
Whimbrel	1	11
<b>Non-migratory Species</b>		
Masked lapwing	4	1, 5, 6 and 12
Australian pied oystercatcher	2	12
Red-capped plover	12	6 and 9
Black-fronted dotterel	2	6
Beach stone-curlew	2	12

Birds were well scattered throughout the survey areas, with no site of particular note. The pair of beach stone-curlew was recorded at Site 12 near the mouth of the Calliope River adjacent to the Wiggins Island wetlands. Australian pied oystercatcher were also noted at this site. All counts were well below thresholds of national and international significance.

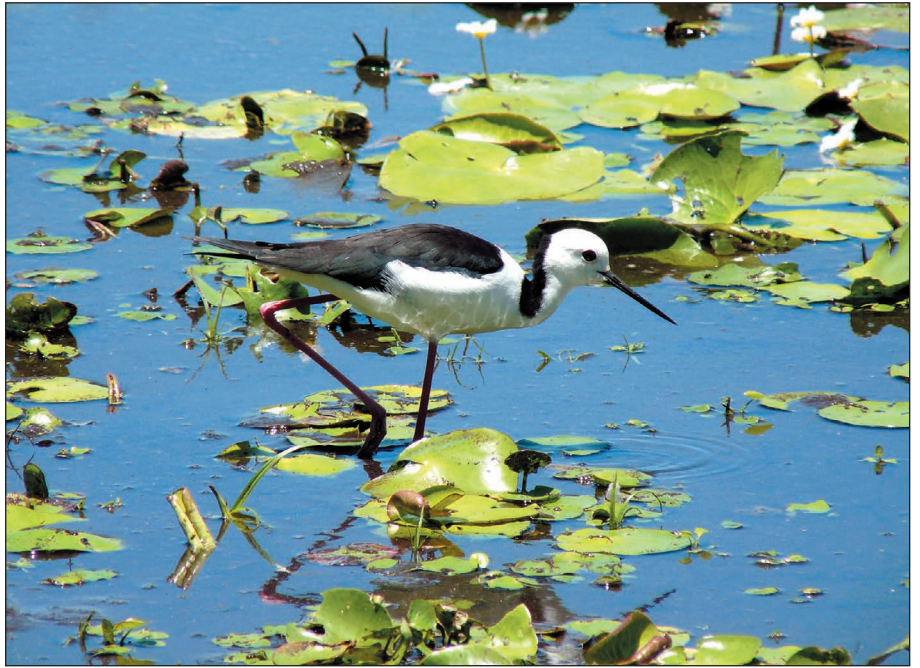
### **September 2012 (Southbound Migration Count)**

Seven migratory species of shorebird were present in the September 2012 shorebird counts. Numbers increased in September, although again birds were generally well distributed across the survey area in small numbers. Resident species consisted of masked lapwing, Australian pied oystercatcher, red-capped plover, black-fronted dotterel and black-winged stilt (Plate 19.9).

Eastern curlew was the most numerous migratory shorebird in September, with numbers exceeding the criteria for a nationally important site (at least 0.1% of the flyway population of a single species) at Clinton ash ponds and the adjacent mudflats on the Calliope River (Plate 19.10) (sites 5 and 6). Counts are summarised in Table 19.6.

**Table 19.6 Shorebird species present during September 2012 counts**

Species	Number	Sites
<b>Migratory Species</b>		
Common sandpiper	2	
Eastern curlew	68	2, 5, 6, 10, 11, 12, 15, 16 and 20
Bar-tailed godwit	38	6 and 12
Whimbrel	46	2, 5, 12, 15 and 16
Lesser sandplover	30	6
Pacific golden plover	2	6
Greenshank	3	6
<b>Non-migratory Species</b>		
Masked lapwing	1	6
Australian pied oystercatcher	11	2, 15 and 20
Red-capped plover	15	6, 12 and 16
Black-fronted dotterel	1	6
Black-winged stilt	4	20



**Plate 19.9**  
Black-winged stilt  
(library image)



**Plate 19.10**  
Area of mudflat and mangrove  
foraging and roosting habitat  
adjacent to launch site 1

No EVNT shorebird species other than those listed above were noted on either count. No Australian painted snipe were recorded, and consistent with the desktop study, the species is unlikely to be present and is not considered further in this assessment.

Shorebird numbers were generally low on the first two surveys, and further survey work at peak shorebird periods in December 2012 and January 2013 will provide further information on the usage of sites adjacent to project infrastructure.

## **19.7 Impact Assessment**

Migratory shorebirds are assessed under the EPBC Act and in particular the EPBC Act Policy Statement 3.21, Significant Impact Guidelines for 36 Migratory Shorebird Species. This policy states that a 'significant impact' is an impact that is important, notable, or of consequence having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected and upon the intensity, duration, magnitude and geographic extent of the impacts (DEWHA, 2009d).

### **19.7.1 Potential Impacts and Management Measures**

#### **Impacts on Shorebird Habitat**

In determining impacts on migratory shorebirds, the key component is impacts on important habitat as defined in DEWHA (2009a). Four factors to assist in determining a 'significant' impact on important habitat for migratory shorebirds have been developed (DEWHA, 2009b). They are habitat loss, habitat degradation, disturbance and direct mortality (Section 19.4.5).

Using these factors, impacts on shorebirds within the survey area have been assessed (Table 19.7), based on the type of habitat (foraging or roosting) and its importance (either internationally or nationally important habitat under EPBC guidelines or secondary habitat).

Mitigation measures are consistent with those presented in the EIS. New or amended mitigation measures relevant to shorebirds are presented in Table 19.7

**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures at Project Sites	Residual Impacts
<p>Potentially important foraging habitat (field validated) (EPA, 2003)</p> <p><b>Medium sensitivity</b></p>	<p>Site 11 (Targinie wetlands adjacent to mainland tunnel launch site)</p> <p>Site 12 (mouth of Calliope River near Mud Island, approximately 3 km southeast of mainland tunnel launch site)</p>	<p><b>Habitat loss:</b> there will be no loss of potentially important foraging habitat as a result of the Arrow LNG Plant.</p> <p><b>Habitat degradation:</b> potentially altered hydrological regimes, potential disturbance of acid sulfate soils, and potential sedimentation and pollution from runoff may degrade habitat.</p> <p><b>Disturbance:</b> noise, light and movement (personnel and vehicular) from construction and operational activities from nearby areas of project infrastructure may disturb foraging.</p> <p><b>Direct mortality:</b> slightly increased risk of bird strike into structures but of negligible risk. No project infrastructure in these areas.</p> <p>The impacts on potentially important foraging habitat are of <b>moderate significance</b> prior to the implementation of mitigation measures.</p>	<ul style="list-style-type: none"> <li>• Review the need for an ongoing program to monitor the shorebird population at project sites following the completion of survey work in 2013 (C17.51).</li> <li>• Develop measures to minimise disturbance around important shorebird habitat, during construction and operation. Measures could include exclusion zones or screens as recommended in Rohweder et al. (2011) (C17.52).</li> <li>• Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant including: <ul style="list-style-type: none"> <li>– Assess the necessity and choice of lighting in the plant area:</li> <li>– Use low-pressure sodium (LPS) lights as a first-choice light source and high-pressure sodium (HPS) lights where LPS is not practical.</li> <li>– Replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters.</li> <li>– Avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required.</li> <li>– Minimise the number and wattage of lights, and recess lighting into structures where possible.</li> <li>– Use timers and motion-activated light switches.</li> </ul> </li> </ul>	<p>There will be no loss of potentially important shorebird foraging habitat. Impacts from the mainland tunnel launch site on Targinie wetlands will be minimal as the mangrove belt separating the two sites will shield Targinie wetlands from construction and operation disturbance.</p> <p>Standard project controls will prevent impacts from runoff, sedimentation etc affecting the habitat quality of this site.</p> <p>It is unlikely that the project will significantly impact on Site 12, as an increase in boat traffic will be negligible against background levels of boat traffic in Port Curtis at this site. Increased wash from boat traffic may impact on this site, although the area is already heavily utilised by boat traffic and any increase in wash will be negligible.</p> <p>The impacts on potentially important foraging habitat are of <b>minor significance</b> following the implementation of mitigation measures.</p>

**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area (cont'd)**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures at Project Sites	Residual Impacts
<p>Potentially important foraging habitat (field validated) EPA, 2003) (cont'd)</p> <p><b>Medium sensitivity</b></p>			<ul style="list-style-type: none"> <li>– Use reflective materials to delineate equipment or pathways and use embedded lighting for roads.</li> <li>– Position doors and windows on the sides of buildings facing away from marine turtle nesting beaches and install and use window coverings to reduce light emissions.</li> <li>– Maintain elevated horizons (such as topographic features, vegetation or barriers) to screen rookery beaches from light sources. (C17.47)</li> </ul>	
<p>Potentially important roosting habitat (field validated) EPA, 2003)</p> <p><b>High sensitivity</b></p>	<p>Site 5 (Calliope River east bank adjacent to Clinton ash ponds) Site 6 (Clinton ash ponds)</p>	<p><b>Habitat loss:</b> there will be no loss of potentially important roosting habitat as a result of the Arrow LNG Plant.</p> <p><b>Habitat degradation:</b> potentially altered hydrological regimes, potential disturbance of acid sulfate soils and potential sedimentation and pollution from runoff may degrade habitat. However, these sites are in an existing heavily industrialised setting and already likely to be subject to processes that reduce the quality of shorebird habitat. Shorebird counts in these areas show a reduction in numbers (Rohweder et al., 2011), although this trend is to be confirmed in further surveys later in 2012 and early 2013.</p> <p><b>Disturbance:</b> noise, light and movement (personnel and vehicular) from construction and operational activities from nearby areas of project infrastructure may disturb roosting. Sites are already heavily disturbed by construction activities and traffic.</p> <p><b>Direct mortality:</b> slightly increased risk of bird strike into structures but of negligible risk. No project infrastructure in these areas.</p>	<p>In addition to general mitigation for shorebirds proposed above (under potentially important foraging habitat), the following additional mitigation measures is proposed to mitigate impacts to Clinton ash ponds:</p> <ul style="list-style-type: none"> <li>• Shield/direct the light source onto work areas where practical, and avoid light spill on to habitat areas (such as mangroves and Clinton ash ponds) where practical (C17.16).</li> </ul>	<p>There will be no loss of potentially important shorebird roosting habitat. One potential alignment of the access road to launch site 1 passes by Clinton ash ponds and the Calliope River (site 5) using an existing haul road alignment. If this option is pursued, increased traffic along the haul road may impact upon roosting shorebirds, through increased noise and dust, however the road is already frequently used.</p> <p>Any shorebirds using Clinton ash ponds are likely to be habituated to high levels of disturbance. The number of shorebirds using this site has dropped in recent years and it is likely this is due at least in part to this increased disturbance, as well as to a reduction in the quality of roosting habitat available (site recently</p>



**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area (cont'd)**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures at Project Sites	Residual Impacts
<p>Potentially important roosting habitat (field validated) EPA, 2003) (cont'd)</p> <p><b>High sensitivity</b></p>		<p>The impacts on potentially important foraging habitat are of <b>moderate to high significance</b> prior to the implementation of mitigation measures.</p>		<p>covered in mulch to suppress dust).</p> <p>This area will most likely be remediated (filled in with capping material to encapsulate the fly ash) as part of fly ash disposal and reclamation, associated with the NRG power plant station activities. This reclamation process is an ongoing activity at Clinton ash ponds.</p> <p>The common practice in this area is to fill (for the purposes of fly ash disposal and reclamation) the designated ash pond areas, dewater and remediate with a 300mm clay cap to ensure the fly ash does not dry out and become airborne. Although this reclamation may occur after the upgrade of the haul road past the ash ponds to launch site 1, reclamation is an ongoing activity in this area with frequent vehicle and personnel movements in and around the ash ponds.</p> <p>Standard project controls will prevent impacts from runoff, sedimentation etc affecting the habitat quality of these sites.</p> <p>The impacts on potentially important roosting habitat are of <b>moderate significance</b> following the implementation of mitigation measures.</p>

**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area (cont'd)**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures at Project Sites	Residual Impacts
<p>Secondary foraging habitat</p> <p><b>Low sensitivity</b></p>	<p>Site 2 (rocky foreshore and mudflat east of Boatshed Point)</p> <p>Site 3 (Boatshed Point and western margin. Adjacent to Arrow Energy LNG plant site)</p> <p>Site 4 (Rocky margin to the east of Hamilton Point. Away from project infrastructure.)</p> <p>Site 8 (rocky shoreline north of launch site 1)</p> <p>Site 10 (intertidal area and rocky shoreline west of Boatshed Point)</p> <p>Site 14 (Mangrove island upstream launch site 1)</p> <p>Site 15 (intertidal area east of Boatshed Point)</p> <p>Sites 16 and 17 (narrow bands of mudflat opposite launch site 1)</p> <p>Sites 18 and 19 (mudflat and mangrove upstream of launch site 1 on the Calliope River)</p> <p>Site 20 (small area of sandy beach on island in Port Curtis)</p> <p>Site 21 (mangrove shrubland on island in Port Curtis.</p>	<p><b>Habitat loss:</b> 2.8 ha of secondary foraging habitat will be lost due to construction of project infrastructure. This loss is minimal in the context of Port Curtis, and the generally low value of the habitat.</p> <p><b>Habitat degradation:</b> potentially altered hydrological regimes, potential disturbance of acid sulfate soils and potential sedimentation and pollution from runoff may degrade habitat.</p> <p><b>Disturbance:</b> noise, light and movement (personnel and vehicular) from construction and operational activities from nearby areas of project infrastructure may disturb foraging.</p> <p><b>Direct mortality:</b> slightly increased risk of bird strike into structures but of negligible risk.</p> <p>The impacts on secondary foraging habitat are of <b>minor significance</b> prior to the implementation of mitigation measures.</p>	<p>General mitigation measures as proposed under potential important foraging habitat.</p>	<p>Seven of the sites of secondary foraging habitat will not be directly affected by the Arrow LNG Plant and are not located near project infrastructure (sites 4, 14 16, 17, 18, 19 and 20).</p> <p>Site 8 is low value rocky shoreline located at the mouth of the Calliope River and is considered of limited value for shorebirds.</p> <p>Sites 2, 10 and 15 are located adjacent to Boatshed Point. A small area (less than 3 ha) of site 10 will be lost to project construction of the jetty at Boatshed Point. However, this area is of limited value for shorebirds.</p> <p>Project activity on Boatshed Point will increase levels of disturbance to sites 2, 10 and 15. These sites are generally of low value to shorebirds and significant numbers were not noted during surveys at these sites. Standard project controls will prevent impacts from runoff, sedimentation etc affecting the habitat quality of these sites.</p> <p>The impacts on secondary foraging habitat are of <b>minor significance</b> following the implementation of mitigation measures.</p>

**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area (cont'd)**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures at Project Sites	Residual Impacts
<p>Potentially foraging and roosting habitat</p> <p><b>Medium sensitivity</b></p>	<p>Site 7 (mudflat with sparse mangroves, adjacent to potential access road to launch site 1)</p>	<p><b>Habitat loss:</b> 1.4 ha of potential foraging and roosting habitat (if the alignment of the access road to launch site 1 follows the route that passes site 7) will be lost due to construction of project infrastructure. This loss is minimal in the context of Port Curtis, and the generally low value of the habitat.</p> <p><b>Habitat degradation:</b> potentially altered hydrological regimes, potential disturbance of acid sulfate soils and potential sedimentation and pollution from runoff may degrade habitat. However, this site is in an existing heavily industrialised setting and already likely to be subject to processes reducing the quality of shorebird habitat.</p> <p><b>Disturbance:</b> noise, light and movement (personnel and vehicular) from construction and operational activities from nearby areas of project infrastructure may disturb foraging or roosting. Site is already disturbed by construction activities and traffic, although less so than sites 5 and 6 nearby.</p> <p><b>Direct mortality:</b> slightly increased risk of bird strike into structures but of negligible risk. No project infrastructure in this area.</p> <p>The impacts on potential foraging and roosting habitat are of <b>minor to moderate</b> significance prior to the implementation of mitigation measures.</p>	<p>General mitigation measures as proposed under potentially important foraging habitat.</p>	<p>A small area (less than 2 ha) of site 7 will be lost to project construction of the access road to launch site 1. However, this area is of limited value for shorebirds.</p> <p>One potential alignment of the access road to launch site 1 passes by Clinton ash ponds and the Calliope River (site 7) using an existing haul road alignment. If this option is pursued, increased traffic along the existing haul road may impact upon roosting shorebirds through increased noise and dust, however the road is already frequently used.</p> <p>Standard project controls will prevent impacts from runoff, sedimentation etc affecting the habitat quality of this site.</p> <p>The impacts on potential foraging and roosting habitat are of <b>minor significance</b> following the implementation of mitigation measures.</p>

**Table 19.7 Potential impacts on shorebird habitats within the Arrow LNG Plant shorebird survey area (cont'd)**

Habitat Type	Survey Sites in Relation to Project Infrastructure	Impact Criteria Following DEWHA, 2009	Proposed Mitigation Measures	Residual Impacts
<p>Potential roosting habitat</p> <p><b>Medium sensitivity</b></p>	<p>Site 1 (claypan west of Boatshed Point)</p> <p>Site 9 (claypan at mainland tunnel launch site)</p> <p>Site 13 (claypan east of Boatshed Point)</p>	<p><b>Habitat loss:</b> approximately 48 ha of potential roosting habitat will be removed for construction of the Arrow LNG Plant, the majority on the mainland at site 9 (33 ha). The footprint of the mainland tunnel launch site is a small proportion of the overall size of this claypan with large areas of more suitable habitat retained close to the mangroves, especially to the north around Boat Creek.</p> <p>The remaining loss is on the west side of Boatshed Point (site 1). The claypan on the east side will not be cleared (site 13).</p> <p><b>Habitat degradation:</b> potentially altered hydrological regimes, potential disturbance of acid sulfate soils and potential sedimentation and pollution from runoff may degrade habitat.</p> <p><b>Disturbance:</b> noise, light and movement (personnel and vehicular) from construction and operational activities from nearby areas of project infrastructure may disturb roosting. Site 9 is subject to existing disturbance from flytipping and other activities.</p> <p><b>Direct mortality:</b> slightly increased risk of bird strike into structures but of negligible risk.</p> <p>Based on available information and the current state of this habitat, its value as roosting habitat to shorebirds is predicted to be limited. The impacts on potential roosting habitat are of minor to moderate significance prior to the implementation of mitigation measures.</p> <p>The value of this habitat for shorebirds, and the significance of impacts, will be confirmed in the forthcoming surveys.</p>	<p>General mitigation measures as proposed under potential important foraging habitat.</p>	<p>Approximately 48 ha of potential roosting habitat will be lost to project construction (33 ha of this being at the mainland tunnel launch site). These areas are suspected of being of limited value for shorebirds, being predominantly dry. Areas of RE 12.1.2 to be cleared at these sites contain large areas that are predominantly bare clay pan (0.3 ha of the 35 ha of RE 12.1.2 to be cleared at the mainland tunnel launch site is vegetated). Planned surveys will confirm this assessment. Large areas of similar habitat will be retained adjacent or close to cleared areas.</p> <p>Standard project controls will prevent impacts from runoff, sedimentation etc affecting the habitat quality of this site.</p> <p>The impacts on potential roosting habitat are of <b>minor significance</b> following the implementation of mitigation measures.</p> <p>The value of this habitat for shorebirds, and the significance of impacts, will be confirmed in the forthcoming surveys.</p>

Note: The lighting mitigation measure proposed under potentially important habitat was originally developed for the technical study assessing the impact on turtles from light from the Arrow LNG Plant (Appendix 9 Marine Ecology (Turtles) Technical Study – Curtis Island Baseline Light Monitoring 2012) but contains lighting commitments which are also of benefit to minimising impacts of lighting on shorebird habitat.

No direct loss of previously determined important shorebird foraging habitat will occur as a result of the project. These areas could be degraded or disturbed by project activities, leading to reduced availability of invertebrate food for shorebirds in intertidal areas. Management plans will be developed to address potential threats such as acid sulfate soils, pollution runoff, erosion and sedimentation, and weed incursion. With implementation of the measures contained in such plans, there should be minimal residual impact on important shorebird foraging habitat.

Potentially important roosting habitat could be disturbed and indirectly impacted from increased vehicle and personnel movement in the vicinity. These impacts would only occur if one of the options for an access track to launch site 1 is chosen that passes the adjacent Clinton ash ponds. The significance of impacts at this site is assessed as being moderate.

At this time, areas of identified potential shorebird habitat are not expected to provide habitat for sufficient numbers or diversity of shorebirds to meet important habitat criteria. Surveys planned for these areas after rain during the peak shorebird season (over a number of visits) will confirm this assessment. Some of these sites are located adjacent to areas of project infrastructure (Arrow Energy LNG plant and mainland tunnel launch site). The presence of large, highly visible structures, with high levels of vehicular and personnel movement, and light spill onto adjacent areas may render potential habitat immediately adjacent to these facilities unfavourable.

Arrow Energy will develop a shorebird management and monitoring plan for approval prior to construction commencing. The plan will take account of similar programs developed for other similar projects being undertaken within the study area and surrounds. The plan will include the mitigation measures identified in Table 19.7. An outline of this plan is presented in Attachment 5, Other Plans.

### **Impacts on EVNT Shorebird Species**

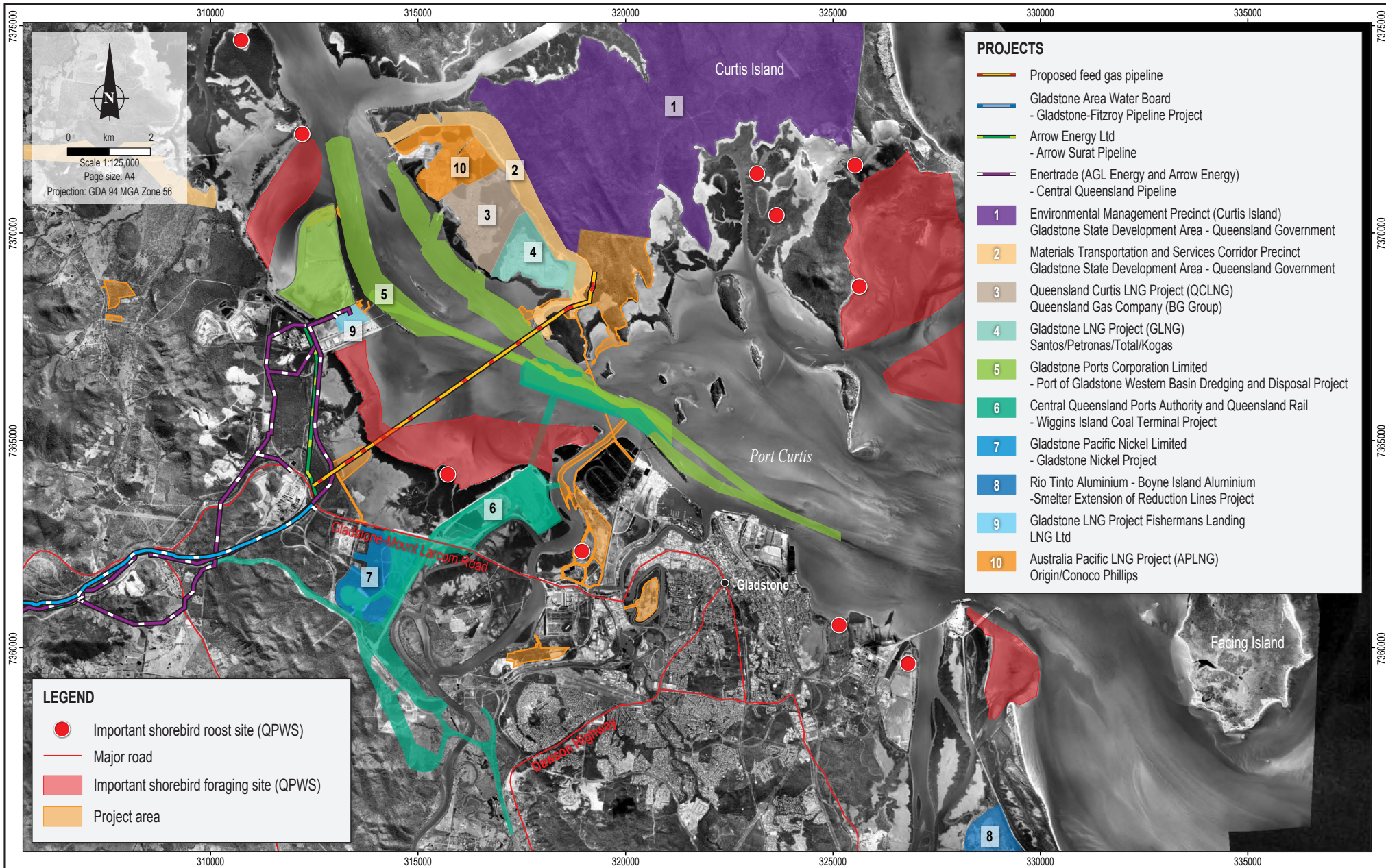
Impacts on EVNT shorebird species that are likely to be present in Port Curtis (sooty oystercatcher, beach stone-curlew, eastern curlew) are anticipated to be minimal, and it is unlikely that clearing or disturbance would impact significantly on these species.

Some individuals may forage within areas that will be cleared or disturbed as part of the project, but these species are more frequently located north of the study area. Mitigation measures to protect migratory shorebird habitat proposed as part of this project will also assist in reducing any impacts on these species.

## **19.8 Cumulative Impacts**

Figure 19.3 shows projects that were considered in the cumulative impacts assessment presented in the EIS and their distribution in Port Curtis in relation to important shorebird habitats. The majority of infrastructure development is taking place within the upper port, which is already heavily industrialised. The lower port, which includes such areas as Southend mudflats, Facing Island and Pelican Banks, all important shorebird sites, is largely unaffected by direct impacts. Further afield, significant shorebird sites around the Fitzroy Estuary and North Curtis will also be retained.

Indirect cumulative impacts (such as pollution, runoff, and sedimentation, from increased infrastructure) on habitats in Port Curtis will need to be managed through relevant construction and environmental management plans prepared for each project.



**PROJECTS**

- Proposed feed gas pipeline
- Gladstone Area Water Board - Gladstone-Fitzroy Pipeline Project
- Arrow Energy Ltd - Arrow Surat Pipeline
- Enertrade (AGL Energy and Arrow Energy) - Central Queensland Pipeline
- 1** Environmental Management Precinct (Curtis Island)  
Gladstone State Development Area - Queensland Government
- 2** Materials Transportation and Services Corridor Precinct  
Gladstone State Development Area - Queensland Government
- 3** Queensland Curtis LNG Project (QLNG)  
Queensland Gas Company (BG Group)
- 4** Gladstone LNG Project (GLNG)  
Santos/Petronas/Total/Kogas
- 5** Gladstone Ports Corporation Limited  
- Port of Gladstone Western Basin Dredging and Disposal Project
- 6** Central Queensland Ports Authority and Queensland Rail  
- Wiggins Island Coal Terminal Project
- 7** Gladstone Pacific Nickel Limited  
- Gladstone Nickel Project
- 8** Rio Tinto Aluminium - Boyne Island Aluminium  
- Smelter Extension of Reduction Lines Project
- 9** Gladstone LNG Project Fishermans Landing  
LNG Ltd
- 10** Australia Pacific LNG Project (APLNG)  
Origin/Conoco Phillips

**LEGEND**

- Important shorebird roost site (QPWS)
- Major road
- Important shorebird foraging site (QPWS)
- Project area

Source:  
Important shorebird areas in Port Curtis from Curtis Coast Regional Coastal Management Plan, QPWS.  
Place names and roads from DME.  
Project area from Coffey Environments.  
Imagery from Nearmap (captured 7 August 2012).  
NOTE: For projects' source information please refer to report reference notes.



Date:  
12.12.2012  
MXD:  
7033CC\_16\_GIS076\_v1\_1  
File Name:  
7033\_16\_F19.03\_GIS\_VS

**Arrow Energy**  
**Arrow LNG Plant**



**Important shorebird habitats  
in and near Port Curtis  
in relation to major projects**

Figure No:  
**19.3**



Table 15.4 in Chapter 15, Marine Ecology presents an estimated cumulative area of marine habitat to be directly or indirectly impacted by projects around Port Curtis. The Arrow LNG Plant will result in the loss of approximately 5.6 ha of intertidal zone habitat, which is less than 1% of the area directly affected by other projects in Port Curtis. Approximately 4.7 ha of mangrove habitat will be cleared for the Arrow LNG Plant base case (5.1 ha for the alternative case) which is 24% of the total clearance within Port Curtis for all projects assessed. Total clearance in Port Curtis forms 0.04% of the total extent of this regional ecosystem within the bioregion. Approximately 55 ha of RE 12.1.2 will be cleared for the Arrow LNG Plant, the majority of which is predominantly bare clay pan. This is 47% of the total clearance within Port Curtis for all projects assessed. Total clearance in Port Curtis forms 0.4% of the total extent of this regional ecosystem within the bioregion.

All calculations are based on available data and in many cases total areas of clearance were not available for a project. Therefore, the contribution of the Arrow LNG Plant as stated above is likely to be a higher percentage than is actually occurring, with areas of clearance not available for many projects in Port Curtis.

Cumulative impacts from projects on shorebirds around the upper port are likely to be substantial through reclamation of foraging habitat, removal of roost sites and increased levels of disturbance. However, the contribution of the Arrow LNG Plant is likely to be relatively minimal, with impacts largely to areas of habitat of limited value to shorebirds. Arrow will contribute to less than 1% of the total loss of benthic zone and intertidal habitat within Port Curtis.

## 19.9 Offsets

As no impacts upon shorebirds are likely to be significant, no offsets specific to shorebirds are proposed for the Arrow LNG Plant. Offsetting of REs 12.1.2 and 12.1.3 (saltpan vegetation and mangroves respectively) under Queensland offset requirements will indirectly provide an offset for shorebird habitat protection for these two regional ecosystems.

Impacts from the Arrow LNG Plant are likely to be relatively minimal, and largely to areas of habitat of limited value to shorebirds. Arrow Energy will contribute to less than 1% of the total loss of benthic zone and intertidal habitat within Port Curtis.

## 19.10 Conclusion

No areas defined as important habitat for shorebirds under EPBC guidelines will be cleared for the project. There is potential for disturbance or habitat degradation to potentially important roosting habitat at Clinton ash ponds. This area held nationally important numbers of eastern curlew in the September 2012 survey. Recent trends for this site show a reduction in shorebird numbers, likely due to high levels of disturbance from reclamation of some of the ponds, and from construction traffic, as well as general habitat degradation. This area will likely be filled in as part of fly-ash disposal and reclamation, associated with power plant activities. Further field survey work later in 2012 and in early 2013 will establish whether this site still constitutes important habitat.

Areas of potential roosting habitat were also identified, although no birds were present at the time of the survey. These areas constituted the largest area of potential or actual habitat to be removed. Migratory shorebirds may only utilise these sites rarely, perhaps after rain or during particularly high spring tides. Further field survey work being undertaken later in 2012 and early 2013 will establish the importance of these areas.



Potential impacts to important shorebird habitat were assessed using four criteria: habitat loss, habitat degradation, disturbance and direct mortality (DEWHA, 2009). No loss of previously determined important habitat will occur as a result of the project. There is a risk of or disturbance to shorebirds using this habitat, although implementation of standard project controls for minimising impacts on water quality should result in negligible impacts.

Arrow Energy will develop a shorebirds management plan for approval prior to construction that will be based upon the final findings from the shorebird monitoring program. An outline of the content of this plan is provided in Attachment 6 of the SREIS.

## 19.11 Commitments Update

Two new commitments have been added, and one commitment revised, in response to the findings of the supplementary shorebirds assessment and the assessment of impacts on Clinton ash ponds and areas of important shorebird habitat.

Commitment C17.47 was developed for the technical study assessing the impact on turtles from light from the Arrow LNG Plant (Appendix 9, Marine Ecology (Turtles) Technical Study – Curtis Island Baseline Light Monitoring 2012). Aspects of the commitment are also of benefit to minimising impacts of lighting on shorebird habitat. Commitment C17.02A relates to offsets and has also been revised.

The new and revised commitments relevant to shorebirds are set out in Table 19.8.

**Table 19.8 Commitments Update: shorebirds**

No.	Commitment	Comment
C17.02A	<del>Determine areas (if any) requiring to be offset in consultation with DERM and DSEWPC and other government stakeholders prior to commencement of construction. This is likely to include the two areas of endangered (Vegetation Management Act) remnant vegetation (RE 12.3.3; Assets 27 and 31) within the LNG plant site, and the <i>Cupaniopsis</i> sp.indet population.</del> Develop an Environmental Offsets Operational Management Plan that addresses terrestrial and marine offset requirements in consultation with relevant government stakeholders prior to commencement of construction. The plan will provide details on offset options and opportunities, and details on how the offset meets relevant policies and how it will be managed over the life of the offset.	Changed to include marine offsets and government stakeholders and to align with confirmed approach.
	Implement measures to reduce the impacts of light from the LNG plant and ancillary facilities including:	No change
C17.16A	<ul style="list-style-type: none"> <li>Shield/direct the light source onto work areas where practical, and avoid light spill onto habitat areas (such as mangroves and Clinton ash ponds) where practical.</li> </ul>	Changed to expand on intent of commitment

**Table 19.8 Commitments Update: shorebirds (cont'd)**

No.	Commitment	Comment
C17.47	<p>Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant including:</p> <ul style="list-style-type: none"> <li>• Assess the necessity and choice of lighting in the plant area: <ul style="list-style-type: none"> <li>– Use low-pressure sodium (LPS) lights as a first-choice light source and high-pressure sodium (HPS) lights where LPS is not practical.</li> <li>– Replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters.</li> <li>– Avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required.</li> <li>– Minimise the number and wattage of lights, and recess lighting into structures where possible.</li> </ul> </li> <li>• Use timers and motion-activated light switches.</li> <li>• Use reflective materials to delineate equipment or pathways and use embedded lighting for roads.</li> <li>• Position doors and windows on the sides of buildings facing away from marine turtle nesting beaches and install and use window coverings to reduce light emissions.</li> <li>• Maintain elevated horizons (such as topographic features, vegetation or barriers) to screen rookery beaches from light sources.</li> </ul>	New commitment
C17.51	Review the need for an ongoing program to monitor the shorebird population at project sites following the completion of survey work in 2013.	New commitment
C17.52	Develop measures to minimise disturbance around important shorebird habitat, during construction and operation. Measures could include exclusion zones or screens as recommended in Rohweder et al., (2011).	New commitment

Supplementary Report to the Arrow LNG Plant EIS  
Arrow LNG Plant